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Dickens and Science: Summaries of Contributions Related to Science
in *Household Words* and *All the Year Round* with an Introduction

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A thesis submitted in partial fulfilment of the requirements for the degree of Ph. D to
the English Literature Department in
The University of Glasgow

1999

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The study is an attempt to find a reasonable basis on which to form an estimate of Dickens's knowledge of science as far as it can be seen in his two weekly journals, *Household Words* and *All the Year Round*. Some recent and influential criticism on Dickens by commentators such as George Levine, Gillian Beer and their followers, has pioneered the study of Dickens and Science, and their ideas have also been popularised by Peter Ackroyd, Dickens's major biographer currently in print. They argue or imply that Dickens's knowledge of science was considerable, and that science is part of the very form of his novels, including *Bleak House*, *Little Dorrit*, *Our Mutual Friend* and *Great Expectations*. However their assertion that Dickens's understanding of the second law of thermodynamics, "entropy," and Darwin's evolutionary theories in his *Origin of Species* (1859) have influenced his writing is highly questionable, and there is the need to examine what evidence there is for Dickens's knowledge of science in his life, letters, speeches, his library and the journals he edited. A preliminary survey of the scientific works in Dickens's library was undertaken for my M. Litt. The present study continues this work by investigating science in Dickens's journals, and by offering brief summaries of their articles on scientific subjects.

An introduction discusses questions about the extent of Dickens's supervision. It looks at reasons for doubting whether it was as close as has sometimes been thought, the problems of inferring Dickens's own views on scientific subjects, and how we can decide whether the articles reflect his personal ideas about creation, man and the universe. The introduction also looks at some of the writers who contributed scientific articles: it shows that, with few exceptions, they were journalists or laymen, and examines how they conveyed to general readers accounts of the new discoveries in astronomy, geology, chemistry and physics. The relationship between Dickens's journals and his fiction is of critical significance. This cross-boundary exploration of Dickens and his journals in relation to science aims to find a reliable methodology for studying Victorian periodicals based on actual reading of them.

Acknowledgments

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I am especially grateful to Professor K. J. Fielding of the University of Edinburgh, who has generously allowed me to study and quote some first-hand materials and given great encouragement, which is really Dickensian and unforgettable.

I deeply appreciate my supervisor, Mr. David J. Newell, whose valuable advice on the style and structure of this thesis, and whose patience and understanding, have helped me to complete my project.

There are a number of scholars and colleagues who have helped me in various ways. I am indebted to my examiners Professor Andrew Sanders and Mr. Richard Cronin who gave me their most helpful suggestions and discussed with me their own approach to Dickens. I would like to thank Professor Elisabeth Arbuckle and Professor Michael Slater for their encouragement, Dr. Susan Shatto and Dr. Alice Jenkins for their enthusiastic assistance and support.

I am also grateful to the help I received from the National Library of Scotland.

Finally I thank my parents and my husband Wei-Po Lee who are my strongest backup all the year round.

Declaration

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I hereby declare that the following thesis has been composed by myself and is my own work.

Shu-Fang Lai
1999

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ABBREVIATIONS

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References to Dickens's novels are to the Penguin Classics edition unless otherwise stated and are cited in their abbreviated form in parenthesis in the text.

- AN* *American Notes For General Circulation*, eds. John S. Whitley and Arnold Goldman (1842, London: Penguin, 1987).
- BH* *Bleak House*, ed. Norman Page (1853, London: Penguin, 1985).
- BR* *Barnaby Rudge*, ed. Gordon Spence (1841, London: Penguin, 1986).
- CB* *Christmas Books*, ed. Michael Slater, 2 vols (1843-48, London: Penguin, 1985).
- DC* *David Copperfield*, ed. Trevor Blount (1850, London: Penguin, 1985).
- D&S* *Dombey and Son*, ed. Peter Fairclough (1848, London: Penguin, 1985).
- GE* *Great Expectations*, ed. Angus Calder (1860-61, London: Penguin, 1985).
- HT* *Hard Times*, ed. Kate Flint (1854, London: Penguin, 1995).
- LD* *Little Dorrit*, ed. John Holloway (1857, London: Penguin, 1985).
- MC* *Martin Chuzzlewit*, ed. P. N. Furbank (1844, London: Penguin, 1968).
- MED* *The Mystery of Edwin Drood*, ed. Arthur J. Cox (1870, London: Penguin, 1985).
- NN* *Nicholas Nickleby*, ed. Michael Slater (1839, London: Penguin, 1978).
- OCS* *The Old Curiosity Shop*, ed. Angus Easson (1841, London: Penguin, 1985).
- OMF* *Our Mutual Friend*, ed. Stephen Gill (1865, London: Penguin, 1985).
- OT* *Oliver Twist*, ed. Peter Fairclough (1838, London: Penguin, 1985).
- PP* *The Posthumous Papers of the Pickwick Club*, ed. Robert L. Patten (1837, London: Penguin, 1986).
- SB* *Sketches by Boz* (1836, Oxford Illustrated Dickens). This edition includes the *Mudfog Papers*.
- TTC* *A Tale of Two Cities*, ed. George Woodcock (1859, London: Penguin, 1985).
- UT* *The Uncommercial Traveller*, ed. Deborah A. Thomas (London: Penguin, 1985).

- ABF* *Archives Biographiques Françaises and Index*.
- AYR* *All the Year Round, 1858-70*.
- BAAS** The British Association for the Advancement of Science.
- Boase* *Modern English Biography*, ed. Frederic Boase.
- CBD* *Chambers Biographical Dictionary*.
- CD** Used in the footnotes in all references to Charles Dickens.
- DAB* *Dictionary of American Biography*.
- DNB* *Dictionary of National Biography*.
- DSB* *Dictionary of Scientific Biography*.
- EB* *The Encyclopaedia Britannica*, 11th ed.
- HW* *Household Words, 1850-58*.
- Lehmann** *Charles Dickens as Editor*, ed. by R. C. Lehmann (London: Smith, 1912).
- Life* John Forster, *The Life of Charles Dickens*, 3 vols. (London: Chapman and Hall, 1872-74).
- Lohrli** Anne Lohrli, *Household Words, A Weekly Journal 1850-59 Conducted by Charles Dickens* (Toronto: University of Toronto Press, 1973).
- MDCB* *The Macmillan Dictionary of Canadian Biography* (Toronto: Macmillan, 1978).
- Nonesuch* *The Letters of Charles Dickens*, the Nonesuch Dickens, ed. Walter Dexter, 3 vols. (London: Nonesuch, 1938).
- OED* *Oxford English Dictionary*.
- Origin* Darwin, *On The Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* (Murray, 1859; London: Penguin, 1985).
- Oppenlander** Ella Ann Oppenlander, *Dickens' All the Year Round: Descriptive Index and Contributor List* (New York: Whitston, 1984).

- Pilgrim* *Letters of Charles Dickens*, the Pilgrim edition, 10 vols. (Oxford: Clarendon, 1965-98).
- Speeches* *The Speeches of Charles Dickens, A Complete Edition*, ed. K. J. Fielding (Hertfordshire: Harvester-Wheatsheaf, 1988).
- Vestiges* [Robert Chambers], *Vestiges of the Natural History of Creation* (1844, Leicester: Leicester University Press, 1969).
- WWW* *World Who's Who in Science: A Biographical Dictionary of Notable Scientists from Antiquity to the Present*, ed. Allen G. Debus (Chicago: Marquis-Who's Who, 1968).

Introduction

(i) Preface

The subject of this thesis follows on from my M. Litt. thesis, "Dickens in Relation to Science," which examined some recent and influential criticism of Dickens by such writers as George Levine, Gillian Beer, and Ann Wilkinson.¹ Their ideas have been popularised by Peter Ackroyd, Dickens's most recent major biographer.² They argue or imply that Dickens's knowledge of science was considerable and ran far ahead of his time. He is said to have incorporated important theories or discoveries in science and alluded to them in his novels especially *Bleak House*, *Little Dorrit*, and *Our Mutual Friend*. As Wilkinson and Ackroyd assert, they are sometimes part of the "very form" of the novels.³ They and those whom they have influenced have written about Dickens's understanding of the second law of thermodynamics, his interest in it and its practical and theoretical application, "entropy" (now accepted as a critical term), Darwin's theories in his *Origin of Species* (1859) and how they see these in Dickens's fiction.⁴ Most of their observations and inferences are open to significant challenge and sometimes simply incorrect; and I have tried to examine what external evidence there is for Dickens's knowledge of science in his life, letters, journalism, speeches, his library and the journals he edited. A preliminary survey of the library was made for my M. Litt. thesis. In brief, there is some evidence that Dickens was interested in what he could learn about science especially during the 1840s: as a general reader he was quite well informed, and in particular, his vigorous but anonymous review of Robert Hunt's

¹ Edinburgh, 1996; see also K. J. Fielding and Shu-Fang Lai, "Dickens, Science, and 'The Poetry of Science,'" *Dickensian* 93 (1997): 5-7; Philip Collins's letter questioning this article and the reply, *Dickensian* 93 (1997): 136; 205.

² For Levine, Beer and Wilkinson, see the subjoined Bibliography; Peter Ackroyd, *Dickens* (1990; London: Minerva, 1991).

³ Wilkinson, "Bleak House: From Faraday to Judgment Day," *ELH* 34 (1967): 226; Ackroyd 663.

⁴ For example, Howard W. Fulweiler, "'A Dismal Swamp': Darwin, Design, and Evolution in *Our Mutual Friend*," *Nineteenth-Century Literature* 49 (1994): 50-74 and Jonathan Smith, "Heat and Modern Forces of Nature in *Our Mutual Friend*" in "Experimenting with Method: Science and Victorian Literature," diss., Columbia University, 1991, 253-331.

The Poetry of Science; or Studies of the Physical Phenomena of Nature (1848), in the *Examiner*, 9 December 1848, shows how open he was to new ideas, ready to think for himself, and that he had a keen understanding of new discoveries in science at a popular level. It is evident, too, that he was ready to commit himself to evolutionary theories put forward anonymously by Robert Chambers in his *Vestiges of the Natural History of Creation* (1844), defending them in his review of Hunt's book. Evidently there is also reason to believe that he was at least interested in the evolutionary theories of the astronomer and Glasgow professor, John Pringle Nichol, whose books feature in Dickens's library though his ideas have been forgotten.⁵

The question is whether Dickens's grasp of science reached beyond the level of an intelligent general reader of his time, and whether it could possibly have affected his fiction except in the most general manner. If it did, evidence for it is wanting. The suggestion that his journalism might offer a promising line of inquiry was made many years ago by William Axton who pointed to Dickens's library books and his periodicals as a source of further knowledge.⁶ This inquiry, therefore, is directed to seeing what can be learned about Dickens and his interest in science by examining the contributions he accepted for *Household Words* and *All the Year Round*, an inquiry related to the question of whether they bear in any way on his fiction after 1850. Above all, it is an attempt to see what the articles themselves have to say, rather than what has been written about them at second or third hand. It is necessary to emphasize now and later that this is not a general study of the treatment of science in such popular journals as those conducted by Dickens, but is about

⁵ John Pringle Nichol (1804-69), astronomer, professor at Glasgow University, 1838; Dickens's library included his *Views on the Architecture of the Heavens* (5th ed., 1845) and *Thoughts on Some Important Points Relating to the System of the World* (1846). His arguments in favour of the possibility of evolution were known to Dickens; see K. J. Fielding with Shu-Fang Lai, "Dickens's Science, Evolution and 'The Death of the Sun,'" *Dickens, Europe and the New Worlds*, ed. Anny Sadrin (London: Macmillan, 1998) 206-7.

⁶ William F. Axton, "Religious and Scientific Imagery in *Bleak House*," *Nineteenth-Century Fiction* 22 (1968): 359.

what his journals have to tell us, and whether this leaves us better informed about Dickens and his novels.

(ii) About the Two Journals

Instead of being a general study of Dickens's two weeklies, the present account provides short summaries of the articles on scientific subjects that appeared in them. It may be helpful, therefore, to note briefly some information about them and Dickens's part as their editor.

Dickens announced his intention to start *Household Words* at the end of 1849. A sub-editor and business manager, William Henry Wills, was engaged at the end of January 1850, and the first number appeared dated 30 March. The publishers and printers Bradbury & Evans held a quarter share in the enterprise, John Forster an eighth share, Wills an eighth, and Dickens himself a half share, while Wills and Dickens were also salaried.⁷

Each twenty-four page number was made up of seven or eight anonymous contributions, including fiction, prose, and verse. Every article was unsigned, while across each double page of *Household Words* ran a heading that said "Conducted by/ Charles Dickens," which was to be the same with *All the Year Round*. Both journals repeated the phrase on the "masthead." The journal was sold for twopence a weekly number, ninepence for "monthly parts," and five shillings and sixpence for a half-yearly volume.⁸ A surviving

⁷ For basic accepted information and dates, see *Pilgrim* 5 and 6; fuller citations will be given on matters open to question.

⁸ By 1855 sets of five double-volumes could be bought for £2.10.0; see Ann Lohrli, ed., *Household Words, A Weekly Journal 1850-59, Conducted by Charles Dickens. A Table of Contents, List of Contributors and Their Contributions Based on the Household Words Office Book* (Toronto: University of Toronto Press, 1973) 44-45.

office-book of *Household Words* carefully kept by Wills recorded the contributors and what they were paid.⁹ There should usually be no doubt, therefore, about the authorship of every article in the first journal, especially since the publication of Lohrli's work, though some uncertainty still remains. Dickens himself wrote 184 contributions (including joint articles with others whose shared authorship is recorded in the office-book)¹⁰ in the nineteen volumes of *Household Words*, and is known to have written 65 contributions to *All the Year Round*.¹¹ As well as this, he took part in editing, rewriting or demanding changes from Wills.

Readers have to bear in mind that it was in the interest of the two periodicals to emphasize the major part played by Dickens, and yet that there is the need to differentiate between editor and contributors. In his lifetime, some contributors such as John Hollingshead and George Sala were occasionally aggrieved that their best work was credited to their employer. The complexities of this are well explained by Lohrli,¹² and need to be remembered in assessing what Dickens actually wrote or approved rather than what is sometimes attributed to him. Nevertheless the system worked, and was no different from that of most other contemporary periodicals.

The conduct of the periodical went forward without unexpected incident till May 1858 when there was the eruption of Dickens's separation from his wife. On 12 June he published his "Personal" statement about the separation in *Household Words*; but Bradbury & Evans' refusal to republish it in *Punch*, and their siding with Catherine Dickens led him to break up the association and take the publishers to law. After winning the case,

⁹ In the Morris L. Parrish Collection of Victorian Novelists, Princeton University Library.

¹⁰ Harry Stone, ed., *Charles Dickens' Uncollected Writings from Household Words, 1850-1859*, 2 vols. (Bloomington: Indiana University Press, 1968).

¹¹ See Lohrli 249-56, and Ella Ann Oppenlander, *Dickens' All the Year Round: Descriptive Index and Contributor List* (New York: The Whitston Publishing Company, 1984) 258-64.

¹² Lohrli 14.

he was able to discontinue *Household Words* from 28 May 1859, and on 30 April 1859 to launch *All the Year Round* with an addition on the new title-page: "With which is incorporated *Household Words*." The new journal was printed directly for Dickens, the office moved a few doors down Wellington Street,¹³ Wills remained sub-editor till his accident in October 1868, the contributors were treated on similar terms, and it was published at the same price.

It is unknown whether Wills kept an office-book for the new journal; but at the time of F. G. Kitton's *Minor Writings of Charles Dickens* (1900), use was made of a marked office set which authentically noted the authors.¹⁴ Its whereabouts is now unknown. Oppenlander presents an index to all volumes published in Dickens's lifetime, but though useful this is far from complete. The present thesis includes summaries of articles connected with science in *Household Words* and *All the Year Round*, though in discussing Dickens's views and methods rather more stress has been laid in this introduction on *Household Words*. This is because readers can trace them more easily in the earlier periodical, and then observe changes or developments in *All the Year Round*. For, as well as lacking information about the contributors, the invaluable Pilgrim edition of the *Letters* does not yet go beyond 1864. Even so, in Dickens's last decade when the novels seem darker and their author more elusive, the further twenty-four volumes of *All the Year Round* still leave much to be explored.

(iii) Editorial Policy of the Summaries

The selection of the articles summarised depends on first deciding what is meant by "science," and then selecting or sifting those that bear on the matter; and though it has been

¹³ From 16 Wellington Street North to no. 26.

¹⁴ F. G. Kitton, *The Minor Writings of Charles Dickens* (London: E. Stock, 1900) vii.

helpful to choose a circumscribed topic which makes it possible to focus systematically on Dickens's journalism, there are bound to be problems in deciding what to include.

A definition of "science" for the purpose is assumed to be the usually acceptable meaning familiar to readers since the nineteenth century. According to the *OED*, "science" originally meant "the state or fact of knowing" which began to be applied to the systematic study of the laws or principles which govern the material universe. It may sometimes mean "expert knowledge," a short term for "natural science," or a systematic knowledge of the material world, and a reasoned study of the laws and principles which govern the universe, including facts and relations between concepts which try to account for them.¹⁵ Since the mid-nineteenth century it has been accepted that such a study is broken down into such familiar subject divisions as astronomy, mathematics, physics, chemistry, zoology, geology, and those aspects of medicine that investigate such laws and principles. As for "quasi-scientific" subjects such as phrenology, mesmerism, hydropathy, the study of dreams, and the supernatural, though they often attracted much attention in the mid-nineteenth century, they can only be recognised and considered in another context.¹⁶

This study, therefore, concentrates on "science" in the way that the word was used at that time. Dickens had begun his career as "Boz" in the early 1830s when the advance of science was accelerating and making an impact on society. It was the time when leading scientific establishments, such as the Royal Society, the Royal Institution and the British Association for the Advancement of Science (hereafter BAAS), were about to prosper and reach their peak; it was also the decade when such works were published as Charles Lyell's *Principles of Geology* (1830-33). Such advances were milestones in early nineteenth-

¹⁵ There are many reference books regarding the definition of science such as William Cecil Dampier-Whetham, *A History of Science and Its Relation with Philosophy and Religion* (Cambridge: Cambridge University Press, 1930).

¹⁶ For example, Fred Kaplan's *Dickens and Mesmerism: The Hidden Springs of Fiction* (Princeton, NJ: Princeton University Press, 1975).

century science. We see in Dickens's account of two meetings of the "Mudfog Association for the Advancement of Everything," how its meetings were divided into four sections: "Zoology and Botany," "Anatomy and Medicine," "Statistics" and "Medical Science" in the first report, with the addition of a "Display of Models and Mechanical Science" in the second. Self-evidently, this satirises the meetings of the BAAS. At the meeting at Cambridge chaired by Adam Sedgwick in 1833, for example, there were sections on mathematics and physics, philosophical instruments and mechanical arts, natural history, anatomy, physiology and the history of science. The sections of the meetings went on to undergo some variation, and by the time Dickens launched *Household Words*, they included mathematical and physical science, chemistry and mineralogy, geology and physical geography, zoology, botany and physiology, statistics, and mechanical science.¹⁷ This development to a certain extent reflects the increasing scope of science and its general image in this period.

A confirmation of Dickens's impression of what was meant by "science" can be seen in Robert Hunt's *The Poetry of Science*, and in Dickens's review of the book which was his only piece of serious writing on science. Hunt's work is divided into chapters by subjects including motion, gravitation, molecular forces, crystallogenic forces, heat (solar and terrestrial), light, actinism-chemical radiation [the radiation of heat or light], electricity, magnetism, chemical forces and phenomena, geological phenomena, and phenomena of vegetable life and animal life. This repository of information also shows what Dickens at that time would have understood by "science."

¹⁷ O. J. R. Howarth, *The British Association for the Advancement of Science: A Retrospect, 1831-1931* (London: British Association for the Advancement of Science, 1931) 83.

There is also the problem of dealing with what can be called "popular science." Dickens's journals were intended for entertainment as well as instruction. They are not altogether like the old earnest *Penny Magazine* or *Mechanics' Magazine*, nor as desperately serious as some of the quarterlies when they occasionally turned to science. Scientific articles in Dickens's journals were usually general, dealing with anecdote, scientific history, and including subjects such as accounts of alchemy full of self-congratulation on the superior enlightenment of their own time. When they describe scientific museums, they treat them as shows rather than scientific displays, bringing nothing to the reader's understanding, apart from awakening his wonder. Yet they were part of the movement that was sowing the first seeds of scientific education and shifting the current of general understanding. Some of them have to be included in this thesis, though only along the fringes of my definition, and with the proviso that they are hardly accurate or rational.

A further problem is that some of the contributors did not see themselves as specifically writing about new discoveries in science, but just mentioned the word "science" in passing.¹⁸ Where a contribution is partly "scientific" I have tried to include what is to the point and left out the rest.

Certain aspects which touch on science but fall outside the main definition have also been excluded. Articles about industrialisation, technology and general aspects of medical

¹⁸ For example, Dudley Costello, who writes "Alchemy and Gunpowder," (*HW* 1: 135-39) distinguishes alchemy from chemistry; but he still categorises the discoveries of gunpowder as a science; in "The Modern Science of Thief-Taking" (*HW* 1: 368-72), detective work is called "a modern science" just because some similar qualifications such as "knowledge," "coolness" "patience" are involved in detecting; "Winged Telegraphs" (*HW* 1: 454-56) is only about pigeon training and flying; in "Wings of Wire" (*HW* 2: 241-45), the electric telegraph is also called "a science," but strictly speaking, it is mostly technology; one of the most remote links is in "A Few Facts about Matrimony" (*HW* 1: 374-77) where the management of matrimony is said to be "a scientific study" because it should not leave out any detail; "The Zoophytes of Sandybay" (*AYR* 14: 12-15) mentions zoophytes (an animal that looks like a plant and was thought to be a link between the flower and animal life) at the beginning, but turns to describe female bathing attendants at Sandybay and a legend about the "bathing women."

treatment have usually been set aside. Nor have articles simply about manufacturing been included unless they refer to specific related scientific discoveries.¹⁹ Articles that occupy this grey area are better considered in other contexts.

Altogether the advantage of summarising is that it compels an attempt at relevance. Yet, it is crucial to bear in mind that Dickens himself did *not* write a single article for his two weeklies which bore directly on science. Therefore it is necessary to use the evidence of what was accepted for his journals, to see how far his presumed interest extended. We must remain aware that this may not indicate an exceptional interest on his part, and that there is often doubt about whether he or his contributors exactly understood the subjects they were writing about.

The scheme of summarising thus has the advantage of compelling close reading and making decisions about each article. I have generally included contributions on natural history, although many were just catalogues or compilations of observations and facts. For it was from this observation of natural life at home or abroad, through the microscope or telescope, travel, collecting, and observation, that the most questioning theories evolved. They were brought to a wide public through cheap printing, and by such means as new museums, exhibitions, zoos, and showmen. Nevertheless not every article of this kind can be thought of as scientific, though they crowd the borderline for inclusion. A spate of articles, for example, on the arrival of the first hippopotamus in Britain in 1850, sparked off countless allusions, almost none of which were directed to anything but topical satire and the arousal of wonderment, and they often satirically refer to officials of the Zoological Society. Much of this sort, therefore, cannot be called "scientific."

¹⁹ Harriet Martineau wrote many articles about manufacture. For example, "What there is in a Button" (17 April 1852; *HW* 5: 106-12) is about button manufacture at Birmingham. Though the article explains how to make steel and medal buttons, mentioning a kind of medal for the Queen's College at Cork with the Queen's head on the one side and "Science--a kneeling figure, feeding a lamp" on the other, it is not included in the summaries.

In summarising I have tried to be objective, though in order to be brief occasional comment has sometimes been made. The summaries are also necessarily approximate, at times almost notes or an amplified index rather than a full account. The obsolete and inflated language of mid-Victorian journalism has been hard to reduce and change into modern idiom, though this has been my aim. The names of anyone of scientific interest in the eighteenth and nineteenth centuries have been updated and clarified as far as possible, asterisked, and identified in the biographical index.

(iv) The Aim and the Method of the Study

Both the aim and method of looking at such articles related to science in Dickens's two weeklies are fairly clear, and two questions already begin to take shape. The first is how far it is right to think of Dickens as exercising a strict control over what was published in *Household Words* and *All the Year Round*, since this appears open to question; and not only that, but can we ever prove this decisively. A third is less a question than a challenge: have not many biographers somewhat misdirected us by exaggerating Dickens's degree of control? And is not this because they have so often looked at the two journals in a cursory fashion?

There are important exceptions. Humphry House made imaginative use of the periodical in his *Dickens World*, explaining that "Dickens himself is far more factual than might appear; the best commentaries on many parts of his novels are his own articles and short stories, and articles and stories that he supervised as editor."²⁰ In Harry Stone's words the periodicals offer a "rich garnering" and a "subsidiary garnering" that "can help us

²⁰ *The Dickens World* (London: Oxford University Press, 1941) 14. Philip Collins identifies House as the "first Dickens-scholar to recognise the importance of the weeklies he 'conducted' for the last twenty years of his life"; see Collins, "Dickens's Weeklies," *Victorian Periodicals Newsletter* 1 (1968): 18-19.

understand Dickens and his art."²¹ Many other writers have glanced at the periodicals or made selected use of them for special studies. Recently two selections from Dickens's journalism have been published.²²

Yet the biographers have not altogether served us so well. Admittedly, there is great difficulty in writing a proper account of Dickens's journalism in *Household Words* and *All the Year Round*, because they are so extensive in quantity and stretch over such a long period. Percy Fitzgerald foresaw that if anyone could "make his laborious way through the forty or fifty volumes of these journals, and follow his Dickens carefully," he would "find traces of him on every page."²³ In 1961, Philip Collins proclaimed the importance of the periodicals, but regretted that biographers and commentators had "not hastened to repair this omission" by a close study, which had been lacking since John Forster's *Life*.²⁴ In fact, all the biographers such as Edgar Johnson, the Mackenzies, Fred Kaplan, and Peter Ackroyd, have done no more than merely touch on the subject.²⁵ So far as they have done so, they simply agree or coincide in sketching how *Household Words* was started, who first wrote for it, how much each copy cost, and in discussing what it should be called, and so on. Yet nothing new is ever revealed. The same quotations from Dickens's letters are quoted over and over again such as the one to Forster: "My notion is a weekly journal . . . as amusing as possible, but all distinctly and boldly going to what . . . in one's own view ought to be the spirit of the people and the time Now to bind all this together . . . I want to suppose a certain SHADOW, which may go into any place. . . to fall on such and

²¹ Stone, ed., *Charles Dickens' Uncollected Writings* 1: 4.

²² Michael Slater, ed., *Dickens's Journalism*, 3 vols. (London: Dent, 1994-99); David Pascoe, ed., *Charles Dickens: Selected Journalism 1850-70* (London: Penguin, 1997).

²³ Percy H. Fitzgerald, *Memories of Charles Dickens with an Account of Household Words and All the Year Round and of the Contributors Thereto* (Bristol: Arrowsmith, 1913) 105.

²⁴ Philip Collins, "The Significance of Dickens's Periodicals," *A Review of English Literature* 2 (1961): 55-64 Collins quotes Forster's account in his *Life* that "less has been said . . . than might have been wished" about Dickens's editorship of his two journals.

²⁵ Edgar Johnson, *Charles Dickens, His Tragedy and Triumph*, 2 vols. (London: Gollancz, 1953); Norman and Janne Mackenzie, *Dickens, A Life* (Oxford University Press, 1979); Fred Kaplan, *Dickens: A Biography* (London: Hodder, 1988).

such a subject; or to expose such and such a piece of humbug"²⁶; or the familiar letter to Wills: "KEEP 'HOUSEHOLD WORDS' imaginative! is the solemn and continual Conductorial Injunction."²⁷

In his book on Dickens's literary life, Grahame Smith notices the same problem as Fitzgerald: "To plough our way through twenty-four pages of closely printed text in double columns with no relief from illustrations might seem a daunting experience for modern readers."²⁸ His chapter entitled "Periodicals, Journalism and the Literary Essay" also deliberately pays great attention to Dickens's early reading and enthusiasm for periodicals such as Goldsmith's *Bee* or the *Spectator*. Meanwhile he writes about Dickens's "editorial policy" merely as he sees it reflected in his letters. For he does not actually bring himself face to face with those twenty-four page issues of the periodicals that Dickens was editing. The later years of *Household Words* and *All the Year Round* are scarcely dealt with at all.

Biographers and commentators are naturally concerned with Dickens's own contributions. After that their attention is always mainly directed to the drama of his relations with serial storytellers such as Elizabeth Gaskell and Wilkie Collins. But what these biographers write about is not *Household Words* or *All the Year Round* so much as what Dickens has to say about them in his letters, where, as we shall show there was always a gap between practice and principle. This is even true of Philip Collins's articles. Of all the writers on Dickens's journalism, Collins has probably used the periodicals to best effect in his two monographs, *Dickens and Crime* and *Dickens and Education*. But he does not deal with how these topics are treated in the journals. Other articles that have appeared on Dickens's journalism are mostly general surveys, such as Gerald Giles Grubb's

²⁶ 7 October 1849, *Pilgrim* 5: 621-23, e. g. quoted by Johnson 2: 701; Mackenzie 219.

²⁷ 17 November 1853, *Pilgrim* 7: 200, e. g. quoted by Johnson 2: 712.

²⁸ Grahame Smith, *Charles Dickens, A Literary Life* (London: Macmillan, 1996) 76.

"The Editorial Policies of Charles Dickens,"²⁹ Philip Collins's "The Significance of Dickens's Periodicals" and "Dickens's Weeklies,"³⁰ Angus Easson's "Dickens, *Household Words*, and a Double Standard"³¹ and Harold F. Clark's thesis "Dickensian Journalism: A Study of *Household Words*."³² Most of them are not based on what Dickens or his contributors contributed, but on what his letters or some external source tell us. Instead of looking at the publications and what appeared in them, they discuss what Dickens had to say about his own editing. The task of exploring the articles has still to be undertaken.

In fact almost the only manageable way in which to discover how Dickens operated as an editor and journalist is to see how he dealt with an individual subject. This is one reason why I am looking at the topic of Dickens and science as it is treated in a number of articles in *Household Words* and *All the Year Round*. There were forty-three volumes of the two weeklies published during his life, a monstrous amount to consider. Even if we limit ourselves to the articles on "scientific" subjects there are as many as about 440 altogether if we suppose that there was an average of eight in each volume of *Household Words* and *All the Year Round*. Though largely neglected, they offer substantial source material.³³

(v) Fact or Fancy?: Dickens's Supervision and the Problems of Style and Content

The idea has grown up that Dickens exercised a strong control over his two weeklies, and it was even one he fostered himself. Yet, as already suggested, this should be

²⁹ *PMLA* 58 (1943): 1110-24.

³⁰ *A Review of English Literature* 2 (1961): 55-64; *Victorian Periodicals Newsletter* 1 (1968): 18-19.

³¹ *Dickensian* 60 (1964): 104-14.

³² Diss., Columbia University, 1967.

³³ John S. North, "The Rationale--Why Read Victorian Periodicals?" *Victorian Periodicals: A Guide to Research*, ed. J. Don Vann and Rosemary T. VanArsdel (New York: The Modern Language Association of America, 1978) 8. North showed that he was not even aware of Lohrli's book or the existence of the office book identifying contributors.

questioned. Among those who have reasonably emphasised Dickens's keen sense of responsibility for anything that appeared in his periodicals is Philip Collins, especially in his article, "'Inky Fishing Nets': Dickens as Editor."³⁴ That phrase, "inky fishing nets," was first used by Dickens in writing to John Forster about his hard work in revising a story by Percy Fitzgerald, since the proofs were so boldly crossed through where he had corrected and improved them. It was used again by Collins about Dickens's work as editor, illustrated by reproductions of some of his galley-proofs.³⁵ Such proof-sheets seem to confirm the belief in Dickens's dominant role as an editor who "carried on a magazine of immense circulation, requiring good business habits besides much sagacity . . . from week's end to week's end--through all the year, never flagging a moment,"³⁶ and so did Fitzgerald's remarks about *Household Words* as a family journal, "exquisitely and adroitly conceived," and conducted by someone who "put himself, his thoughts, feelings, and inspirations, into each column; where he did not write he inspired, and gently compelled his subordinates to feel and think as he did."³⁷

Yet Fitzgerald wrote loosely. He was young and impressionable. He did not meet Dickens until 1856, and as Dickens's alleged "favourite"³⁸ he received an exceptional amount of attention. Much of his writing for *All the Year Round* was fiction, a genre to which Dickens was particularly sensitive. He may have been conscious of being thought of

³⁴ *Dickensian* 61 (1965): 120-25.

³⁵ According to Collins (see n. 34), there exist four sets of proof-sheets: two in England (at Dickens House, London and the Dickens Museum, Broadstairs), and two in America owned by private collectors. It is significant that Collins has declared his doubt about how typical of Dickens's editorial work are the specimens he closely analysed compared to the vast amount of material that has not survived.

³⁶ Fitzgerald, "Some Memories of Dickens and *Household Words*," *The Dickens Souvenir of 1912*, eds., Dioclayton Calthrop and Max Pemberton (London: Chapman and Hall, 1912), 25.

³⁷ Fitzgerald, *The Life of Charles Dickens as Revealed in His Writings*, 2 vols. (London: Chatto & Windus, 1905), 2: 268-69; the book has a whole chapter on *HW*, pp. 266-75.

³⁸ Fitzgerald introduced himself to Dickens when Dickens was on a reading tour in Dublin in 1858; and according to Charley, Dickens's eldest son, he was "a favourite of his [Dickens's]," see his "Preface," *Life of Charles Dickens* 1: xi and *Memories of Charles Dickens* 5; see also Lohrli 271.

as one of Dickens's "young men" who were rightly supposed to be imitative of their master.³⁹ But he was not necessarily an authority on Dickens's usual practice.

The extent of Dickens's supervision of his journals must be examined: "Never flagging a moment" and "in *each* column"? Fitzgerald's comment is exaggerated. One reason why it has to be doubted is because there were so many calls on Dickens's attention in the last twenty years of his life. His own writing, amateur acting, charity work and activities connected with social reform, public speaking, public reading, the demands of a large family, and other relationships, all meant that he was only too glad at times to rely on his sub-editor, W. H. Wills, who knew his ways and was competent to run the journals for long periods at a time. The question of Dickens's supervision deserves close examination before we can begin to draw conclusions about how far *Household Words* and *All the Year Round* really reflect their "conductor." There is much to look into. To some extent, we can tell from Dickens's letters which numbers had his close attention, those he thought well done, those he was disappointed with, and what criticisms he had to make. It is likely that he was more concerned with some kinds of contribution than others: those which were controversial, for example, or any fiction (such as Gaskell's *North and South*). But there is virtually no way in which we can simply deduce Dickens's opinions from contributions written by others, and no alternative to reading them one by one.

As we have seen, the study of such questions has to be selective, since if we think of the nineteen volumes of *Household Words* alone, they are made up of 479 weekly numbers (with eight extra Christmas numbers), and there must be a total of nearly 3,000 articles as each number consists of at least six contributions. If we add to them the twenty-four volumes of *All the Year Round*, the material is too extensive to be assessed within the limits of this thesis. This study, therefore, concentrates on those articles which deal in some ways

³⁹ Johnson 2: 712-13.

with science, and investigates how far we can study Dickens through articles in his magazines. Is it, in fact, reasonable to assume that one can learn more about him from what his contributors wrote? What, if anything, can the articles reveal about his life, his experience, his opinions, and his stand on certain questions of the day? Was William Axton right in suggesting that as well as such topics being interesting in themselves, Dickens's periodicals can reveal aspects of his life and writing?⁴⁰

It is evident that there are two sides to such questions. On the one hand, it is absurd to think that Dickens's journals do not reveal a great deal about the editor. They engaged him for over twenty years and perhaps almost a day a week throughout that time. They brought him into contact with all sorts of issues and with a large number of people. Yet it is undeniable that, except where we have outside evidence, few of the contributions show anything but what the editorial staff let pass as suitable for their supposed readers. The contributions were unsigned. And once we start reading the articles themselves, the point becomes clear that if they are to tell us anything definite about Dickens we must link them with outside evidence.

A strong argument for doubting whether Dickens did carefully revise the contributions is that they were often written in a style that he seems to have deeply disliked. This is almost self-evident: though he often spoke of the problem with dismay, many articles appear to be highly unsuitable for a popular journal. We know, for instance, that *Household Words* and *All the Year Round* sold for twopence a number, and were meant for a wide general readership. It is true, as Anne Lohrli points out, that though aimed at a wide public, the journals assume that their readership was a well-read one; even so, it is hard to believe that most of their readers understood their often clumsy Latinate diction

⁴⁰ Axton 359.

and literary allusions.⁴¹ Dickens saw the problem himself, writing to Angela Burdett Coutts about a certain subject that it was "difficult to approach, in pages that are intended for readers of all classes and all ages of life."⁴²

Dickens's ideal reader, perhaps, was someone whose level of comprehension would have gone well beyond Joe Gargery's even if it remained within the capacity of the self-educated Biddy of *Great Expectations*. He told Sir Edward Bulwer Lytton that *All the Year Round* "has the largest Audience to be got that comprehends intelligence and cultivation."⁴³ The majority of his readers were probably like himself fairly interested in popular science in the same way that he was, but certainly not proficient. Most of them could have been nothing like Margaret Leigh's extraordinary grandfather in Gaskell's *Mary Barton* or the thoughtful weavers who, according to her, read Newton's *Principia* at meal times, and who were "equally familiar with either the Linnaean or the Natural System," and "the name and habit of every plant within a day's walk from their dwellings" (Ch. 5). Dickens rightly wanted simplicity; and when he wrote for his own periodicals, he often did so from the point of view of the working man.⁴⁴ His speeches to Athenaeums and mechanics' institutes show that he liked a clear and forthright way of expression. We would expect him, therefore, to want his journals to be written in a fairly plain style that was easy to understand.

Even more than this he had a relish for expressive and imaginative language, and mocked all forms of affectation in speech, writing, and behaviour. We find this everywhere

⁴¹ Lohrli 17-18; Lohrli points out that many articles addressed readers as "a travelled, educated audience, conversant with books and writers," and acquainted with "English classics and contemporary writings" and even with a "knowledge of the French language."

⁴² 4 February 1850, *Pilgrim* 6: 28.

⁴³ 3 August 1860, *Pilgrim* 9: 281.

⁴⁴ For example, in "To Working Men" (*HW* 10: 169-70) and "A Poor Man's Tale of A Patent" (*HW* 2: 73-75) Dickens thinks of himself as writing for someone with a sound but basic education, who has continued to improve himself by reading.

in his novels. It is sometimes treated affectionately, as with Micawber's grandiloquence; he sometimes mocks pomposity, as with Chadband; he can be contemptuous, as with Pumblechook or laugh at absurdity, as in Mr. Sapsea's epitaph or Mr. Guppy's ridiculous legalistic way of letter-writing. But Dickens is always an unrelenting opponent of abstract, wordy, vague, indirect, and pretentious writing. At the same time he demanded a vigorous and fanciful style, one in harmony with his humour and what he once called his "infirmity to fancy or perceive relations in things which are not apparent generally."⁴⁵ He saw "likeness in unlikeness" and strange correspondences, so that knowledge comes with a flash of illumination. He strongly emphasized the importance of imagination in "The Poetry of Science,"⁴⁶ seeing it as an essential element in understanding, quite inconsistent with jargon, out-of-date Latinisms, unnecessary technicalities, indirectness or condescending to readers. Perhaps this is common to many comic writers, and we constantly find it in his letters, speeches, journalism and particularly his fiction. Yet all this, as we shall see, is quite unlike the way in which many of the articles in his periodicals were written.

His wishes are also obvious in what he tells some of his most respected contributors. No one wrote more for *Household Words* than Henry Morley, a future University of London professor of English, and next to Wills no-one was more useful. He was particularly active, for example, in writing educational pieces, including many about science. Yet Dickens could be severe with him. On one occasion he writes to Henry Morley:

I am afraid you do not give sufficient consideration to some of your papers in *Household Words*. They are not to be done without trouble; and the main trouble necessary to them, is, the devising of some pleasant means of telling what is to be told . . . you know as well as I do how severe the struggle is, to get the publication

⁴⁵ See his letter to Sir Edward Bulwer Lytton, *Life* 3: 309.

⁴⁶ *Examiner*, 9 December 1848.

down into the masses of readers, and to displace the prodigious heaps of nonsense and worse than nonsense, which suffocate their better sense.⁴⁷

Again and again, Dickens made similar demands. He told John Robertson:

Pray avoid anything like a fragmentary appearance. I think I rather observed it in one of the two papers you left with me. I need not tell you that it is never necessary to write "down" to the popular capacity; but that the great merit of plain, easy, flowing narrative, while it is acceptable to all readers, is particularly felt by a large and mixed audience.⁴⁸

Often his criticisms were not made in time to improve an article before it was published but were written after the offence was committed, and it is doubtful how much attention the criticised contributor paid.

There is another way in which we can see Dickens's preferences. He held strong opinions about the need to use plain language in education, which we can see both in *Hard Times* and the part he played in the educational movement concerned with what was known as the "teaching of Common Things."⁴⁹ It is no accident that the novel begins in the classroom, because it draws on Dickens's experience with this movement to encourage simplicity in school teaching by the use of plain language and examples from everyday life. It was headed by Lord Ashburton and promoted by Miss Burdett Coutts, whose writings

⁴⁷ 31 October 1852, *Pilgrim* 6: 790.

⁴⁸ 26 April 1856, *Pilgrim* 8: 98.

⁴⁹ See K. J. Fielding, "Hard Times and Common Things," *Imagined Worlds: Essays on Some English Novels and Novelists in Honour of John Butt*, eds. Maynard Mack and Ian Gregor (London: Methuen, 1968), and *Pilgrim* 7: 559n, 576-77, 589, 615; Miss Coutts instituted a competition at Whitelands College to promote the teaching of domestic subjects; "Not Very Common Things" (*HW* 14: 39-41) praises Miss Coutts's prizes and the kind of school-training that can train a girl "to live by How and Why." Dickens says that in helping Miss Coutts judge some essays written by pupils at Training College he preferred those written with simplicity.

on the subject Dickens helped by revising. Cramming dead languages, and remoteness from ordinary life, were all targeted as unsuitable. He advised an unknown female correspondent "to remember if she sit down to write for a journal like this, that she is just an English woman writing the English language for a large English audience, and to consider whether she cannot get on in such an aim without German lines and French words; to forget herself as utterly as the Gentle Reader, and only to remember what she is describing."⁵⁰ It is a constant theme running throughout Dickens's life and work. How then could he have allowed some of the contributors' work which offended against such principles to pass?

Many instances of the use of Latin words, complicated and dead phraseology, and obscurity can be found in the pages of *Household Words*. They do not make lively reading. One, for example is a "Dr. Brown's" "Falling Leaves" (10 October 1857; *HW* 16: 354-55). Though called a mere "gossip about leaves" and only two pages long, it is extremely detailed, using excessively specific botanical language and Latin words, often couched awkward and indirect sentences. For example, the writer apostrophises leaves, which he calls the "Paterfamilias of the Vegetable World," "shalt thou lie inglorious, rotting, will no friendly, speculative hand grind thee into snuff, or twist thee into the exhilarating Pickwick?" It is extremely hard to follow, and hard to believe that Dickens read and approved it before publication. And perhaps we can guess why it was the unidentified Dr. Brown's only contribution to *Household Words*.

It is the same with "Under-Water Existence" (25 October 1856; *HW* 14: 342-47), probably by John Robertson, which gives information about seaflies, periwinkles, plaice (flounders), and "pholas" (or a kind of mollusc; these terms are rarely explained), what they live on, how they leap or move, why they are called by Latin names or given

⁵⁰ 28 February 1853, *Pilgrim* 7: 34.

Linnaean classifications. The article cites a troop of authorities about them. "Sea-Gardens" (27 September 1856; *HW* 14: 241-45) is an enthusiastic description of coastal seaweeds and plants, probably deriving from the author's Aberdonian boyhood, but heavily dependent on works by French naturalists. The author strays from the subject, which deals with the differently-coloured, so-called "gardens" on the shore, to "cryptogames" (plants without seeds, such as algae), various shell-fish he once saw called "balani," and lastly limpets; but though the article is descriptive and informative, it is unrelenting in its use of Latin names. It might have been written by Miss Blimber, the bluestocking teacher of little Paul Dombey. Such writing shows no consideration for the reader. Similarly, some of the science articles often refer to authorities simply by their surnames as if they never doubted that readers would immediately recognise foreign astronomers and naturalists such as Le Verrier, Fizeau, Lamouroux, Kützing, etc., and know exactly who they were. It is extraordinary. We are supposed to find them as "familiar to our mouths as Household Words"⁵¹

On the other hand, no doubt some articles are carefully written and addressed to the ordinary reader, such as Percival Leigh's retelling the substance of Faraday's lecture on "The Chemistry of the Candle." There are others that are well directed to the interest and capacity of the general public. There is, therefore, no clear reason why others should have been deliberately left in a pedantic and clumsy style. The more expert the author, in fact, the clearer the exposition as a general rule. Yet some writers seem unable to express themselves clearly. The minor poet and literary figure, John Abraham Heraud, in "A Way to Remember" (12 July 1856; *HW* 13: 616-18), for example, launches into the argument that everyday familiar things can sometimes help us understand and remember scientific ideas. He takes his examples from astronomy, trying to convey what is meant by "parallax" and "aberration". We are asked to understand this by an account of how the apparent

⁵¹Dickens adopted the name of his journal from *Henry IV*, Act 4, Scene 3, 50-51.

motion of trees seen from a moving body can be associated with the movement of planetary bodies or stars, as Herschel had discovered (and we are expected to know which Herschel), or how the effect of velocity and light from a moving planet can be understood by comparison with a "ball" shot from a musket in a moving boat. It is hard to suppose that the ordinary reader grasped the point. No doubt there are limits to verbal description, reached perhaps in Henry Morley's "A Puff of Smoke" (7 May 1853; *HW* 7: 234-35) in which, in an account of tobacco, he explains that hydrated silicate of magnesia is $MgO, SiO_3 + HO$. Perhaps this is an experiment in adapting the language of science to journalism. In fact, many of the articles would have benefited from the use of diagrams and tables, to help the reader understand; but it was the policy of *Household Words* and *All the Year Round* not to make use of illustrations. The result is that some of them are extremely hard to follow.

This weakness in responding to Dickens's presumed wishes and intentions is probably not just a sign of his inability to supervise everything, but also of a shortage of interesting popular scientific subjects and suitable people to write about them. The editorial staff had to work out ways of dealing with the problem. The contributors, more often than not, were literary journalists without scientific education, who had to learn the subject themselves, and their standards are inconsistent. For example, the ever-present Dixon,⁵² a Norfolk clergyman with a wide range of interests, competently discusses the nature of light in his ten-column "Polarisation" (14 November 1857; *HW* 16: 463-68): he gives the history of different theories about it, explains its use in microscopes, and how light is polarised. He

⁵² For Edmund Samuel Dixon (1809-93), see Lohrli 256-61. Lohrli appears to offer almost all that is known about him. After Henry Morley and Dickens himself, he was the most prolific contributor to *Household Words*, and evidently an authority on gardening, hens, pigeons and other topics. He taught himself how to use a microscope, knew a good deal of science, had a fluent pen, and the ability to turn himself to almost any subject and write about it with authority. He was helped by drawing on French books and published papers. This itself had an effect on his style and vocabulary, witnessed by his use of "unEnglish expressions" such as "mammifer" and "hyla" (for tree frog), and "Croquenoix" (for dormice), which the editors seemed happy to let pass. But it is distinctly bizarre, and must make one wonder whether Dickens really approved.

does not mention his authorities. He soon found that the handiest way to make a scientific account, paid for at the rate of a guinea for a two-column page, is to do what general periodicals and newspapers do today and that is to review or select what was wanted from newly published work. On the other hand, another of his articles, on "Physical Force" (12 March 1859; *HW* 19: 354-59), confidently conveys the idea of the first law of thermodynamics that the physical forces of the universe are one, that light, heat, and motion are interchangeable forms, and that matter cannot be created or destroyed. Dixon's account is based on William Robert Grove's* *On the Correlation of Physical Forces: Being the Substance of a Course of Lectures* (1846), and a remarkable lecture given by Alfred Smee on 18 February 1857 at the Royal Institution, "The Monogenesis of Physical Force."⁵³

Yet his fluent style can cover up superficiality and haste. For example, in "Vital Heat" (19 June 1858; *HW* 18: 13-18), Dixon takes his information about how living creatures maintain their temperatures independent of their environment, from the French professor, Jules Gavarret's *De la chaleur produite par les êtres vivants* (Paris, 1855), citing numerous other authorities. It is again McChoakumchildlike, giving a list of unknown authors, and using learned terms and long words, unfamiliar to the ordinary reader. It may be questioned whether the editorial staff quite understood all that he was saying in such an cumbersome passage as "it is necessary to have resource to the most delicate methods of investigation, and above all, to be carefully guarded against the refrigerating effects of evaporation." The general sense may be fairly clear, but it is poorly written, and goes

⁵³ The lecture was based on his book *The Sources of Physical Science* (London: Renshaw, 1843), later published as a pamphlet, *On the Correlation of Physical Forces* (London: Highley, 1846). It also appeared in a selection of his miscellaneous writings collected by his daughter, Mrs. E. M. Odling, *Memoir of the Late Alfred Smee* (London: Bell, 1878). It is apparent, therefore, that Dickens *could* have been aware of the first and presumably the second laws of thermodynamics in the 1850s; but he does not allude to them, nor to Smee or Grove, nor Dixon's redaction of their work. So the evidence that Dickens might have been easily familiar with such laws does not exist, and it is extremely unlikely that he made particular use of such ideas in the "very form" of his fiction.

against Dickens's best rules about communicating with his readers. Lohrli gives similar examples.⁵⁴

It may be that we should take into account the fact that two weeks before this number, Dickens's "Personal" statement (12 June 1858; *HW* 17: 601) had appeared. It is unlikely that, in the storm of events and personal problems besetting him, as well as starting to plan an extensive tour of public readings, Dickens was at this stage keeping up a full editorial supervision. If we are really considering how far *Household Words* was supervised by Dickens, we have to take account of such practicalities. A great many articles only provide the kind of derivative "science" which requires no deep thinking, personal experience or judgment from the reader: the authors only summarise the results of someone else's inquiries. In this, in fact, they are "anti-scientific."

This brings us back, therefore, to the recurrent question of the intensity of Dickens's supervision. Too much has been written about how thorough it was, apparently from a sense of veneration and a willingness to take him at his own valuation in his letters. Yet if we refer to what he writes to Wills and other correspondents, and then to the articles themselves, it is almost impossible to believe that he looked over many of them with care before publication. They tell a different story, whether we examine Dickens's comments on proof sheets, or remarks on what had already appeared. The "making-up" of a number sometimes seemed "exceedingly bad," "grievously" depressing him,⁵⁵ needing a great deal of alteration,⁵⁶ or being "awfully and solemnly heavy" and giving him "a Nightmare,"⁵⁷ even though others seemed "very well."⁵⁸

⁵⁴ Lohrli 10-11.

⁵⁵ 13 October 1852, *Pilgrim* 6: 777 [on No. 135].

⁵⁶ 18 September 1853, *Pilgrim* 7: 149 [on No. 184]; 25 September 1853, *Pilgrim* 7: 156 [on No. 185]; 4 May 1854, *Pilgrim* 7: 327 [on No. 217].

⁵⁷ 5 August 1853, *Pilgrim* 7: 124 [on No. 178].

⁵⁸ 27 July 1851, *Pilgrim* 6: 447 [on No. 72]; 18 June 1853, *Pilgrim* 7: 98 [on No. 171]; 1 August 1853, *Pilgrim* 7: 123 [on No. 179]; 18 April 1854, *Pilgrim* 7: 317 [on No. 215].

Yet Dickens also praises Dudley Costello's "Crabs" (7 October 1854; *HW* 10: 176-81), a piece about their nature, various species, specific names, distribution, and behaviour. It is hard to see why Dickens could have thought it "really good."⁵⁹ What Dudley Costello gives is only second hand information, and simple descriptions of the names and nature of different species. No serious consideration is involved; and it must leave us questioning Dickens's judgment.

There are times when Dickens is captious. He writes to Wills of an article by Sala which was evidently dropped and so cannot be identified. He calls it "One of the noblest subjects that can be written on, with really nothing in its treatment," while in the same number, John Lang's article though "very droll," is "full of references that the public don't understand, and don't in the least care for."⁶⁰ In April 1856, he is strongly critical of Sala's "All up With Everything" (26 April 1856; *HW* 13: 337-39), writing to Wills: "All up with everything is loose, scrambling, and careless, for a first article. But I suppose you have nothing better?"⁶¹ Sala's article was a review of Eugène Huzar's book, *La fin du monde par la science* (Paris, 1855), predicting the end of the world as the result of a universal catastrophe caused by "the exaggeration of science and power." Sala recognises Huzar's interest in science, but classes him with charlatans of the day; he ends his account with the ironic conclusion that the cataclysm will mean "all up with everything," not science alone. Dickens was disappointed with it.⁶² Yet, poor as it was, the article was published after all.

⁵⁹ 21 September 1854, *Pilgrim* 7: 417.

⁶⁰ 10 March 1853, *Pilgrim* 7: 48.

⁶¹ 13 April 1856, *Pilgrim* 8: 88.

⁶² 24 April 1856, *Pilgrim* 8: 98.

An idea of what Dickens wanted can sometimes be seen from the "editorial touches" that he sometimes said he had to make to contributions.⁶³ One example is in his comments on a story by his close friend Mary Boyle:

I have devoted a couple of hours this evening to going very carefully over your paper (which I had read before), and to endeavouring to bring it closer, and to lighten it, and to give it that sort of compactness which a habit of composition, and of disciplining one's thoughts like a regiment, and of studying the art of putting each soldier into his right place, may have gradually taught me to think necessary. I hope, when you see it in print, you will not be alarmed by my use of the pruning-knife. I have tried to exercise it with the utmost delicacy and discretion, and to suggest to you, especially towards the end, how this sort of writing (regard being had to the size of the journal in which it appears) requires to be compressed, and is made pleasanter by compression.⁶⁴

This advice shows how he wanted stylistic precision, compression, and compactness, achieved through delicacy and discretion; but though he would make such revision for a close friend, it was not typical of the attention he gave all his contributors. When it came to a story by the well known novelist Anne Marsh, he complained to Wills, "it would be as easy (almost) to write one, as I found it to get point and terseness out of such an infernal hash"⁶⁵ and, of another story, "nothing can improve the design . . . but I have altered the

⁶³ See Harry Stone, "Dickens 'Conducts' Household Words," *Dickensian* 64 (1968): 71-85; Gerald Giles Grubb, "Dickens' Influence as Editor," *Studies in Philology* 42 (1945): 811-23, "Dickens' 'Editorial Methods,'" *Studies in Philology* 40 (1943): 79-100, and "The Editorial Policies of Charles Dickens," *PMLA* 58 (1943): 1110-1124; ; Ellen Casey, "The Specially 'Trying Mode of Publication': Dickens as Editor of the Weekly Serial," *Victorian Periodicals Review* 14 (1981) 93-101.

⁶⁴ 21 February 1851, *Pilgrim* 6: 297-98.

⁶⁵ 9 October 1851, *Pilgrim* 6: 515.

wording of it, to avoid its looking, as it did, exactly like an indifferent translation."⁶⁶ He was often unable to satisfy himself in spite of his efforts at revision.

Almost any reading of *Household Words*, therefore, should show that we often cannot rely on it as expressing what Dickens wanted to say, because it is so clearly written in ways he strongly disliked. Much may have been as he wanted, but much fell short. Nor can we rely on his having seen and approved everything in advance. This has to be stressed if we are to understand how far we can depend on it as an indication of his own views on science or anything else. Nowhere can this be seen more clearly, so far as style goes, than in Dickens's scathing letter to Wills of 16 October 1851, which says he has been looking over recent back numbers: "Wherever they fail, it is in wanting elegance of fancy. They lapse too much into a dreary, arithmetical, Cocker-cum-Walkingham dustyness that is powerfully depressing."⁶⁷

Wills answered at once, writing with some dignity and apparently taking care to copy or draft his reply.⁶⁸ He points out that "elegance of fancy" is too high a standard for a substantial, closely-printed weekly: "Elegance of fancy cannot be thrown broadcast over such an acreage of letter-press." It could be "sprinkled" over it. And if Dickens could attend to it, all would be well: "if you could regularly see and go over each sheet before it goes to press there would be a very thick sprinkling of the excellence in which you say *Household Words* is deficient. When the number *has* had the benefit of your revision the touches you have given to it have improved it to a degree that has seemed to me marvellous." Wills's letter makes it clear that there was much Dickens did *not* revise, being

⁶⁶ 17 July 1853, *Pilgrim* 7: 114.

⁶⁷ *Pilgrim* 6: 522.

⁶⁸ 17 October 1851, *Pilgrim* 6: 850, from R. C. Lehmann, ed., *Charles Dickens as Editor: Being Letters Written by Him to William Henry Wills, His Sub-editor* (London: Smith, 1912) 73-75. Wills's reply next day has apparently not survived in MS, since Dickens burnt his incoming letters on 3 September 1860, see his letter to Wills, *Pilgrim* 9: 304; Lehmann's text must come from Wills's copy among his papers. Evidently it was a matter of deep concern to him.

busy with amateur theatricals, or at the seaside with his family. Wills went on to say that he was "delighted" with the proposal that Dickens would be coming up from Broadstairs each week, as "it would be most gratifying to me if my own judgment could be brought to some corrective test . . . I have my own notion of what such a publication as *Household Worlds* should be; . . . yet I cannot (less perhaps than many other men) be *always* right; and it would lift a great weight of responsibility from me if everything . . . had had the systematic benefit of another judgment before publication." It could not be clearer that *not* all contributions represented Dickens's views. They were sometimes Wills's sole responsibility, and of course broadly the contributor's.

The conclusion is too important not to press, because it means that we have to make a discriminating reading of each article if we are to learn where Dickens himself stood on any question. We must then persist with the further argument that there is not only the question of how the contributor writes but what he has to say, for Dickens also held strongly that "nothing can be so damaging to *Household Words* as carelessness about facts."⁶⁹ Yet mistakes were inevitably made. There could be slips in spelling, minor errors, or wildly misleading statements. Spelling mistakes were easy to correct or ignore, but not infrequent. Then there could be oddities, such as C. T. Hudson's (or Hughes's) articles about Mr. Bubs. The first is about "'Mr. Bubs on Planetary Disturbances" (12 April 1851; *HW* 3: 58-60) which is a strange account of minor variations in the orbits of Mars. The second, "Mr. Bubb's Visit to the Moon" (17 May 1851; *HW* 3: 187-88) not only misspells Bub's name, but makes a mistake about cutting "the sun in half" and the orbit of the moon. A brief note by Wills had to follow about "Mr. Bubbs and The Moon" (31 May 1851; 3: 228) which corrects the misprint or mistake which the author blamed on the printer,⁷⁰ but which the

⁶⁹ To W. H. Wills, 18 March 1853, *Pilgrim* 7: 51.

⁷⁰ Sometimes the mistakes were made by the printer, and Dickens was extremely annoyed if this happened. He wrote to Frederick Evans: "I declare before God that your men are enough to drive me mad! After all the trouble and care I have taken with that Xmas No. I open it now, and find in the second page--in my own article--"therefore we commit his body to the Dark"--for Deep--which was never wrong until now. I don't

sub-editor says was in the author's original manuscript. It was humiliating for the contributor, annoying for Wills, and a clear sign that no-one was properly reading the proofs. A similar Chip by Wills, "The Salt in the Sea" (14 June 1856; *HW* 13: 507) corrects a so-called "typographical error" in "Minerals That We Eat, Chap. I" (24 May 1856; *HW* 13: 437-42) which had said that the amount of salt in the sea averages "forty" percent: we are told that "forty" should have been "four," but that "according to the best authorities," it was really no more than "from two and a half to three per cent." Again, in apparent irritation, Wills publicly belittles his contributor presumably because of having shown up a failure in his own supervision. There are many other slips and corrections of the sort which make clear that *Household Words* could be inaccurate, and the more important point is not that it was simply "careless" but that this confirms the variability of Dickens's supervision.

As well as such accidental mistakes the periodical could be highly misleading or mistaken. A great many of the articles loosely claim to be scientific without in the least being so. In fact, although they pretend to give a rational account, they obviously do nothing of the kind; they are to that extent anti-scientific. For example, E. A. Dixon's "A New Oddity" (1 January 1859; *HW* 19: 102-5) is scientifically absurd. It starts pretentiously: "In science nothing is absolutely new; because everything which is the subject of science has had a previous existence ever since the world began But humanly speaking, everything undiscovered is new at the time of its discovery." Its subject is the so-called discovery by Baron von Reichenbach of an "Od" or "odic force," whereby certain men and women could see in absolute darkness. The German scientist was the "inventor of creosote" and known for his work on geology and meteorites; and his work had been translated by Professor William Gregory of Edinburgh. Scientifically considered

believe there is a beastly unstamped newspaper in London in which such a flagrant and unpardonable mistake would be made. I am so disgusted by it, that I throw down my pen in an absolute despair, and could as soon paint an historical picture as go on writing," 16 December 1851, *Pilgrim* 6: 554-55.

his claim was nonsense. But Dixon's account goes into considerable detail without explaining its impossibility or accusing Reichenbach of "deliberate falsehood." He simply says: "It is either a fact, or a cheat and conspiracy." He feebly concludes that much remains to be discovered, and no one knows how much more is new. Later in *All the Year Round*, an unknown author of "Stick- (Not Table-) Turning" (20 April 1867; *AYR* 17: 391-94) was to be sceptical of Reichenbach's "Od" theory, and asks for a rational investigation, as if there could be one. It is an interesting example of the scientific approach beginning to assert itself in place of simple blind assertion.

Another faulty account is Elizabeth Lynn Linton's "Why Is the Negro Black?" (20 June 1857; *HW* 15: 587-88), which is again taken at second hand. The contributor gets the substance of her article from a work by an American doctor, John W. Draper, *Human Physiology* (New York, 1856). He argues that the black pigmentation was because of the effect of a hot climate on the Negro's liver. Once again, though Linton is hardly to be blamed for not giving a convincing answer, she herself fails to show scientific scepticism about the doctor's claims. This is an example of an article in *Household Words* written by a journalist who knows virtually nothing about the subject, and makes no effort at rational investigation.

There are other examples. "Electric Light" (14 April 1855; *HW* 11: 251-54) by George Dodd and/or John Capper makes the extraordinary announcement of a discovery which will result in making electricity not just "a cheap commodity" but "costless . . . we have it gratis." Readers are told that there is now "cheap electricity" provided "for the million," which is to come from batteries, whose waste acids are so valuable to dye and paint manufactures that their sale will completely cover the cost of the batteries themselves. No thought is given to how this might work out in practice or in financial terms, and how the price of the acid could be kept up once it was produced in quantity. It is a confused

account of the alleged discoveries, and a wildly inaccurate vision of the immediate future when cities will be lit by batteries, ocean-going ships will be driven by the same power, and signalling, smelting and metal-assaying completely transformed. There was no subsequent correction of this, only another Chip on "Brimstone" (26 May 1855; *HW* 11: 398-99) by Wills who, compelled by a correspondent, admitted that the article had been wrong about Britain's production of sulphur.⁷¹ It looks as though Wills was annoyed at having to make what he thought an unnecessary correction. Again, he belittled his own contributor. The sub-editor's odd and uncharacteristic attack on two contributors in these examples cannot excuse the way in which he had let editorial standards slip.

Bizarre assertions and commonplace comment can also be found in *All the Year Round*. For example, "Stomach and Heart" (4 May 1867; *AYR* 17: 438-40) begins by declaring that "great discoveries in science in modern times are made almost everyday." Its argument is that the old belief that "the heart is the organ and seat of the affections" is wrong for it is really the stomach. The account has no scientific foundation, but draws examples from the Bible or various literary sources.

A less outrageous contribution is John Capper's "Important Rubbish" (19 May 1855; *HW* 11: 376-79) which announces the good news that Americans have been able to convert waste "slag" into a firm rocklike building material. With hindsight we might see that this cannot have been true; and we can understand why it was mistaken if we trace the article to its source in a lecture given to the Society of Arts by a Dr. W. H. Smith.⁷² Firstly, the so-called "slag" does not appear to have been what is usually meant by the term, but

⁷¹ The article is so fundamentally wrong, that it raises the question of how well-informed Wills and Dickens were about electricity, and its use in practice. In itself, if we believe Dickens approved it, it seems to dispose of the idea that he understood elementary physics, and still more that he had an intuitive grasp of important scientific discoveries, as supposed by Ackroyd, Wilkinson and others.

⁷² Delivered on 28 March 1855. "The Utilization of the Molten Mineral Products of Smelting Furnaces," *Journal of the Society of Arts* 3 (1855): 335-41.

"the slags of molten mineral products of smelting furnaces"; secondly and thirdly the claim was under investigation and had not been confirmed, and the question whether it could be done at any reasonable cost was entirely unsettled. Capper's account is highly misleading. George Walter Thornbury, in his series "Old Stories Re-Told: The Great Frost of 1814" (23 March 1867; *AYR* 17: 299-304) affably generalises that "science has not yet discovered to what great standing army of polar icebergs we are indebted for these severe seasons Science is short-sighted, and has much to learn." This is another example of a miscellaneous writer or journalist who refers to science but is mainly writing about recent social change and history.

Of course, there are also many sound articles on scientific subjects in Dickens's two periodicals; but we have to consider how far they represent Dickens's views. They need not show the level of his understanding any more than the majority of his inclusions. We cannot simply assume that he approved of the good, while the bad slipped by without his responsibility. There must be a degree of uncertainty about his supervision of the content and the general manner of such articles.

Other contributions run counter to Dickens's beliefs about how they should be written, and raise doubts about his approval. Many are, to use Dickens's word, "encyclopaedical" articles,⁷³ crammed with facts in a way we know he notoriously disliked. A curious series of examples can be found in a number of contributions written by E. S. Dixon which drew on *L'Esprit des bêtes, le monde des oiseaux* (Paris, 1853), by Alphonse Toussenel,* including "Brother Bruin" (20 August 1853; *HW* 7: 577-82), "Equine Analogies" (27 August 1853; *HW* 7: 611-15), "The Phalansterian Menagerie" (17 September 1853; *HW* 8: 64-69) and "Wings and Toes" (26 August 1854; *HW* 10: 31-37). They are badly written, packed with miscellaneous detail and unfamiliar terminology. Two further articles by Dixon

⁷³ Lohrli 9.

were based on Michelet's *L'Oiseau* (Paris, 1856) and his *L'Insecte* (Paris, 1858), which are less factual than rhetorical and wordy.⁷⁴

Or again there is the succession of articles on spiders, not a subject likely to interest the average reader.⁷⁵ Simple natural history, which has to be seen as science of a kind, brings out the worst in some contributors, who do no more than summarise what they have learned at second or third hand. Yet, like Dixon's versions of Toussenel, many such articles appeared just as *Hard Times* was coming out in *Household Words* between 1 April and 12 August 1854. We know the novel is, in part, a satire ridiculing spurious learning of this kind; and yet the editor allows his own contributors to act like Gradgrind and M'Choakumchild in pouring "imperial gallons of facts" into their readers (*HT*, ch. 1, p. 9).

Dixon's articles based on Toussenel ask readers to pore over pages summarising "scientific" accounts, packed with detail and unfamiliar terminology. In fact, Dickens was aware of Toussenel as he wrote to Wills on 5 August 1853 in despairing of their tone and lack of clarity that "it is M. Toussenel who is speaking, and not *H. W.* conducted by C. D."⁷⁶ We see him groaning about the problem: "The Number is an awfully solemn and heavy one I read it last night, and had a Nightmare. I doubt if anything so heavy (except stewed lead) could possibly be taken, before going to bed." And he also found "'The Stereoscope' dreadfully literal. Some fancy must be got into the No. if John [Dickens's servant] writes an article for it himself." Though Wills altered the number it was still heavy.

⁷⁴ "Michelet's Bird" (*HW* 19: 140-44) and "Michelet and Insects" (*HW* 19: 280-86).

⁷⁵ They include, for example, "Spiders' Silk" (*HW* 2: 65-67), "A Spider in Disguise" (*HW* 3: 46-48), "A Bird-Hunting Spider" (*HW* 4: 45-46), and "Mechanics by Instinct" (*HW* 6: 278-81).

⁷⁶ *Pilgrim* 7: 125.

In spite of what was--on the whole--his careful supervision, not everything in *Household Words* and *All the Year Round* was as Dickens wanted; and this is true both of style and content. If we are to deduce Dickens's opinions from them, we have to make a discriminating reading of each contribution in the light of its author and its context. In many ways this need for discrimination makes the articles more interesting. Though "conducted" by Dickens, the two journals represent a complex, unequal and often difficult collaboration among *three* parties: the contributors, the "conductor," and his sub-editor.

(vi) W. H. Wills--the Other Hand

Though *Household Words* and *All the Year Round* were Dickens's journals, even his contemporaries recognised that Dickens was not unaided. Lohrli even claims that "in the public mind, Wills was as much a part of the two periodicals as was Dickens."⁷⁷ William Tinsley, for example, in his *Random Recollections* (1900) said "I take the liberty to think that, when 'Household Words' and Charles Dickens's name is mentioned, the name and good work of William Henry Wills should not be forgotten."⁷⁸

Wills's influence on Dickens's journals needs to be re-estimated, for their joint enterprise from the beginning depended a great deal upon Wills's participation. In his "W. H. Wills' Plans for *Household Words*," Philip Collins draws attention to the evidence of nine pages of "scheme and List of Subjects" in Wills's handwriting "containing ideas for the layout and make-up of the new magazine, and listing possible topics."⁷⁹ As Collins argues, such evidence shows that the sub-editor may have played a more active part than is usually recognised in planning *Household Words*. Whether the paper shows that they were Wills's original ideas at first, as Collins believes, or notes of a conference with Dickens and

⁷⁷ Lohrli 463.

⁷⁸ Tinsley 2: 290-91.

⁷⁹ "W. H. Wills' Plans for *Household Words*," *Victorian Periodicals Newsletter* 8 (1970): 33.

perhaps others on the office staff, they indicate that in addition to his day-to-day editing, Wills also took part in deciding the journal's original plan.

Therefore when we are assessing the articles from the two journals including those related to science, we should bear in mind that both Dickens and Wills had jointly discussed the plan of *Household Words* and carried it out, as well as remembering that some articles that appeared may not have had Dickens's consent.

In Will's "scheme and List of Subjects," the first item which was to be "the inner page matter" was "A 'book' (*quasi review*) translated, or compiled art;[⁸⁰] one of the thousand subjects which daily turn up in newspapers & other periodicals foreign & home [daily]."⁸¹ This explains the origin of those "quasi reviews" and report-like articles. Then the second matter was to be a tale, and the third

A scientific art: hung upon something new in science, as an excuse to go back to [even stupid reading] uninformed (on that subject) readers to the new [thing to be as in the press] discovery of improvement in it. A *teaching* article. One of which appear in every number in [some] one of the inner pages. I have a project for converting a common sitting room & into a lecture laboratory. The fire place shall be enough to teach the elements of combustion -- & ventilation the components of coal -- the windows & atmosphere of the room will teach the chemi[cal]stry [composition] of the air. The candles, the process of gas making -- the lamp the elements of attraction &c. This of course only one [pleasing] series.⁸²

⁸⁰ Translations were already in Dickens's mind from the start.

⁸¹ Square brackets mean deletions.

⁸² Collins, "W. H. Wills' Plans for *Household Words*," 41-42.

Other potential subjects are listed, including "Manufactures. The Exhibition for 1851 will excite a great deal of public attention," "Compilations, Books -- not reviewed, but subjects taken from them," and "the great public questions of the day" including the sanitary question. As we shall see, all these subjects eventually found their way into the journals.

According to the plan, in each article there was to be a purpose which is "the extraordinary condition social, non-political & moral of the present day to be brought out by comparison [of] with the past" and "the looking forward or *progress*." The articles they planned to have were to serve that purpose and to make the journal full of the spirit of "progress." Perhaps because of this wish, it appeared that there were more articles that were optimistic about science than adverse to it, and more about how scientific discoveries could be applied to improve everyday life than discussion of theories and principles.

All these comments in Wills's notes reveal the kind of scientific articles they meant to have. With a few exceptions, most of the articles related to scientific subjects that have been summarised agree with this plan. Eventually the two journals carried articles on lectures and reports, on the Great Exhibition, "process" articles on manufactures, on sanitary questions, reform and progress, quasi reviews of books, and "teaching" articles. A problem still remained with the style. As we have seen, it was impossible to ensure that every article was "in a familiar style" suitable to uninformed readers. Dickens once complained to Wills of a number that it was "frightfully bad. No idea in it, no purpose, no appropriateness to or about anything, a mere hash-up of most indifferent magazine papers at chance medley."⁸³ Afterwards, in another letter, he said that Wills had taken such criticism "too personally," and explained that it was only his way of expressing himself "in a strong manner."⁸⁴

⁸³ 24 April 1856, *Pilgrim* 8: 98.

⁸⁴ 27 April 1856, *Pilgrim* 8: 99-100.

Science had never been a familiar subject to Wills; he was no more competent than Dickens to supervise articles of this kind. What he could do with them himself seems limited. In his 208 contributions to *Household Words*, only eleven articles related to scientific subjects are selected in the following summaries; and of these some are joint pieces, and others noted as "Chips" that were just written in response to correspondents or as corrections. Obviously, those scientific articles with his name as co-author may only show his editorial touch and were perhaps written on Dickens's instruction. For example, "The Stereoscope" (10 September 1853; *HW* 8: 37-42) which Dickens had criticised⁸⁵ was written with Henry Morley. We know that Wills revised "Colour-Blindness" (12 November 1853; *HW* 8: 255-57) by James Knox, as he is listed as its co-author. He seems confident in working out "The Troubled Water Question" (13 April 1850; *HW* 1: 49-54), an article on London's water supply, an example of applied science improving everyday life which is characterised by an objective and experimental spirit, a demand for accuracy and impartial analysis. It says that "second-hand information is not to be trusted too implicitly," and that "every statement in fact, like every story, gains something in exaggeration, or loses something in accuracy by repetition from book to book, or from book to mouth" (p. 50). He sounds authoritative talking about the value of mathematics and statistics, but he no doubt took this from an official publication; and he refers to Dr. Robert Christison's scientific analysis of London water, and what its suitable ingredients should be. Even so, we find Dickens verifying this, writing to consult his brother-in-law Henry Austin, who was Secretary of the General Board of Health.⁸⁶ In all, Wills writes as a practical but general journalist, happy to turn a few phrases about popular science but without any particular knowledge. We can see this in his opening paragraph to a piece based on the Annual

⁸⁵ 5 August 1853, *Pilgrim* 7: 125.

⁸⁶ 20 March 1850, *Pilgrim* 6: 69.

Report of the Registrar-General of Births, Marriages and Deaths, entitled "A Few Facts About Matrimony" (13 July 1850; *HW* 1: 374-77). Wills says:

Modern science is invading all the old realms of whims and fancies, charms and witchcrafts, prejudices and superstitions The wise men of our generation are evidently bent beyond recall on finding out all things that may by possibility be discoverable, no matter what pains the search may impose. Not content with making lightning run messages, chemistry polish boots, and steam deliver parcels and passengers, the *savants* are superseding the astrologers of old days, and the gipsies and wise women of modern ones, by finding out and revealing the hitherto hidden laws which rule that charming mystery of mysteries. . . matrimony.

He means that management (in this case, keeping marriage records) is like a scientific study and should not leave out any detail which could be informative or meaningful and must always be based on facts. Even so the link between science and matrimony is a remote one. Another example is in the title of his "Winged Telegraphs" (3 August, 1850; *HW* 1: 454-56) jointly written with Thomasina Ross, about carrier pigeons, based on Johann Georg Kohl's *Reisen in den Neiderlanden* (Leipzig, 1850), which says nothing about actual telegraphy. He was, perhaps, interested in topical scientific subjects, but apart from his journalistic expertise he brought no special knowledge to bear.

It is helpful to have a look at some of the 450 letters in R. C. Lehmann's *Charles Dickens as An Editor: being Letters Written by Him to William Henry Wills, his Sub-Editor* (1912), which demonstrates Wills' role in editing and helps us understand how the editorial standard sometimes weakened. Most of these letters are from Dickens to Wills,

and a mere five from Wills to Dickens which come from Wills's "Letter Book."⁸⁷ These five carefully worded letters, mostly written because of editorial differences, reflect on Dickens's occasionally shaky supervision.

Like Dickens, Wills did not go to university, but learned by experience. He was on the staff of *Punch* from its start in 1841, on the staff of the *Daily News* from its beginning, and was assistant editor of *Chambers's Edinburgh Journal* in 1842-45.⁸⁸ After his resignation from the *Daily News*, Dickens said to Wills "I miss you a great deal more than I miss the Paper." Although Wills was recommended for *Household Words* by Forster, Dickens must already have liked him and considered him helpful. According to Lehmann, the correspondence between the two men shows Wills "as an editor, ardent, but patient; sometimes impulsive, but always immovably steadfast in the execution of his purpose; firm in his grasp of principles but resolutely careful in every detail which might serve to carry those principles into execution."⁸⁹ Wills, in Lehmann's words, was Dickens's "alter ego."⁹⁰

In a letter to Dickens regarding Horne's overly high-rated payment⁹¹ and Horne's not doing enough for the journal, Wills begged Dickens to understand that "in all I do I aim at one only object: --the welfare and success of the property in which we have embarked" (16 August 1850).⁹² Dickens recognised Wills's ability. Recommending Wills to Miss Coutts as her secretary, Dickens says: "It is impossible to find a more zealous, honourable, or reliable man."⁹³ Dickens did not hesitate to say "my friend Mr. Wills who is my other self in

⁸⁷ Preserved by Wills, passed to his widow, and then her niece Lady Priestley and others, and now at the Huntington Library.

⁸⁸ For more information, see Lotrli 461-65.

⁸⁹ Lehmann v.

⁹⁰ Lehmann xii.

⁹¹ As Wills explains, the limit for the average cost of contributions was sixteen pounds for each number and on a salary of £5.5 per week, Horne had not done enough contributions; see Lehmann 35-36.

⁹² Lehmann 35.

⁹³ 16 November 1855, *Pilgrim* 7: 746.

Household Words . . . his object being mine"⁹⁴ and called him "my sub-Editor and confidential right hand in Household Words."⁹⁵

But there were times when he was not completely satisfied. On one occasion, Dickens was extremely annoyed by Wills's making deletions in one of his articles: "You remember, I suppose, that the statement in question is NOT OURS? . . . I must consider whether it is worth while to alter the making up by putting it in again; but in future don't touch my articles without first consulting me."⁹⁶ On the same day, Wills immediately replied justifying himself, saying it was only to avoid contradiction, and to ensure the readers' confidence in the narrator. He thought it was utterly for their journal's good. He explained: "when I make an objection to *any* article I do it suggestively. I am exceeding jealous of anything appearing which might have the remotest tendency to damage the name which appears at the top of each page; and which is responsible for every word printed below it, unless the contrary be specifically stated."⁹⁷ In the same letter, he also gently defends himself against Dickens's sharp accusation of his choice of a title as "the worst one within the range of human understanding."⁹⁸

In spite of his hard work, Wills did not always fulfill the editor's wishes. Dickens urged him to "feel and judge the more readily both for yourself and me too," and at the same time, be "one and indivisible," when he was away.⁹⁹ He complained to Catherine on 21 November 1853 "I have now heard twice from Forster. He complains of Wills as not

⁹⁴ 26 August 1855, *Pilgrim* 7: 694.

⁹⁵ 26 August 1855, *Pilgrim* 7: 695.

⁹⁶ 12 July 1850, *Pilgrim* 6: 129-30.

⁹⁷ Lehmann 30-32.

⁹⁸ Following Wills's "The Modern Science of Thief-Taking" (*HW* 1: 368-72) which is on detective police, Dickens wrote three articles on the same subject: "A Detective Police Party" in two instalments (*IHW* 1: 409-414 and 457-60) and "Three 'Detective' Anecdotes" (*HW* 1: 577-80). But Dickens strongly disapproved of the heading Wills had decided for his articles, "Three 'Detective' Anecdotes" and instead suggested "A Night with the Detective Police."

⁹⁹ 10 March 1853, *Pilgrim* 7: 48.

consulting him enough, and is evidently very sore in that connection. Wills seems to be blundering, so far as his correspondence is concerned; for he tells me nothing of *Household Words*, its contents, the state of the accounts on the Audit Day, or anything else that I naturally want to know."¹⁰⁰ On 27 November 1853, he wrote to her again saying "I have now been two months away, and I have not received the least account of one single paper that has been put into *Household Words*, except a vague allusion to a story of Mrs. Gaskell's. Nor have I the least idea . . . of the reported condition of *H. W.*"¹⁰¹

At another time, Dickens told Wilkie Collins:

I fell foul of Wills yesterday, for that in "dealing with" the second part of your story, he had not (in two places) "indoctrinated" the Printer with the change of name. He explained to me that on the whole and calmly regarding all the facts from a politico-economical point of view, it was a more triumphant thing to have two mistakes than none--and indeed that, philosophically considered, this was rather the object and province of a periodical.¹⁰²

However both men knew that the journals demanded Wills's full attention. When Wills thought of taking on an additional editorial job, Dickens firmly objected. He wrote to him:

When you proposed to me the terms of your association with *Household Words*, you expressly set forth to me the necessity of your giving yourself wholly up to it. Since its establishment, you have frequently shewn me that the demands made by its business on your time, have prevented your writing in it. I am perfectly sure of my own knowledge that it must always draw sufficiently on all the energies and

¹⁰⁰*Pilgrim* 7: 205.

¹⁰¹*Pilgrim* 7: 215.

¹⁰² 15 April 1855, *Pilgrim* 7: 593.

qualities you possess for the management and conduct of any periodical work. And although I can imagine your having leisure for some literary labor apart from it, now and then, I must hold to the position that its claims are engrossing, and that it must not be put into double-harness with any other periodical editing or sub-
 editing.¹⁰³

The next day Wills replied, saying that the demands for the proposed work for the *Civil Service Gazette* were light and he had thought of it for financial reasons. Dickens agreed to pay extra for Wills's contributions, in addition to his salary: "Your zeal and fidelity in all respects, of course I have never doubted. How could I!"¹⁰⁴ And when Forster left the board, Dickens distributed half of Forster's one-eighth share to Wills and said he hoped Wills could be gratified "in this, and in all other little ways in which I can ever testify my affection for you and my sense of the value of your friendship and support, I merely gratify myself by doing what you more than merit."¹⁰⁵ It was a complete commitment for both men; in fact, later Dickens also turned down an offer to himself of another editorial job.¹⁰⁶

Dickens's joke about his being Scrooge and Wills being Bob Cratchit is interesting in illuminating their relationship.¹⁰⁷ The dedication in Wills' *Old Leaves: Gathered from Household Words* (1860) shows his recognition of Dickens: "TO/ 'THE OTHER HAND,/ Whose masterly touches gave to the OLD LEAVES here freshly/ gathered, their brightest tints, they are affectionately/ INSCRIBED." He puts the mark of a "hand" as a sign to indicate articles with Dickens's touch. In his introduction to *Sir Roger de Coverley*, by *The Spectator* (1851), Wills's description of the "divided labour," the "companionship" and "partnership" between Addison and Steele almost corresponds to his own situation as

¹⁰³ 10 June 1855, *Pilgrim* 7: 645.

¹⁰⁴ 12 June 1855, *Pilgrim* 7: 648.

¹⁰⁵ 15 February 1856, *Pilgrim* 8: 57.

¹⁰⁶ 6 April 1860, *Pilgrim* 9: 232.

¹⁰⁷ 16 September 1855, *Pilgrim* 7: 704.

Dickens's sub-editor. Wills says that the outline of the character was first imagined and partly traced by Steele and the colouring and more prominent lineaments by Addison. "What Steele's impatient genius planned, Addison's rich taste and thoughtful industry executed: what were and would perhaps have ever remained, dreams in Steele's brain, came out distinct realities from under Addison's hand," he quotes from a critic.¹⁰⁸ Therefore in his edition, Wills separates the thirty Coverley papers, and notes that twenty are by Addison, eight by Steele and two by Budgell. Yet he says that most readers prefer to believe that the creation of Sir Roger de Coverley

comes from a single source; --from those nicely-balanced stores of touching pathos and refined humour; of sound common-sense and polished wit; of keen satire and kind words; of sharp observation and genial description, which belong to the single gentleman who paints his own portrait in the first pages, and who is known wherever English letters can be read, as "The Spectator."¹⁰⁹

Whether or not Wills had his own relation to Dickens in mind when writing this passage, he was clearly aware of the problems of collaboration and of giving a fair recognition to each contributor.

The long-term companionship between Dickens and Wills built up their mutual understanding. While they were editing *All the Year Round*, Dickens paid Wills a curious back-handed compliment in speaking of him to Sir Edward Bulwer-Lytton: "Wills has no genius, and is, in literary matters, sufficiently commonplace to represent a very large

¹⁰⁸ *Sir Roger De Coverley, by the Spectator, with Notes and Illustrations by W. H. Wills* (London: Longman, 1851), 5.

¹⁰⁹ *Sir Roger De Coverley*, 6.

proportion of our readers. Moreover, he has had 12 years experience of this work, weekly and daily, with me."¹¹⁰

Another important member of the editorial board was Henry Morley who was useful for scientific articles. Morley first studied and practised medicine before abandoning it to become a school master.¹¹¹ When in charge of Dr. Beard's school in Manchester in 1848, he especially included a large portion of "practical scientific knowledge" in the curriculum and established a laboratory for teaching chemistry; and in 1849, when he went to direct another school in Liverpool, he particularly wanted the pupils to study natural science. His educational methods and principles emphasise the teaching of science; so do his articles. Some of them on public health attracted Dickens's attention, and he commanded Wills to invite contributions from Morley: "It is Mr. Dickens's desire to help on the Sanitary movement by any means in his power and he is anxious of obtaining your assistance."¹¹² He thought an "amusing article, similar in tone and purpose" to those he had already written, "would have a very good effect" in *Household Words*. On this invitation, Morley at first told his fiancée that "Dickens' journal does not seem my element . . . the readers are an indiscriminating mass to whom I'm not accustomed to imagine myself speaking."¹¹³ He preferred to write for people such as the readers of the *Journal of Public Health* or the *Examiner*, with "cultivated tastes" who are "clever, liberal-minded, and love wit." He thought he could not write "naturally" for *Household Words*. He was not even sure about the editor, saying " he has not a sound literary taste; his own genius, brilliant as it is, appears often in a dress which shows that he has more heart and wit than critical refinement I much doubt whether he is the right man to edit a journal of literary mark." He preferred Forster. Then on 13 April 1850 he worked out how to write a

¹¹⁰ 15 May 1861, *Pilgrim* 9: 415.

¹¹¹ For Morley's life, see Henry Shaen Solly, *The Life of Henry Morley* (London: Arnold, 1898).

¹¹² 2 April 1850, *Pilgrim* 7: 901.

¹¹³ Solly 150.

particular article for Dickens's journal: "I write as a gossip old lady with conceits and prejudices, giving *my* views of things, characteristic and laughable, but so put as to inculcate sanitary truths. It's the same upside-down style as in the Examiner" and would be "just what Dickens wants of me."¹¹⁴ As the result, an ironic "Letter from a Highly Respectable Old Lady" (18 May 1850; *HW* 1: 186-87) deals with the fatal effect of white or yellow phosphorus which caused the so-called "phossy jaw" in match factory workers who were exposed to it. Such a piece in its peculiar "upside-down style" is short but powerful. Later on the same subject is followed up by "One of the Evils of Match-Making" (1 May 1852; *HW* 5: 152-55) relying on an account from a medical journal and what Morley had witnessed himself.

On 2 June Wills wrote to invite Morley to join the staff: "We are in want of help in that branch of our editorial labours which relate to the getting up and superintending (without always actually 'writing up') the various subjects which are pressed upon us."¹¹⁵ Altogether Morley wrote more than 300 items for *Household Words*, nearly thirty of them related to science. He was the only one on the staff with a university education, and contributed more than anyone else. He was a perfect contrast and complement to Dickens and Wills. As he had done in the school he conducted, he dealt with all kinds of scientific subjects. In 1851 he wrote a series of lengthy articles on geology, oceanography and geophysics, conveying knowledge about the action of oceans, currents and tides.¹¹⁶ He advocated the merits of scientific discovery and scientists¹¹⁷ and he was often concerned with public health¹¹⁸ and education.¹¹⁹ He introduced new information from the most recent scientific reports given

¹¹⁴ Solly 151.

¹¹⁵ *Pilgrim* 7: 904.

¹¹⁶ "The World of Water" (*HW* 3: 204-9), "The Wind and the Rain" (*HW* 3: 217-22); "Our Phantom Ship on An Antediluvian Cruise" (*HW* 3: 492-96).

¹¹⁷ For example, "The Work of the World" (*HW* 3: 589-92).

¹¹⁸ Including the two on match-making mentioned above, "Chloroform" (*HW* 7: 179-81), "An Ugly Nursing" (*HW* 8: 406-8), "Change of Air" (*HW* 8: 570-72), "Poison" (*HW* 13: 220-24).

¹¹⁹ "The Learned Sailor" (*HW* 9: 458-62), "Not Very Common Things" (*HW* 14: 39-41),

to the BAAS and the Royal Society,¹²⁰ and was the most serious contributor on scientific subjects in the early years of *Household Words*. He made extensive studies and was capable of drawing accounts from authorities such as Hugh Miller on prehistoric creatures, from Liebig on chemistry and its application, William Grove's book on physics, George Wilson on colour-blindness, Charles Johnson on poisonous plants, and so on.¹²¹ He was able to explain recent advances in technology such as railway signaling.¹²²

Yet Morley had disadvantages. "The Stereoscope" was blasted as being "dreadfully literal," and as if written by John McCulloch.¹²³ In a long letter, Dickens gave his most severe criticism of Morley's style:

It is very disagreeable to me to connect a subject which has nothing but pleasure in it, with a faint shadow of dissatisfaction . . . I must do that violence to my inclination.

I am afraid you do not give sufficient consideration to some of your papers in *Household Words*. They are not to be done without trouble; and the main trouble necessary to them, is, the devising of some pleasant means of telling what is to be told. The indispensable necessity of varying the manner of narration as much as possible, and investing it with some little grace or other, would be very evident to you if you knew as well as I do how severe the struggle is, to get the publication down into the masses of readers, and to displace the prodigious heaps of nonsense and worse than nonsense, which suffocate their better sense. I know of such

¹²⁰ "Our Own Temperature" (*HW* 6: 11-12).

¹²¹ "Our Phantom Ship on An Antediluvian Cruise" (*HW* 3: 492-96), "The Work of the World" (*HW* 3: 589-92), "Light and Air" (*HW* 3: 612-16), "Colours and Eyes" (*HW* 12: 521-24), "Our Poisonous Wild Flowers" (*IHW* 14: 234-36).

¹²² "Need Railway Travellers be Smashed?" (*HW* 4: 217-21) and "Self-Acting Railway Signals" (*HW* 7: 43-45).

¹²³ To W. H. Wills, 5 August 1853, *Pilgrim* 7: 125-26. John Ramsay McCulloch (1789-1864; *DNB*), statistician and political economist, known for his encyclopaedic works.

"perilous stuff" at present, produced at a cost about equal to the intrinsic worth of its literature, and circulating six times the amount of Household Words.

My confidence in the ability of such people to receive and relish a good thing, is so far from being in the least shaken by this knowledge that I only feel the more strongly that the good thing must be done at its best. And what I particularly want to impress upon you is, that it is not enough to see a thing and go home and describe it, but that the necessity is, for ever upon us of patiently considering *how* to describe it, so as to give it some fanciful attraction or some new air. I have kept back the gold-refining paper, because it is exactly like a hundred other papers we might shake into a drawer together; merely shewing the reader what is to be seen as the Peep-Show man does.¹²⁴

On 24 March 1854, he also wrote to Wills to express his worry about Morley's being sarcastic: "He will be perfectly fair and just, of course; but I hope he will not turn the equitable balance" in writing about factory accidents.¹²⁵ Morley also wrote a sarcastic account of the quality of contemporary physicians.¹²⁶ After reading his criticism on some London quacks in "One Cure More" (8 March 1856; *HW* 13: 191-92), Dickens asked Wills to take out the attack on the Cold Water cure in the article because Dickens, his wife and Wills had tried it and he himself thought it good.¹²⁷

Thus, like Wills, Morley was not perfect but reliable, and "has unquestionably done us very good service indeed."¹²⁸ On 19 March 1855, Dickens told him: "I wish therefore you would so re-touch the paper, as to make it appear to describe what you saw during the frost. . . . I do not like to use my pen upon a paper that is so feelingly done from the

¹²⁴ 31 October 1852, *Pilgrim* 6: 790-91.

¹²⁵ *Pilgrim* 7: 297-98.

¹²⁶ "The Modern Practice of Physic" (*HW* 8: 169-73).

¹²⁷ 2 March 1856, *Pilgrim* 8: 64.

¹²⁸ *Pilgrim* 6: 317.

heart."¹²⁹ He wrote to Wills on 31 August 1861: "In the making-up, I find Morley very helpful indeed--always there early on the Wednesday, always ready with his proofs and scheme, and always prepared for any kind of alterations on my part."¹³⁰

Wilkie Collins as a sub-editor was another matter. Dickens liked him and recruited him as a member of staff after 4 October 1856, because he was "exceedingly quick to take my notions," "industrious and reliable,"¹³¹ was in time with his serial stories and willing to write jointly with Dickens. But such writing was not connected with science, except perhaps the comic "Small Shot: Cooks at College" (29 October 1859; *AYR* 2: 6-7) which pretends to advocate scientific education for people in the workhouses and kitchens. It suggests that they should be taught "the effect of fire on solids or fluids," "the law of boiling," etc., and that there should be "an Oxford for cooks" with "lectures on the elements of the chemistry of cooking."

These represent only a selection of Dickens's contributors, how they spoke for themselves, and came under his eye for sometimes failing to do what he wished. They show how hard it is to tell how far anything on science in the weeklies can stand for Dickens's own knowledge or belief, but make it clear that he was content to have such pieces written by journalists whose knowledge was often no more advanced than his own.

But a curious exception appears to arise with George Henry Lewes. Lewes is confidently said by Rosemary Ashton, in her collection of his articles to have contributed the one on "Magic and Science" (23 March 1861; *AYR* 4: 561-66).¹³² Ashton says that "Dickens asked Lewes to contribute a few light popularising articles on science [!] to both

¹²⁹ *Pilgrim* 7: 572.

¹³⁰ *Pilgrim* 9: 450-51.

¹³¹ To W. H. Wills, 16 September 1856, *Pilgrim* 8: 188.

¹³² Rosemary Ashton, ed., *Versatile Victorian: Selected Writings of George Henry Lewes* (London: Bristol, 1992) 290-98.

his papers, *Once a Week* and *All the Year Round* between 1859 and 1861."¹³³ She gives the wrong date for the article (25 March) and is of course wrong in saying that *Once a Week* was Dickens's. Nor is there any reference to such correspondence between them in *Pilgrim*, vols. 9 and 10 (1859-64) or in Gordon S. Haight's edition of the *George Eliot Letters*.¹³⁴ It has not been possible to see William Baker's edition of the *Letters of George Henry Lewes*;¹³⁵ and it is certainly a pity to leave any questions unresolved at the time of completing the present thesis. It is a matter for immediate investigation. Nevertheless the question of what Lewes had to say about science and religion, and his other articles (none of which is referred to by Oppenlander) is intriguing, because of Lewes's own particular interest in both science and fiction.

(vii) Creation, Evolution and Providential Design

The most important scientific question thrust on the mid- and late- Victorians was whether they ought to believe in an instant creation or in evolution. This topic is one which Dickensian criticism has taken up in spite of its apparently slight reflection in the novels. In fact, it can reasonably be suggested that Darwinian ideas must have affected current thought and imagination in many ways without their being easily detectable; this has been the argument of such writers as George Levine, Gillian Beer, H. W. Fulweiler and others.¹³⁶ Before their argument can be profitably pursued, it is reasonable to ask whether

¹³³ Ashton 15.

¹³⁴ Gordon S. Haight, ed., *The George Eliot Letters*, 9 vols. (New Haven: Yale University Press, 1978).

¹³⁵ William Baker, ed., *The Letters of George Henry Lewes*, 2 vols. (Victoria, Canada: University of Victoria, 1995).

¹³⁶ In "Dickens and Darwin," George Levine suggests that Dickens's novels, "in their way, work with the materials that Darwin transformed in another," and that there are some "Darwinian elements in Dickens," *Dickens and Other Victorians: Essays in Honour of Philip Collins*, ed. Joanne Shattock (London: Macmillan, 1988): 129-30; Levine also asserts in another chapter entitled "*Little Dorrit* and Three Kinds of Science," that "*Bleak House* works through many of the crises that Darwin's thought made explicit" and "*Little Dorrit*, while including all those Darwinian elements. . . takes the experiment further," Shattock 153-54. Gillian Beer in her "Origins and Oblivion in Victorian Narrative," argues that "creative narratives" such as those of the geologists including Sir Charles Lyell and Darwin can be examined "alongside Victorian works of fiction" such as Dickens's, and that "the process of interchange of metaphors and concepts

it can possibly be established that Dickens was aware of contemporary thinking on evolution, and what his own views were. There are many ways of looking at this, but one of the most important is to see how Dickens's contributors dealt with the question over the whole period of 1850 to 1870. What was the attitude to creation and evolution in the two periodicals before the publication of Darwin's *Origin* in 1859, and what was said about it after it appeared? Did Darwin's ideas alter the attitude to evolution that had been previously expressed in the journals? Is there much variety in the contributors' views? Can we infer that there was any editorial policy about the matter? This topic allows us to investigate whether Dickens preferred his journals to take a particular position on topical controversies. A consideration of these questions ought to precede or at least accompany any critical discussion about whether evolution or Darwinism (since they are distinct) had any effect on Dickens's fiction.

In fact, there is scarcely any evidence of direct contact between Dickens and Darwin, and none to show Dickens's awareness of Darwin except for his owning a copy of the second edition of the *Origin*.¹³⁷ It is not mentioned in his *Letters*; a wisp or echo of a phrase may have found its way into the second paragraph of *Great Expectations*,¹³⁸ but though we know that Darwin read Dickens, there is no tangible evidence, in spite of the

between fields" can be observed too; Ruth Bernard Yeazell, ed., *Sex, Politics and Science in the Nineteenth-Century Novel* (Baltimore: Johns Hopkins University Press, 1986) 65. It is perhaps to the point to note that in putting forward his arguments, George Levine sometimes ascribes articles in *Household Words* to Dickens that were not written by him, Shattock 126 and 292. Both H. W. Fulweiler in "A Dismal Swamp: Darwin, Design, and Evolution in *Our Mutual Friend*," and Jonathan Smith, in "Experimenting with Method: Science and Victorian Literature," refer to articles in *All the Year Round* and link them to *Our Mutual Friend* in very questionable ways (see the following section). In a similar way, Goldie Morgentaler recently puts her arguments on *Great Expectations* in "Meditating on the Low: A Darwinian Reading of *Great Expectations*," *SEL* 38 (1998): 708-9.

¹³⁷ J. H. Stonehouse, *Catalogue of the Library of Charles Dickens from Gadshill* (London: Fountain, 1935) 26.

¹³⁸ In the opening of the story, Pip ponders over the gravestones of his brothers who died early "in that universal struggle"—the same words appear in the third chapter of *Origin*. See Robin Gilmour, ed., the Everyman edition of *Great Expectations* (London: Dent, 1994) 435.

probabilities, that Dickens was personally aware of Darwin.¹³⁹ His apparent attitude in the periodicals is, therefore, all the more significant.

The first point to make is that it is wrong to try to draw conclusions about the *Origin* and evolution without first seeing what is expressed or implied in the many contributions which bear on evolution before the *Origin* appeared. For all through the 1850s *Household Words* has articles on natural history, astronomy, and general science which indirectly bear on evolution. There are so many, in fact, that one is bound to feel that they have been ignored by those who have taken up the matter, because they contradict what commentators have strongly wished to find. They are not "Darwinian" or "pre-Darwinian." On the contrary, they are usually conventionally orthodox, not just passively accepting that creation was the work of a purposeful God, but emphasising it. We have the paradox that while we know that Dickens was probably an evolutionist, as we see from his review, "The Poetry of Science," and from his interest in John Pringle Nichol (see p. 2 above), his contributors seem to have been disinclined even to mention evolution.¹⁴⁰

It seems, in fact, that most contributors to *Household Words* and *All the Year Round* were anxious to avoid controversy over the matter, and this may have been part of Dickens's general policy. On religious questions, he was usually inclined not to take or allow a provocative stand.¹⁴¹ On general matters, his advice to Wills was usually in favour

¹³⁹ In his speech in Birmingham in 1869, Dickens said "It is commonly assumed. . . that this age is a material age, and that a material age is an irreligious age. I have been pained lately to see this assumption repeated in certain influential quarters for which I have a high respect and desire to have a higher," *Speeches* 403. Dickens's comment was in reply to Dr. Francis Close, Dean of Carlisle, who, in a sermon had just scolded Darwin and his followers for arousing an evil spirit of the "bottomless pit" and said that he himself would prefer "the testimony of God respecting the origin of our species," *The Times*, 22 September 1869.

¹⁴⁰ As has been mentioned (p. 1-2), in his *Examiner* article, "The Poetry of Science," Dickens argues in support of Robert Chambers, and there is reason to think that he was at least interested in the evolutionary ideas put forward by Professor John Pringle Nichol of Glasgow.

¹⁴¹ Nonetheless, he caused some offence to contributors such as Harriet Martineau, and friends such as G. R. Leslie, by taking what they saw as a prejudiced line on Roman Catholicism at a time when this was a topical question; see Lohrli 358.

of not giving offence.¹⁴² On questions about capital and labour, it can be argued that he tried to keep an even balance.¹⁴³ It was a sound way in which to conduct a popular journal which aimed at as wide a readership as possible. Most, if not all, contributors held fast to Christian orthodoxy, without defining too closely what that may be. They constantly reassured their readers of God's existence, his benevolence, and that his designing hand and purpose are evident in his creation. These ideas are clear, for example, in Henry Morley's little poem, "The Love of Nature" (3 August, 1850; *HW* 1: 452), describing the beauties of Nature, which ends, "I welcome all, O God--share all Thou wilt provide!" Mrs. Hoare in "Mechanics by Instinct" (4 December 1852; *HW* 6: 278-81) mentions that a certain kind of spider knows how to build a diving bell to enable it to breathe and catch its prey under water, because "Her Maker has taught her how to solve a problem which would have baffled the genius of Newton."

It is true that from the first volume of *Household Words*, some contributors showed an interest in the new ideas about geology and evolution, and start enquiring about natural law. In the first chapter of R. H. Horne's "The True Story of A Coal Fire" (6 April 1850; *HW* 1: 26-31), a short story about coal mining, the chief character Flashley Dalton is carried back to the antediluvian period by a dwarf creature called "Elfin" to see changes in nature in many parts of the world including giant forests "destined to follow the law of transmutation" which will one day make them into coal. The detailed description of "the antediluvian period" is presumably based on the author's reading of elementary works on geology, and it describes the earliest vegetation, chaotic jungles, and a dreary swamp without animals or humans. Elfin says that "these vast trees and plants, this richly poisoned

¹⁴² For example, regarding one of Collins's articles "Highly Proper!" (*HW* 18: 361-63), which condemns some parents for the pressure they exerted on the proprietors of schools, Dickens asked Wills "not to leave anything in it that may be sweepingly and unnecessarily offensive to the middle class"; he said: "Don't be afraid of the 'Truth, in the least; but don't be unjust"; see *Pilgrim* 8: 669.

¹⁴³ As in "On Strike" (*HW* 8: 553-59), in which Dickens argues for a settlement by agreement: "Masters right, or men right; masters wrong or men wrong." He recommends arbitration.

atmosphere, this absence of all animal life of man, and beast, and bird, and creeping thing, is all arranged in due order of progression." The article expresses some basic evolutionary ideas in speaking of transmutation, natural process, and an "order of progression," and the author seems optimistic about such natural laws. Dickens was interested in this piece and, while Horne was writing it, asked him "How goes on the coal rig?"¹⁴⁴

In Ernest Abraham Hart's "The History of a Coal Cell" (10 December 1853; *HW* 8: 354-55), a discussion about how every living being depends on cells and how growing organisms turn into coal, a source of energy, the author concludes his account:

there can be no doubt that in digging up the coal, men are furnishing the means under a natural law, which they unconsciously obey, of the increase of their species. We cannot refuse to see in this an instance of the beautiful adaptation of the laws of nature to created beings; of the complete subservience to man of the great organic laws of the universe; of their instrumentality in promoting his comfort; and the necessity he is under of acting in accordance with and support of those laws.

The ideas are generally vague, but the author believes that there is a law of nature and wishes to pursue a further understanding of the laws and principles of the universe. Nature and mankind are adapted to each other.

Yet some contributors are curious only up to a certain point; faced with an inevitable question, they avoid the answer. By 1860 hardly anyone could avoid the problem of fitting into an "orthodox" time-scheme the geological record of the earth, and the evidence of fossils and archaeology. Dickens showed his own understanding of the problem in his

¹⁴⁴ 12 February 1850, *Pilgrim* 6: 36.

novels. For example, the omniscient narrator at the beginning of *Bleak House* while echoing Genesis ("as if the waters had but newly retired from the face of the earth"), combines his view of Holborn Hill with the idea that "a megalosaurus, forty feet long or so," may come "waddling like an elephantine lizard" up it, probably out of the pages of one of the *Bridgewater Treatises* and the Rev. William Buckland's discoveries.¹⁴⁵ Charley Hexam, looking into the fire with Lizzie, has to combine a knowledge of the history of coal and the stories of Noah's Ark and "Pharaoh's multitude that were drawn in the Red Sea" (*OMF*, book 1, ch 3, p. 61). The brother earnestly explains to his sister what she sees in the burning coal is "gas. . . coming out of a bit of a forest that's been under the mud that was under the water in the days of Noah's Ark" (*OMF*, book 1, ch. 3, p. 71). Three months before Dickens began to compose *Bleak House*, Henry Morley's "Our Phantom Ship on an Antediluvian Cruise" (16 August 1851; *HW* 3: 492-96) describes an imaginary cruise into the age of Silurian fossils.

So Dickens was clearly aware of how the teaching of the Bible was being challenged by new scientific discoveries when he began composing *Bleak House* in November 1851. And in 1863, writing to his friend W. W. F. De Cerjat about the notorious *Essays and Reviews*,¹⁴⁶ he expressed his doubt in the Bible and belief in the "science of geology":

Again, it is contended that the science of geology is quite as much a revelation to man, as books of an immense age and of (at the best) doubtful origin, and that your consideration of the latter must reasonably be influenced by the former. What these bishops and such-like say about revelation, in assuming it to be finished and done with, I can't in the least understand. Nothing is discovered without God's intention and assistance, and I suppose every new knowledge of His works that is conceded to man to be distinctly a revelation by which men are to guide themselves.¹⁴⁷

¹⁴⁵ Susan Shatto, *The Companion to Bleak House* (London: Allen and Unwin, 1988) 23.

¹⁴⁶ 1860; 8th ed., 1861, in D's library.

¹⁴⁷ 28 May 1863, *Pilgrim* 10: 252-53.

Such a comment shows Dickens's standpoint on the side of Broad Church Anglicanism in its reconciliation of faith with science. But the obvious challenge to orthodox Christianity's time-scheme is never faced in the pages of *Household Words*. The unwillingness of *Household Words* and *All the Year Round* to express this was, no doubt, to avoid controversy.

Thus the famous remains of a frozen mammoth¹⁴⁸ are mentioned in F. K. Hunt's "The Hunterian Museum" (14 December 1850; *HW* 2: 277-82) and Samuel Rinder's "Four-Legged Australians" (30 April 1853; *HW* 7: 208-214), but neither author has any intention of querying where mammoths come into the history of creation. In Hunt's article especially, the narrator is conscious of coming in "contact with some things that moved upon the earth before the Flood" and seeing "innumerable forms in which life has been." He considers the curious "relics of the huge monsters who roved in the primeval wilds of our earth long before the Flood," and yet says no more than that the existence of those gigantic bones of extinct monsters is "now one of the romances of geology and of the animal world." "Coprolite" (18 April 1857; *HW* 15: 380-81), by an unknown correspondent, is also about newly-discovered fossils, but it never ventures to ask how and why the creatures they came from existed "before the flood." In such articles as these, the Flood still has an historical existence, and yet *Household Words* keeps silent about whether Genesis is consistent with what has been discovered by naturalists, geologists and anatomists.

Thomas Satchell's "A Spider in Disguise" (5 April 1851; *HW* 3: 46-48), giving a naturalist's observations of various kinds of spiders in British Guiana, begins to ask questions about natural laws, especially the relationship between the predator and its prey,

¹⁴⁸ Two specimens of the skin and hair of a mammoth preserved entirely by being embedded in a stratum of mixed soil and ice in the north of Siberia were discovered by a Tungusian hunter in 1799. They were presented to the Hunterian Museum by Sir Joseph Banks in 1808 and henceforth kept in the lower gallery of Room V; see Arthur Keith, *Illustrated Guide to the Museum of the Royal College of Surgeons, England* (London: Taylor, 1910) 80.

and recognises that there is only a limited moral sense in nature, but the article does not press this idea as far as Darwinism does. The article ends with the author's worshipping the "Creator's mandate," saying that the spiders' artistically woven and structured threads enable them to "obey the primary mandate of the Creator--'Increase and multiply'," and declares that good and natural actions are "rewarded" and the bad and unnatural "punished." "Man Magnified" (27 September 1851; *HW* 4: 13-15) by Frederick Knight Hunt, also concludes on a reassuring note like that of the *Bridgewater Treatises* saying that "the ultimate forms of living structure" can reveal the Creator's purpose: "the roughness of the skin, covered by its myriads of perspiratory ducts, teaches the need for careful cleanliness; the hair, tortured by frizzling-irons and mutilated by razors, suggests a thought as to the purposes for which portions of the frame were thus carefully covered by the Author of all things." According to R. H. Horne's poem, "The Camera-Obscura. A Sunday Morning Lecture" (20 March 1852; *HW* 5: 11-12), we can get a religious thrill out of looking at scenes through a camera obscura:

We feel strange pleasure, like a novel sense
 Derived from Art and Nature--Science, Sight--
 Which God permits, in His munificence.

Dickens's journals show a varied blend of natural theology and popular science, and most contributors, like the self-confident Ernest Abraham Hart, while studying various aspects of the material world, its laws and principles, still hold to an orthodox faith, invariably reminding readers that God is the cause of the universe. They often end their articles by urging us to worship God. Hart wrote a series of articles on plants for *Household Words* in 1854. In "Lives of Plants" (21 January 1854; *HW* 8: 483-86), he explains how they obtain nutrition and how some physical laws such as gravitation take part in the process; but throughout the article he praises "nature's great Master" and "the Mighty

Designer." "We must" he concludes, "tread here with reverential step; for we have reached the utmost boundaries of human science, and stand in the presence of the Almighty maker of all things, with whom alone rests the power of creation or annihilation." His "Birth of Plants," (18 February 1854; *HW* 9: 1-4) deals with how plants reproduce themselves; but it begins with a copious literary and religious introduction. Though he pays tribute to science, considering it "the highest truth" which gives "all-embracing principles," he admires the "mighty Author and Sustainer." He believes that the eternal being is "symbolised" in the laws of plants, and that the material world is the "interpreter" of the spiritual one. An interesting passage parallels ideas in Dickens's "The Poetry of Science":

Alas, that earnest truth-loving Science should step in to crush this graceful fabric of the imagination, to strip this history of all its glowing passion, and all its mystery of almost human love! And yet we have no real cause for lamentation. The highest truth is in itself the highest poetry. The simple but eternal and therefore sublime truths which science substitutes for the visionary beauties of the human imagination, far transcend the invention of the greatest masters of poetry. In the place of isolated and mysterious facts, without visible connection or harmony, it has given us all-embracing principles, and has furnished us with a mastery which will unlock the secret chambers of Nature, and enable us to behold all her operations, regulated by an universal frame of laws.

Though in a sense Hart echoes Dickens, the two go different ways: Hart puts the worship of God first, when Dickens apparently tried to see Creation in evolutionary terms as explained by Robert Chambers and supported Chambers's *Vestiges*.¹⁴⁹ We may wonder if the contributor was less radical than the editor, or whether the editor wished to preserve the

¹⁴⁹ Dickens was acquainted with Chambers; see his letter to Chambers, 7 April 1854; *Pilgrim* 7: 306 & n., but there is no evidence that they ever discussed anything to do with science.

magazine from giving offence. In "Plant Architecture" (25 March 1854; *HW* 9: 129-32), after demonstrating the whole organism of a plant, Hart says that within each cell there are forces at work, such as "Light--Heat--Attraction--Gravitation--Electricity" which are "compelled to obedience by the resistless laws of their Great Author, at whose decree the vegetable cell appears as the artificer of the organic creation." Oddly, after preaching to his readers, in "Nature's Changes of Dress" (13 May 1854; *HW* 9: 304-6), on the distribution of plants in different climates, Hart seems restrained in using the term "Nature" rather than referring directly to God and his Design.

In *Household Words* and *All the Year Round*, it was usual for popular scientific articles to end with a homiletic conclusion. Edmund S. Dixon was another who adopted this pattern. "Unsuspected Neighbours" (6 February 1858; *HW* 17: 172-76) on animalcules seen through the microscope, ends in praise of God: "O Lord, how manifold are thy works." In "A Sweep through the Stars" (22 May 1858; *HW* 17: 531-35), on astronomical discoveries, Dixon raises such questions as where the sun came from, and, if from a larger creation, where that originated. He also asks: "To what first commencement can we trace the life, the laws, and the movement, which the Eternal Almighty Ruler has ordained to exist?" In the end, he says that before the world was made "there was One who ruled from everlasting, and who will rule world without end." In "Michelet and Insects" (19 February 1859; *HW* 19: 280-86), he considers the growth and physical development of insects as suggesting the hope of immortality--the "hope founded on justice," and "on the impartial love of the Creator of all things living."

The clerical Dixon always ends his discussions of nature with a Biblical echo and a reminder of God. This is foreign to Dickens's usual attitude, which was to look first at the world about him. We find him writing to a Danish correspondent, Emmely Gotschalk:

In every human existence, however quiet or monotonous, there is range enough for active sympathy and cheerful usefulness. It is through such means I humbly believe that God must be approached, and hope and peace of mind be won. The world is not a dream, but a reality, of which we are the chief part, and in which we must be up and doing something. A morbid occupation, as your mind with books--even with good books--and sad meditation is not its purpose. There should be its beliefs and rewards. Come out into the world about you, be it either wide or limited. Sympathize, not in thought only, but in action, with all about you. Make yourself known and felt for something that would be loved and missed, in twenty thousand little ways, if you were to die, then your life will be a happy one, believe me. . . .

Be earnest--earnest--in life's reality and do not let your life, which has a purpose in it--every life upon the earth has--fly by while you are brooding over mysteries.

The mystery is not here, but far beyond the sky. The preparation for it, is in doing duty. Our Saviour did not sit down in this world and muse, but labored and did good. In your small domestic sphere, you may do as much good as an Emperor can do in his.¹⁵⁰

Dickens's readers often hear of Chambers's *Vestiges*. In "A Dish of Frogs," (26 July 1856; *HW* 14: 25-30), Dudley Costello is fairly sceptical about *Vestiges*,¹⁵¹ and Eliza Lynn

¹⁵⁰ 1 February 1850; *Pilgrim* 6: 25-26.

¹⁵¹ Costello wonders at the variety of frogs, mentions Lamarck's ideas--which he jokingly says could have led to an astonishing "development of a tadpole into a man"--and the "development theory, adopted and enlarged by the more modern and mysterious author of the *Vestiges of the Natural History of Creation*,"

Linton, in "The First Idea of Everything" (8 May 1858; *HW* 17: 481-84), mentions *Vestiges* in passing and its belief that higher organisms arise from simpler ones. She asks, "Was any such scientific secret lying hidden beneath the roots of the old Brahminical lotus bearing the triune God--Creator, Preserver, and Destroyer--as belongs emphatically to the supreme and archetypal Hand?" After mentioning some natural laws, such as geometric laws shown in the formation of crystals and the "chromatic law," she ends: "the more we truly know of Nature, the greater must be the admiration and wonder, and the more profound the humility, with which we pass from her to her Creator." She is asking questions to which Darwin was to give a different answer and to which, of course, a different answer had already been given by earlier evolutionists. But once again, we see how Dickens's contributors turned from simply looking at nature to seeing it anticipate man, arguing that nature was the work of a purposeful "Creator."

Sir Richard Owen is a more dominant figure in Dickens's journals than Chambers or Darwin. It was Forster who first suggested that Owen should write for *Household Words*,¹⁵² and because he was the leading zoologist and palaeontologist of the day, Dickens earnestly welcomed him as a contributor to his magazine. On 7 May 1851, Dickens wrote to say: "Both your proposals are most delightful to me, especially the Zoological one."¹⁵³ Again on 19 October 1852, Dickens wrote to invite him to contribute, saying that Forster "perfectly overwhelmed me with delight by telling me you had intimated to him that you might sometimes find leisure to write some familiar papers on Natural History, yourself, for this Journal."¹⁵⁴ Owen then wrote the first of three articles, "Poisonous Serpents" (6 November 1852; *HW* 6: 186-88). Later, Dickens proposed that he should write "some articles describing the peculiarities and points of interest of many of the animals in the

which he briefly explains. But he implies scepticism of this "striking" theory, though it is one "to which some recent philosophers seriously incline." He comes to no conclusions.

¹⁵² R. S. Owen, *The Life of Richard Owen*, 2 vols. (London: Murray, 1894), 1: 389.

¹⁵³ *Pilgrim* 6: 376.

¹⁵⁴ *Pilgrim* 6: 779-80.

Zoological Gardens, under some such title as Private lives of public friends."¹⁵⁵ Owen then wrote "Justice to the Hyaena" (1 January 1853; *HW* 6: 373-77) in which the narrator describes visiting the Hunterian Museum and meeting the Hunterian Professor, Richard Owen, who examines a hyaena's skull and teeth. Dickens was close to the Owen family. When Dickens was going away, he even wrote to tell Mrs Owen that he would still have "an eye to Household Words."¹⁵⁶

Owen and his work became familiar to readers of Dickens's journals as an authoritative figure on zoological objects and his name is mentioned in many articles.¹⁵⁷ Among the three articles Owen wrote for *Household Words*, the most intriguing is "A Leaf from the Oldest of Books" (7 June 1856; *HW* 13: 500-2) which is one of the few examples of a famous scientist talking about his first-hand studies. It is genuinely scientific. He writes about his expedition in Sheppey and experience of collecting fossils of tropical plants and animals which will be "the subject of two beautiful plates in the forthcoming number of Owen's History of British Fossil Reptiles." It mentions other fossils bought on his expedition. Here Owen presents his work in a light tone, emphasising procedure and personal experience. Yet he has not the slightest doubt why the Creator provided the sharp teeth or fangs on extinct raptorial vultures, suggesting they were mercifully designed to make the agonies of their prey last as briefly as possible.

Certainly Owen was no Darwinian. Owen's ideas were determined by his being a conservative Anglican. It is important to remember that Owen held that the "villainous low" ape-features are not modifiable and loathed the idea that the ape could be transmuted into a human. In 1854, he gave a speech before the British Association, of which he was

¹⁵⁵ 20 November 1852, *Pilgrim* 6: 806.

¹⁵⁶ 2 September 1857, *Pilgrim* 8: 428.

¹⁵⁷ For example, in R. H. Horne's "Zoological Sessions" (*HW* 2: 4-10) and "The Hunter and the Student" (*HW* 5: 157-62) and Samuel Rinder's "Four-Legged Australians" (*HW* 7: 208-14).

President, about the impossibility of apes standing erect and developing into men.¹⁵⁸ And in another talk to the British Association a year before the publication of *Origin*, he continued the theme. He could accept that animal species had appeared in a "successive and continuous" fashion, but not that one species "gradually transmuted" into the next. Rather, he thought that each new species appeared in a kind of "Creative leap," as if "from the womb of its antecedent, according to some Creative law."¹⁵⁹

Directly opposed to Owen, Thomas Huxley, in his lecture on "The Special Peculiarities of Man," given to the Royal Institution in March 1858, compared the baboon, gorilla, and man, and emphasized their complete continuity:

It is true that we are in possession of the links between the [baboon] & the Gorilla which we have not between the latter & man—but that does not affect the question . . . I believe that the mental & moral faculties are essentially & fundamentally the same in kind in animals and ourselves to the very root & foundation of his nature man is one with the rest of the organic world.¹⁶⁰

Following these debates, "Our Nearest Relation" (28 May 1859; *AYR* 1: 112-5) appeared, based on Owen's paper "Memoir on the Gorilla" read to the Royal Institution in February 1859, about the recently-discovered gorilla, its form, habits, intelligence and its similarity to man, but concluding with the implication that it was a creature without the "divine spark." Then "An Ugly Likeness" (1 June 1861; *AYR* 5: 237-40), which also refers to Owen's study, is about Du Chailu's discovery of the gorilla. The author carries on with the topic, noting that the "most essential difference" between the gorilla and man is "the brain-capacity of the skull, for in all other aspects the resemblance is so close as to amount

¹⁵⁸ Adrian Desmond and James Moore, *Darwin* (1991; London: Penguin, 1992) 451

¹⁵⁹ Desmond and Moore, 478.

¹⁶⁰ Desmond and Moore, 465.

to identify." He considers it a miracle that the unsightly, fierce and treacherous gorilla was selected as the "foundation" of man, and that "with scarcely a change in the bodily framework," what has been produced is "the noblest and most intelligent being . . . formed 'in the image of God'." His ideas coincide with Owen's notion of a creative leap from one species to the next: "What the law of development could do, or whatever else the law of production of species may be, seems to have terminated in the gorilla. Intellect, a moral sense, and a soul being superadded, the gorilla is converted into a man."

Later Owen published a *Memoir on the Gorilla* (London: Taylor and Francis, 1865), a complete collection of papers on the gorilla. A copy, inscribed "Charles Dickens, Esq., from his friend and the Author," was in Dickens's library.¹⁶¹ On 12 July 1865, Dickens wrote to thank Owen for the book, saying that "Studying the gorilla last night for the twentieth time," he suddenly realised that he had not thanked him for "the admirable treatise."¹⁶² He told Owen, "If you know how much interest it has awakened in me, and how often it has set me a thinking, you would consider me a more thankless beast than any gorilla that ever lived." In spite of such a compliment, we hardly know Dickens's real opinions, but do have the two articles mentioning Owen's ideas in *All the Year Round*. Whoever the articles were written by, such pieces might seem to suggest the journal's support of Owen.

Owen appears to have believed in creation as an "ordained continuous becoming," in a providential evolution, and was unwilling to admit that the gorilla or any apelike creature could have developed into man.¹⁶³ His own beliefs are not entirely clear. Yet the respect for him shown in *Household Words* and *All the Year Round* may well have been paralleled with an acceptance of what he had to say. In contrast, Huxley is certainly never given any

¹⁶¹ Stonehouse 86.

¹⁶² *Nonsuch* 3: 431.

¹⁶³ Desmond and Moore, 452.

support in Dickens's journals, nor elsewhere referred to.¹⁶⁴ An unwillingness to agree with the Darwinian hypothesis, and a belief in a world which is governed by a providential God as well as by natural laws, is one which matches the implications of the later novels as well as the earlier ones. All this might be argued from the novels themselves without it being possible to come to a definite conclusion. But the evidence of the journals is certainly that either Dickens was sceptical about recent evolutionary ideas, or extremely unwilling to show that he accepted them. We do not know.

A chapter about Dickens and Owen has recently been written by Victor Sage entitled "Negative Homogeneity: *Our Mutual Friend*, Richard Owen, and the 'New Worlds' of Victorian Biology," in *Dickens, Europe and The New Worlds* (1999).¹⁶⁵ Sage argues clearly that Dickens and Owen were close associates, "they both had the same low-key, but deeply felt Protestantism," and that Dickens's periodical "acted as a mouthpiece for the Owenite line on the question of 'the production of species.'" His arguments go further than one might wish to follow, but he is clear that Dickens *was* an Owenite, that his periodicals supported Owen, and that their agreed views can be traced in *Our Mutual Friend*. Thus, Dickens is not a strict Darwinian, and the implication is that most of what has been written on that assumption is wrong. Again, whatever the conclusion we should be guided by the evidence of the periodicals.

We know there were three articles in *All the Year Round* discussing Darwin's *Origin* after its publication. The first edition of the *Origin* went on sale on 22 November 1859 and was almost immediately sold out. Modern critics seem overwhelmed by the fact that

¹⁶⁴ It is extremely unlikely that Dickens and Huxley were friends: Huxley once commented on Dickens and his journal in a letter to Hooker: "Can you get at the 'Household Words'? If only one knew that snob Dickens"; and Dickens had a false book-back marked "Collected Poems of T. H. Huxley," as if he were mocking Huxley's lack of imagination; see Adrian Desmond, *Huxley: From Devil's Disciple to Evolution's High Priest* (1994, London: Penguin, 1997) 252, 339-40.

¹⁶⁵ Sadrin 212-226. Sage also writes "Dickens and Professor Owen: Portrait of a Friendship," *Portraits: Cahiers du centre de recherche*, ed. P. Arnaud (Paris, Sorbonne IV) which is now in press.

Dickens published three articles relating to the work, but they ignore the fact that the first did not appear until almost half a year after the *Origin*.

The first article is "Species" (2 June 1860; *AYR* 3: 174-78). The neutral title must have been the result of careful thought. The article is carefully argued, dealing fairly with different points of view. According to the author, the fact that the various species show "a series of forms" does not necessarily prove successive creation. It is supposed that life has developed from "a very few primordial forms into which life was first breathed by the Creator." The author explains how life develops: "Every living creature is the lineal descendant of some creature that has lived before it," and "there have been no successive new creations at successive geological epochs." A species survives by the process of natural selection. The author recognises that such a theory has been "gradually gaining ground and has obtained a fuller acceptance amongst a limited group of scientific men." He considers the view "not necessarily irreligious," because it does not deny the existence of "a Supreme Overruling Power," nor of "a Sustaining and Regulating Influence." He argues that the theory agrees with the belief that "God is Continuous and Unyielding Law, and Incessant Energy, and All-pervading Life." The creation around us is "so complicated and perfect, that it can only be sustained by an All-wise, Almighty Divinity," and the mechanism of creation is "just as noble a conception of the Deity." After this reassurance, he then directly refers to what he sees as Darwin's ideas: "Natural Selection . . . according to Mr. Darwin--not independent creations--is the method through which the Author of Nature has elaborated the providential fitness of His works to themselves and to all surrounding circumstances." He urges that "We ought not to feel greatly surprised, nor need our self-esteem be deeply wounded, if long-observant, reflective, and reverent men suggest that we have hitherto misapprehended the modus operandi of the Great Artificer." Darwin's other general ideas are thoroughly introduced, for example, how plants and animals are "bound together by a web of curious relations"; the distribution of species; and the great passage of

time needed for their development. In all, the whole piece is full of a conciliating spirit as the author tries to persuade the reader that a belief in the existence of God and his Creation can be reconciled with the ideas of Darwin.

Then without reservation, the author of "Natural Selection" (7 July 1860; *AYR* 3: 293-99) deals with Darwin's ideas in depth and in a straightforward way. In a light tone, the author says in the opening paragraph that Darwin was fortunate in the time in which he lived or he might have been punished for publishing his book and offending those in authority. Moreover, "Mr. Darwin also enjoys the benefit of the bygone heresies of previous heretics . . . Astronomical and geological innovations render possible the acceptance of doctrines that would have made people's hair stand on end three centuries ago." The author considers Darwin as someone with the privileges of wealth and talent, and praises the simplicity and clarity of his *Voyage of the Beagle* (1839). "Mr. Darwin believes he knows" the Truth or is "on the way to know." And yet as the author realises "the world is in general quite unprepared to hear his unaccustomed views propounded." He considers Darwin's theory "grand, clear, and decided." It is "already supported by a small party of disciples and fellow-labourers" while "the great majority shrink back in alarm at the boldness of his conclusions." The writer urges readers to "think twice" before accepting any such theory. The previous article, "Species" (2 June 1860; *AYR* 3: 174-178), is referred to and the laws that have already partly been outlined are explained further. The difference in this second article is that it speaks more frankly about Darwin's ideas being opposed to the orthodox Christian belief that the various species were independently created and "purposefully fitted and adapted to the place in creation which they were intended to occupy by an Overruling Intelligence"; species are perfected "not at once in the first-created individual, by the Hand of the Maker" but by "the accumulation of innumerable slight variations" and for the good of "the individual processor for the time being, during an exceedingly long succession of individuals from generation to generation."

There are times when the argument does not exactly follow Darwin, as for example when it argues that natural selection is somehow "apparently not perfect, but liable to mistakes" as when ants make slaves of fellow-ants or when the cuckoo ejects its "foster-brethren" out of the nest (p. 295). It is equally hostile in complaining that he sometimes assumes the need for "hundreds of millions of generations" to work out slight yet profitable changes. The author tenaciously argues that Darwin's arguments often depend on his mere assertion that something is probable because it fits within the general theory. Giving space to the views of some scientists who promote contrary opinions, such as the cataclysm theory, the author admits that no one is able to come to definite conclusions yet, but "two men may arrive at contrary opinions, both reasoning with perfect sincerity of heart and desire for truth."

This writer wholeheartedly appreciates Darwin, his close observation, intellectual ability and boldness of speculation, and describes opposition to him and his disciples. He himself is a willing theorist, and is imaginatively stimulated to remark that "We are no longer to look at an organic being as a savage looks at a ship--as at something wholly beyond his comprehension; we are to regard every production of nature as one which has had a history." In conclusion, he twice repeats his belief that "Natural Selection can only act through and for the good of each being," adding that "timid persons who love to cling to their preconceived ideas, fearing to look at such a mighty subject from an unauthorised and unwonted point of view" may be reassured that Darwin's theory will itself be subject to the process of natural selection.

"Transmutation of Species" (9 March 1861; *AYR* 4: 519-21) wide-rangingly discusses theories about the subject, referring to the seventeenth-century French naturalist, Benoît de Maillet. Maillet's theories on evolution anticipated those of Lamarck, the author of the

Vestiges, and Charles Darwin--"our most ingenious and most sound geologist"--who has advanced a modification of earlier ideas. Again, Darwin's theory is explained clearly and with conviction. Passages are quoted directly from the *Origin*. The author mentions Professor Owen, whose views in opposition to Darwin's are "hardly more natural and involve quite as many difficulties." He finds it hard to give Owen's views "in simple language." Though "the mystery of creation has yet to be solved," the author is optimistic that the way to discover it is by close observation, and readiness to accept what has been discovered.

The three articles may be by the same hand, though there is considerable doubt about this. If we read through them in sequence, we can detect how, like many Victorians, the writer or writers were changed and influenced by Darwin's theories. In the first article, "Species," the narrator is cautious and reserved, still struggling to cling to old beliefs. Then, in the second, "Natural Selection," the author seems mostly to agree with the idea, though he is still sometimes sceptical and questioning. Perhaps for the sake of his readers, he is concerned to show how Darwin's ideas could be reconciled with orthodox Christian beliefs. Finally, the author of the third article, "Transmutation of Species," discusses Darwin in the context of his predecessors, appreciates him and his work and criticises opponents such as Owen, but goes no further than saying it is necessary to remain open-minded.

There are a number of casual references to Darwin in *All the Year Round*. In "Ignoramus at the Exhibition" (23 August 1862; *AYR* 7: 559-64), the author visits the International Exhibition of 1862 and refers to "the new method of breeding wheat, and the lift which Darwin's theory of selection seems to have got thereby." "Can You Swim?" (27 August 1864; *AYR* 12: 54-58) mentions that "the Darwinites" explain that ducks and geese have webbed feet, because this is a hereditary feature surviving modified habits. Accepted or not, Darwin and the Darwinite seem to have become "familiar in their mouths as

HOUSEHOLD WORDS." Incidentally in "Varieties of Men" (19 March 1864; *AYR* 11: 128-30) there is a discussion of different races and speculation about the reasons for their differences, preceding Darwin's *The Descent of Man, and Selection in Relation to Sex* (1871), a book which deals with the subject in chapter 7, "On the Races of Man." In general, among Dickens's known contributors, there were anti-Darwinian figures like Owen as well as some pro-Darwinians. The geologist, Professor David Ansted, for example, one of the leading figures of the Great Exhibition, was a Darwinian who also contributed to *All the Year Round*.¹⁶⁶ His book *Geological Gossip* (1860) reviewed in "Water Everywhere" (9 December 1860; *AYR* 4: 202-5), includes a chapter devoted to Darwin's evolutionary theories entitled "The Battle of Life."

Yet despite the three important articles on Darwin, and contributors such as Ansted, it would be too hasty to conclude that from now on Dickens or, at the least, the journal turned from something like Owenism to Darwinism. In "Owen's Museum" (27 September 1862 *AYR* 8: 62-67), the writer says that when he walked to "the monkey cases," he saw the ape, the long-armed gibbons, the chimpanzee, the orang-outan, and gorilla--animals close to humanity and making one "shudder at the theory of 'links.'" Then he asks: "what if, in very truth, the grandfather of all life should be a polype, and an ape the parent of humanity?" If so, all animals' natures would be seen in humans. He does not argue any further about this.

Regardless of articles mentioning Darwinian theory, there continued to be reassuring voices in *All the Year Round* throughout Dickens's period as editor. The outlook of the journal did not turn overwhelmingly evolutionary; many writers remained conventional. Readers are reassured again and again of the existence of God. In "Under the Sea" (2

¹⁶⁶ In addition to three unidentified papers, Ansted contributed the following articles to *All the Year Round*: "The Treasures of the Earth. In Two Chapters" (18 May 1861; *AYR* 5: 174-81; 25 May 1861; *AYR* 5: 198-200) "Recent Discoveries Concerning Light" (15 June 1861; *AYR* 5: 270-72), see *Pilgrim* 9: 217n.

March 1861; *AYR* 4: 493-500), about the work of Captain Matthew Maury of the U. S. Navy, the author says that anyone who studies the nature of sea must look at it as a part of "exquisite machinery" and "will begin to perceive the developments of order and the evidence of design," and "the expression of One Thought--a unity with harmonies which One Intelligence, and One Intelligence alone could utter." And in "Before the Deluge" (13 January 1866; *AYR* 15: 7-11), which reviews Figuier's *The World before the Deluge* (1865), a copy of which was in Dickens's library, the author makes the point that the Creator or "Sovereign Master" has willed that some species should become extinct "quite naturally" after they have made way for more perfect races according to the plan of the "All-powerful." "We see the work of creation perfecting itself increasingly," he says; and "in science its professors should never be afraid to say, *I do not know*." Some answers will come "from the will of the Author of the universe." For example, the answer to the question of when mankind is doomed to disappear "is hidden in the knowledge of the Almighty Creator of the world, who formed the universe."

In contrast to this, some writers stand out in refuting anti-scientific ideas. For example, the author of "Something Strong in Water" (24 February 1866; *AYR* 15: 157-58) criticises the Abbé Gaume's idea that the reason why "an all-wise, all-just, all-merciful, and loving Creator" lets there be things in water that cause epidemic diseases such as cholera and cattle-plague, is because people's general "sinfulness" has offended God. Gaume blamed the scientists' intense desire to find out the real cause of diseases, and emphasised the virtue of holy water and its supernatural power to cure all sorts of ills and diseases. The article condemns Gaume's thesis as "having no origin whatever in any rational, scientific, or natural grounds."

By 1866 opinion had changed so far that Darwinism is accepted as a normal belief, at least for the young. In "Chesterfield Junior--A Son's Advice to His Father" (20 January

1866; *AFR* 15: 45-48) the narrator says that things have been turned "topsy-turvy"; accepted facts have altered, and everyone should remodel his ideas to catch up with the times. He was shocked to hear his father contradict Professor Barnacles' assertion that a certain cliff was "composed of the remains of minute creatures." The father had criticised Darwinian theory: "Why, bless my life and soul, does the man mean to tell me that my grandfather was a monkey?" But the son advises his father not to try too hard to resist the "inevitable march of modern events" and "the irresistible tide of progress." Incidentally a topical event is mentioned, as the narrator describes how scientists suffer from strain and anxiety, such as the man who "steals away to his dressing-room and blows his brains out" because he is "desperately perplexed" and not able to keep up with the pace of his competitors. Possibly the writer may have been thinking of Hugh Miller who shot himself allegedly because of doubts about evolution. The "luxury of the age" allows people to do things more swiftly than before, but some of them still have difficulty in adapting themselves to the changing world. Yet in spite of this, perhaps the last reference to Darwin and his followers in his journals in Dickens's lifetime is in the anonymous satirical poem "The Philosopher and the Monkey" (12 February 1862; *AFR*, *N. S.* 3: 251-52), which disagrees with them.

The conclusion we may come to is that no single article can represent Dickens's or even his journals' beliefs. The nature of the journals was to be topical, and generally inclusive. Dickens himself once put a "Note" in *All the Year Round* (10: 419) saying: "The statements and opinions of this journal generally, are, of course, to be received as the statements and opinions of its conductor." This is highly misleading, though the stream of articles related to science does confirm that there was an earnest wish to study and understand the universe and to catch up with new ideas. The present rather detailed account has not aimed to decide Dickens's or his journals' overall attitude toward evolution

from the articles, but to emphasise the kind of limits that there are to our inferences and conclusions.

(viii) The "Design" and Structure of the Universe: Astronomy, Geology and Physics

It is always an advantage when dealing with science in journalism if the journalists can relate their writing to the reader's experience; and this is evidently so with the popular subjects of astronomy and geology in Dickens's journals. Usually the articles succeed in making themselves interesting. Many of them take up recent discoveries following on the development of more powerful telescopes and improved photography and spectroscopy, and they familiarise readers with a general knowledge of the heavens and the earth.

It has to be left to the reader of today to see whether general conclusions can be drawn from the articles on astronomy and geology. In fact they are mostly informative rather than speculative. F. K. Hunt, for example, reports on visiting Greenwich Observatory, after reading an article in the *Edinburgh Review*, and writes his amateur's account of "The Planet-Watchers of Greenwich" (25 May 1850; *HW* 1: 200-4). Mr. Bubbs's (or Bubs) fanciful space expeditions described in C. T. Hudson's "Mr. Bubs on Planetary Disturbance" (*HW* 3: 58-60; 12 April 1851) and Mr. Hughes's "Mr. Bubb's Visit to the Moon" (*HW* 3: 187-88; 17 May 1851) are only half-serious, though meant to convey basic astronomical knowledge. Other educational pieces include Hudson's "Very Long Chalks" (9 August 1851; *HW* 3: 472-73), about using "light years" to express distance. E. S. Dixon's "The Harvest Moon" (11 September 1858; *HW* 18: 293-96) advances extremely dubious ideas, which he believes are based on personal experience, though he also refers to William Thomson's observation and measurement of the sun's heat and to Herschel's *Outline of Astronomy* (1849). His "Journey to the Moon" (5 June 1858; *HW* 17: 583-88)

is equally speculative, drawing on French astronomers in discussing the belief that the moon was shot from volcanoes on earth, and the fantastic possibility that something of the kind might happen again to cause the total extinction of life. The article ends with the customary obeisance to religion: "Thus, the boldest deductions of modern science accord with the declarations of Holy Writ, that the earth shall one day melt with fervent heat, and that there shall be new heavens and a new earth." Later, in *All the Year Round*, the subject is taken up again in "All Moonshine" (7 May 1864; *AYR* 11: 299-301), which discusses weather forecasting and disapproves of certain superstitions about the effect of the moon. Such superstitions are mentioned again in "Wise Doctor Lemme" (12 February 1870; *AYR N. S.* 3: 258-61), the author of which does not believe in Dr. Lemme's ideas that moonshine can drive people to strange behaviour, such as cannibalism. Such pieces cannot be thought particularly profound or related to Dickens's fiction.

Comets and meteors make topical subjects. "Meteors" (16 February 1856; *HW* 13: 103-5) mentions one seen to fall like a fire ball on 7 December 1855, and the 184 meteors seen in America and elsewhere on 14 November 1833. The author asks, "What are they before we see them, and where do they come from?" He speculates on their make-up, without giving any definite answer. In spite of having an inquisitive spirit, keen to take advantage of what contemporary astronomers had to say, those who write on astronomical subjects often readily admit the limits to what they know about the universe and its origin: the author of "Meteoric Stones" (16 January 1864; *AYR* 10: 488-91), for instance, says that "the only real conclusion we can arrive at, is, that we know no more of the origin of meteoric stones, than we do of the origin of the globe on which we live." "Gaps in the Solar System" (10 November 1866; *AYR* 16: 414-15) explains the so-called "Bode's Law" put forward by a German astronomer but later shown to be questionable, summing up such uncertainty by saying that even though astronomers are making all kinds of inquiries and speculations, "we do not yet know all the members of our solar system."

There is a cluster of articles in *Household Words* on comets and their predictability, while "Comets, and their Tails of Prophets" (23 May 1857; *HW* 15: 481-84) by the poet Edmund Ollier discusses the belief that coming comets portend disaster, and the destruction of the world. Perhaps not surprisingly, the article is written in a light-hearted spirit, with allusion to fables, myths and scientific anecdotes. Dixon is another who often writes about comets. His "A Sweep through the Stars" (22 May 1858; *HW* 17: 531-35), on comets and the solar system, considers how planets revolve around the sun, why there are sun spots, and the effects of gravity. He goes on to speculate about what the sun is made of and where it came from; and he predictably closes his argument with a biblical reminder of God, who "will rule world without end." Dixon optimistically opposes any speculation about the end of the world. "Five Comets" (16 October 1858; *HW* 18: 409-12), is based on French sources such as the article in a recent *Journal Astronomique* about five comets which had appeared in 1857. It discusses recent discoveries. "Farewell to the Comet" (30 October 1858; *HW* 18: 463-66) also based on French sources, discusses Donati's comet which stayed visible till the end of October. It is said to be more beautiful than the comets of 1811 and 1853. Following this, Dixon's "Chips From the Comet" (20 November 1858; *HW* 18: 541-44) reports on the progress of Donati's comet. He wonders fancifully whether it has inhabitants or not, and mentions the new scientific discovery that its light source is the sun. More interestingly, he speculates on whether the universe is infinite and if its energy will last for ever.

It will be seen from the summaries how *All the Year Round* turned its attention particularly to eclipses, and that even before *All the Year Round* Willis had written a humorous sketch "My Annular Eclipse" (24 April 1858; *HW* 18: 433-36) about the popular interest in the subject. His touch is light-hearted; the narrator is more interested in the astronomer's daughter than in portents of disaster, or anticipation of the sun's eventual

extinction. "A Lady on the Peak of Teneriffe" (18 February 1865; *AYR* 13: 85-88) focuses on an astronomer's journey to the observatory on Teneriffe, and how his wife and daughter made the expedition with him under rough conditions.

The topic of lunar and solar eclipses leads to one of the contributors' favourite astronomical subjects in *All the Year Round*, the sun. The study of the sun and the solar system is fundamental to the journal's concept of the universe. "Respecting the Sun" (22 April 1865; *AYR* 13: 297-300) explains that in 1874 there will be the chance to settle exactly how far off the sun is, since a transit of Venus across the sun will take place then. The author considers the sun's enormous volume, its density, weight, and speed, and touches on leading scientists such as Dominique François Jean Arago and the Herschels' ideas about what the sun is made of. Most importantly, based on Herschel's study he discusses the seven phases of the sun as a cooling star, concluding:

The earth and the moon, we are told, offer examples of this successive evolution. Evidently, the earth was once a veritable sun for the moon....The moon, whose mass is very much smaller, was naturally the first to cool. Then the earth...at last acquired a crust and became entirely solid at the surface...It is likely that life was developed in the moon when it had scarcely yet appeared on earth. We are informed that the moon represents the earth's future, the sun her past.

Such evolutionary speculation also seems to anticipate the eventual extinction of the earth and sun, but the article does not display the anxiety about eclipses which some modern critics claim to have seen.¹⁶⁷ In fact, the author ends his account by saying calmly that

¹⁶⁷ Gillian Beer in "Origins and Oblivion in Victorian Narrative," asserts that the metaphor of "the death of the sun" in *Bleak House* is somehow associated with new theories put forward by Helmholtz, and supposes that Victorians were left in anxiety about the future of the Earth. The same argument is seen in Crosbie Smith and M. Norton Wise's *Energy and Empire, a Biographical Study of Lord Kelvin* (Cambridge: Cambridge University Press, 1989) 35.

"Each star passes through its successive transformations in the eternal harmony of the universe." Such an account of astronomical evolution is analogous to Victorian ideas in biology, though no specific parallel between them is hinted at. Nevertheless it should be taken into account when consideration is given to the effect of biological evolution (Darwinian or earlier) on Dickens and his readers.

Dickens's contributors also looked at eclipses as an opportunity to study the sun. "A Long Look-Out" (1 February 1868; *AYR* 19: 174-77) gives further details of the distance from the sun to the earth. The author says that the exact distance can be determined by the transit of Venus across the disk of the sun which is to be expected on 9 December 1874 and again on 16 December 1882. Sophisticated accounts are given, including a table of the transits of Venus in the past and future up to 2012, and an explanation of how the "parallax" is used to measure the distance from the earth to the sun. There is also speculation about the existence of Venusians. The author mentions Whewell's belief in the uninhabitability of Venus, a topic already dealt with in articles such as William Brough's "Plurality of Mites" (9 August 1856; *HW* 14: 95-96), which suggests that it is as impossible for us to know if other planets are inhabited as it is for a cheese-mite to be aware of life outside its piece of cheese. "The Coming Eclipse" (1 August 1868; *AYR* 20: 185-87) reports that there is to be one visible in southeast Asia on the 18th August, and refers to observations and hypotheses about the sun made in the past by astronomers such as Herschel and Arago. Questions such as "What is source of the sun's heat?" "What does the sun consist of?" and once again whether it can have inhabitants, are all discussed. "The Eclipse Seen in India" (13 February 1869; *AYR*, *N. S.* 1: 250-53) says that scientists, including the French astronomer, Henri de Parville, have disproved the notion that the sun is habitable, and it notes that the sun is not solid nor liquid, but gaseous. "Our Lengthening Day" (15 September 1866; *AYR* 16: 232-36) offers a great deal of information about the solar system, but does not explain satisfactorily that days are shorter in winter and longer in

summer because of the tilt in the earth's axis. Instead, it tells how the speed of the earth's rotation is slowing down because of the effect of the moon on the tides, reaching the conclusion that the earth's temperature is expected to drop very gradually, though the exact amount of the slackening of the earth's rotation is not known. The author thinks it "right" to tell readers of this decline, as if to justify himself for imparting news that must immediately dismay them. The article is well-enough written, though it may have been bewildering to the ordinary reader.

One of the main purposes of Victorian science, especially of astronomy and geology, was to study the structure of the universe. In contrast to modern cosmology which from the 1920s has claimed that the universe began in an explosion, the author of "The Universe" (5 June 1869; *AYR N. S.* 2: 10-12) claims that it had no origin, yet is expanding as new matter is continually created. Scientific discoveries tend to prove that "the universe is one, a unity, made up of like co-ordinate parts, and of similar when not identical materials." Tyndall's words are also quoted: "the motion of the mass, as a whole, is transformed into a motion of the molecules of the mass to describe the mechanical and material constitution--the universe is one--a unity."

Though possessing a fair general knowledge from wide reading, Dickens's contributors, with a few prominent exceptions,¹⁶⁸ were merely men of letters rather than "scientists." Their contributions often mix information and fanciful imagination. They often show how *little* was known or fully understood, and often the explanations are not satisfactory. "A Few Saturnine Observations" (2 September 1865; *AYR* 14: 129-33) resorts to myth and folk-lore before it turns to an historical account of how Saturn's rings have been observed by various astronomers. The astronomical pieces generally aim to convey and discuss

¹⁶⁸ Such as Sir Richard Owen, Francis Buckland, and Professor David Thomas Ansted.

recent observations,¹⁶⁹ and so rarely lead to philosophical debate or conflict with religion. Even though there is vague and unscientific speculation about life in other worlds, no argumentative or disturbing tone appears which might offend the reader. Readers, one feels, were not expected to come to conclusions about the relation between science and their beliefs: it was enough to begin to take in quantities of facts about new discoveries.

There must have been great difficulty introducing new ideas in physics to the general reader, and the task usually appears to have been left once more to E. S. Dixon. We are introduced to the conception that creation is still a matter of force or energy, manifested in heat, light, and matter. It is hard to say how far Dickens grasped the principles of physics even as explained in his own journals, and it is significant that the only scientific article with a manifest connection to him is the one on Faraday's "The Chemistry of a Candle" (3 August 1850; *HW* 1: 439-44). He does not seem to go beyond this--something simple and familiar--, though he may well have drawn on it in his ideas for *Bleak House*.¹⁷⁰

In *Household Words*, in addition to those early pieces based on Faraday's public lectures, there is also George Meredith's little poem entitled "Force and His Master" (13 September 1851; *HW* 3: 588-89) which characterises the great power of Force to create as well as to destroy. E. S. Dixon based his "Physical Force" (12 March 1859; *HW* 19: 354-59) on William Robert Grove's *On the Correlation of Physical Forces: Being the Substance of a Course of Lectures* (1846) and on Alfred Smee's lecture at the Royal Institution explaining the principle of the first law of thermodynamics: that the physical forces of the universe are one, and light, heat, and motion can be transmuted into each other. Then in *All the Year Round* a steady flow of articles gives substantial knowledge about "Atoms" (17 March 1866; *AYR* 15: 235-38), "Force and Matter" (21 July 1866;

¹⁶⁹ Later examples include "Meteors" (*AYR N. S.* 3: 469-73) and "Shooting Stars" (*AYR N. S.* 3: 571-76).

¹⁷⁰ See Wilkinson, "Bleak House: From Faraday to Judgment Day."

AYR 16: 35-38), and "Sound" (22 February 1868; *AYR* 19: 255-58), mostly based on John Tyndall's books. "Is Heat Motion?" (1 July 1865; *AYR* 13: 534-38) is also based on Tyndall's work, but the author refers to other contemporary authorities as well, including Sir William Grove, Alfred Smee, and William Thomson. He mentions Thomson's demonstration of how the heat of the sun was maintained and his conclusion that "the total heat provided by all the planets falling into the sun would cover its emission for forty-five thousand five hundred and eighty-nine years." Following this, "Heat and Work" (5 August 1865; *AYR* 14: 29-33) deals further with the subject, but turns to Tyndall's illustrations of the way in which the energy of the sun is stored on earth and converted into power and force. Finally, it considers the sun as "an inexhaustible source of physical energy," but admits that there are some problems not yet solved by science. The same conclusion about the limits of "the territory of science" is repeated in "Force and Matter" (21 July 1866; *AYR* 16: 35-38). We also find that though these articles are largely scientific, they are coloured by a pious appreciation of one "Almighty Force," and His "Wisdom and Benevolence." In "Might and Magnitude" (24 March 1866; *AYR* 15: 255-57), the author claims that as the source of heat and power, the sun is God's material instrument throughout the solar system and on the earth, and such a source of material blessings has been arranged by "one Supreme Omnipotent Being, the Maker of the Universe." The author both seems to have a good general knowledge of physics and chooses to apply the first law of thermodynamics to religious purposes. In contrast, "Fire" (18 January 1862; *AYR* 6: 393-96) objectively describes "fire" as an "energetic manifestation of one of these forces" including "Heat, Light, Electricity, Magnetism, Chemical Affinity, and Motion." The author also mentions the new notion of "caloric."

Compared to other aspects of science, geology was fairly understandable and well accepted by the general reader. Yet most of the articles on geology remain factual rather than speculative or at the cutting edge of scientific knowledge. There are various backward

looking journalistic pieces written by hacks of journalism, men like William Jerdan and John Robertson, who could write elegantly on any subject but who had nothing new or original to say. Many articles about discovering minerals in new places are thoroughly utilitarian: geological activities are treated as the exploration of materials for people's use. For example, after the Great Exhibition of 1851, George Dodd in "Cornish Stone" (9 September 1854; *HW* 10: 92-96) describes how different kinds of stone such as granite and serpentine can be found in Cornwall and mentions the specimens displayed in the exhibition. "Stone for Building" (24 November 1860; *AYR* 4: 149-52) is mainly about the choice of building stone for the New Houses of Parliament, and criticises the "scientific commissioners" who have relied more on artistic feeling than scientific knowledge.

Some articles touch on the important issue of the origin of the earth, though they merely scratch the surface of the topic. Richard Owen's "A Leaf from the Oldest of Books" (7 June 1856; *HW* 13: 500-2) is written in a light tone about the fossils he once collected on an expedition, enlarging upon things such as the geologist's forgetfulness, instead of considering how conceptions of geological time may affect man's thought. The "Coprolite" (18 April 1857; *HW* 15: 380-81), on the petrified excretions of extinct animals discovered in a cave, refers to "the fossil dung of the Pleasiosaurus [sic], Ichthyosaurus, and other inhabitants of the world before the flood." The author is curious only up to a certain point, and never ventures to ask how and when such creatures existed "before the flood." It seems to have been the policy of *Household Words* not to pursue such questions and to be unwilling to look at or discuss them. "The Age of Stone" (3 October 1868; *AYR* 20: 394-96) is a review of a French book entitled *La Chute du Ciel*, or *The Fall of the Sky* (1865) and claims that not only meteorites, but also fossils, coal, erratic boulders and flint implements have fallen from the heavens. The argument is evasive, though the reviewer does look at questions about the age of the earth and of mankind, discussing prehistoric discoveries by a French archeologist which show that man had been on earth for thousands

of years, and quoting from Sir Charles Lyell and other writers on early man. A similarly evasive attitude can be seen in "Before the Deluge" (13 January 1866; *AYR* 15: 7-11), already mentioned before (p. 70). The reviewer of Louis Figuier's *The World before the Deluge* (1865) says that Figuier has ably illustrated change "from Chaos to the Deluge" with his vivid imagination and the authentic use of fossils, and compliments his inclusion of various scientific explanations of the glacial epoch, and his confession of ignorance. Yet "Fallen from the Clouds" (22 November 1862; *AYR* 8: 250-56), though giving information about the temperature of the strata of the Earth, volcanoes and their eruptions, turns to writing about the fantastic but unlikely phenomena of creatures such as butterflies, spiders, frogs and fish falling on the sea or land.

Other pieces, such as Francis Buckland's "Chip: A Small Monkish Relic" (9 February 1856; *HW* 13: 90-91), are merely anecdotal rather than geological. "Behind the Scenes at Vesuvius" (6 June 1863; *AYR* 9: 345-48) is not on serious scientific aspects of the volcano but on the author's own experience of its eruption. There is also an article on the woman geologist, "Mary Anning, The Fossil Finder" (11 February 1865; *AYR* 13: 60-63), her story and contributions to geology. More remotely, "Flint Jack" (9 March 1867; *AYR* 17: 259-264) is about a fraudulent manufacturer of fossils and antiquities. "Hammering It In" (17 January 1857; *HW* 15: 59-60) by Morley, is actually a satire on the absurdity of those who enthusiastically take up geology as a hobby.

More important geological issues are seen in articles about fossils such as "How Old Are We?" (7 March 1863; *AYR* 9: 32-37), and another based on Sir Charles Lyell's *The Geological Evidences of the Antiquity of Man, with Remarks on the Theories of the Origin of Species by Variation* (1863), noted as just published "a few days ago." As the author points out, Lyell was known as "the great opponent of sensational geology." He investigates what the traces of early man (not found in fossils) can tell us and describes

what can be learned from remains in the Danish islands, North America and Switzerland already dealt with in "Subterranean Switzerland" (5 November 1859; *AYR* 2: 25-31). Such discoveries have left no doubt that "man and the mammoth once co-existed." The author concludes that the antiquity of man is "much greater than chronologists have hitherto supposed." It is one of the few articles which faces the fact that old assumptions have to give place to new ones. "Water Everywhere" (8 December 1860; *AYR* 4: 202-5), based on Professor Ansted's *Geological Gossip* (1860), leads on to a topical discussion of earthquakes. It is notable, perhaps, that Ansted's book (said to "show how pleasantly and usefully its writer gossips about the newest discoveries in the fascinating branches of science") has a chapter on Darwin's evolutionary ideas entitled "The Battle of Life." Ansted believed in them. It is another indistinct particle of evidence that may be relevant to the subject of Dickens and Darwinism.

In *All the Year Round*, there is a stream of articles on earthquakes. "Earthquakes" (9 June 1860; *AYR* 3: 197-201) mentions how often over the past few hundred years there have been earthquakes affecting London, and we are told about research just reported to the British Association and a French scientist's inquiries about the subject. Yet the article is hardly rigorous. It ends by quoting Newton's famous words: "I seem to have been only like a boy playing on the sea-shore, and diverting myself in now and then finding a smoother pebble, or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me," saying that although "no second Newton has yet arisen," investigations of earthquakes also "represent pebbles on the shore of the ocean of truth." Such writings on geology are nevertheless often facile, merely toying with random ideas. "The Fire Sea" (28 November 1863; *AYR* 10: 321-25), about earthquakes, volcanoes, and the presumably hot molten interior of the earth, was written after the experience of a strong earthquake felt in the centre and west of England on 6 October. The event confirmed the hypothesis of molten fire at the centre of the earth, and thus the theories held by La Place and Buffon

that planets were cooling stars, on whose surface a crust eventually formed. It is an example of a popular science article by a widely read journalist, who gives odd scraps of information; nevertheless, it is often loose, uncoordinated, and at times inaccurate. For example, it says that the "oscillations of the solar heat in the aerial covering of the Earth" "make the vicissitudes of the seasons," which is hardly clear, and also make "the changes in atmospheric pressure upon the surface of land and water." Other pieces on the nature of Earth include the rambling "Earth. In Two Chapters." (24 December 1864 and 31 December 1864; *AYR* 12: 469-74 and 486-89). The second chapter is a mixture of elementary science fiction and scientific journalism; though it includes more recent information, much of its material had been dealt with in articles published previously. "Old Stories Retold: Earthquakes" (30 November 1867; *AYR* 18: 545-49), by George Walter Thornbury, is merely anecdotal and almost entirely a description of what has happened in past earthquakes. According to the author, earthquakes have aroused great scientific curiosity about their relation to the weather. Again, the subject is treated very generally.

Oceanography and meteorology were also dealt with by Dickens's contributors. For example, John Capper's "Air Maps" (8 October 1853; *HW* 8: 128-33) and "When the Wind Blows" (24 March 1855; *HW* 11: 188-91), "Under the Sea" (2 March 1861; *AYR* 4: 493-500) and "The North Pole Question" (21 September 1867; *AYR* 18: 306-9) perhaps also by Capper, are on the activities of Captain Matthew Maury of the U. S. Navy, and his pioneering work in meteorology, oceanography and charting the winds and currents of the oceans. Such new discoveries had an enormous and immediate effect on people's lives because they shortened voyages all over the globe. The last article asserts that "the Great Creator of all things has made nothing in vain." "Under the Sea" does not forget to say that whoever studies the sea will begin to perceive "the developments of order and the evidence of design," and "the expression of One Thought--a unity with harmonies which One Intelligence, and One Intelligence alone could utter."

Henry Morley's lengthy "The World of Water" (24 May 1851; *HW* 3: 204-9), on the earth's movement in relation to the formation of oceans, currents, and tides, is based on a recent scientific report. Dickens improved his "The Wind and the Rain" (31 May 1851; *HW* 3: 217-22) by adding the descriptive ending. "Light and Air" (20 September 1851; *HW* 3: 612-16) is a study starting with the light of the sky and rainbows, mentioning William Robert Grove's *Correlation of Physical Forces* (1846). Other articles on meteorology, such as "Thunder" (13 June 1863; *AYR* 9: 375-78) and "A Great Thunder-Storm" (8 August 1863; *AYR* 9: 565-70), are written in the style of the familiar essay and in a lighter tone. Though some scientists are mentioned, such as Mary Somerville and Hugh Miller, and questions are raised about the cause of storms and thunder, these articles include much personal description and loose illustration. "Earth. In Two Chapters." (24 and 31 December 1864; *AYR* 12: 469-74, 486-89) gives general information on the earth, what it is composed of, and the nature of its soil, but the author sometimes trails away into literary allusions.

Modern critics often want to believe that Dickens's journals were teaching good science to the general reader, as perhaps they often were; but the science is mixed up with generalities which show that editor, writer and readers may not have clearly understood the topics. They were frequently based not on reason or observation, but on second or third hand reporting. What such articles show is that the journals were filled with reports and anecdotes, and accounts that are more fanciful than scientific. It was a world in which the writer of fiction and his skills still had a place. Morley is right in what he says in "The Poetry of Fact" (14 September 1867; *AYR* 18: 277-79): that, much as in J. R. Campbell's folk tales from the West Highlands, what men read was still a mixture of fact and fancy--as Dickens had always argued.

Therefore, it is folly to think of Dickens as a super-scientist who knew about and understood the great contemporary issues: discoveries in physics, the second law of thermodynamics, theories about the nature of electricity, and the nature of matter. Dickens, his fellow-editors, and their readers tried (sometimes a little half-heartedly) to grasp them; but they were much more at home and remained at home with the observed world about them, old beliefs, and an interest in human nature and everyday experience.

This may not be the place to come to firm conclusions about how the journals see God's relation to mankind and to science, and how these topics are represented in Dickens's novels. For example, in *Bleak House* we read about "Smoke lowering down from chimney-pots, making a soft black drizzle, with flakes of soot in it as big as full grown snow-flakes--gone into mourning, one might imagine, for the death of the sun" (chapter 1, 49);¹⁷¹ in *Hard Times*, Stephen Blackpool speaks of something that will never happen "till the sun turns to ice" (book 2, ch. 5, p. 154); and in *Our Mutual Friend*, there appears the metaphor of the extinguished sun: "Gaslights flared in the shops with a haggard and unblest air . . . while the sun itself, when it was for a few moments dimly indicated through circling eddies of fog, showed as if it had gone out and were collapsing flat and cold" (book 3, ch. 1, p. 479). Are they casual allusions? Have they any scientific foundation? There is no definite answer; but it is unlikely that they refer to the theory that the sun is gradually cooling and that the earth will become too cold for life, as modern critics such as Ann Y. Wilkinson and J. Hillis Miller claim,¹⁷² or signify the kind of "Victorian anxiety" about the future as Gillian Beer argues. As we know, William Thomson (later Lord Kelvin) formulated the second law of thermodynamics by 1851, and the word "entropy" was

¹⁷¹ This can also be seen as a biblical apocalyptic allusion instead of a scientific one.

¹⁷² Wilkinson asserts that Dickens was able to "translate" physical laws into poetry, and to make use of the metaphor of "entropy" to create the fictional world of *Bleak House*. J. Hillis Miller remarks that "he [Dickens] finds England in a bad way. It is in a state dangerously close to ultimate disorder or decay. The energy which gave the social system its initial impetus seems about to run down. Entropy approaches a maximum," see his "Introduction" to *Bleak House* (London: Penguin, 1971) 11.

coined by the German mathematician and physicist, Rudolf Julius Clausius in 1865. Through Tyndall's lectures at the Royal Institute and his articles, and conflicts and arguments among physicists and geologists, such ideas were gradually disseminated. There is no convincing evidence of the second law of thermodynamics being thought of by Dickens and the general reader before the 1860s.

It is also extremely doubtful that *Little Dorrit* is a novel developing a "plot of entropic decline" as alleged by Levine.¹⁷³ It is true that at the time when Dickens was writing *Little Dorrit*, he was experiencing social and political disillusion and "crisis". Yet even Levine himself admits, "of course we do not need science for this."¹⁷⁴ There were other reasons for Dickens's feeling that his energy was declining: he was then middle-aged; he had recently seen the death of his father and of his first child; he was no longer in love with his wife; and though he had achieved most things he wanted, he felt for the first time that his creative powers were waning, and he needed to resort to keeping a Book of Memoranda.¹⁷⁵ Meanwhile, in *Little Dorrit* as well as in his other novels, we can still find that Man and the Universe are both seen in relation to a reassuring divine creator. The ending of the novel is reassuring: Clennam and Little Dorrit are married in St. George's Church with "the sun shining on them through the painted figure of Our Saviour on the window" (*LD*, book 2, ch. 34, p. 894). In a chapter of his *Dickens and Religion* devoted to religion in *Little Dorrit*, Dennis Walder has shown how the novel is fundamentally and predominantly religious and that Dickens meant to affirm his faith in the New Testament and its message of love and redemption, in contrast to the "gloomy theology" of the Old Testament.¹⁷⁶ Dickens's optimistic belief in love and forgiveness can be discerned in the

¹⁷³ George Levine, *Darwin and the Novelists: Patterns of Science in Victorian Fiction* (Cambridge: Harvard University Press, 1988) 164.

¹⁷⁴ Levine, *Darwin and the Novelists* 8.

¹⁷⁵ According to Forster, Dickens began the Book of Memoranda for possible use in his work in January 1855, six months before he started writing *Little Dorrit*, *Life* 3: 245.

¹⁷⁶ Dennis Walder, *Dickens and Religion* (London: Allen and Unwin, 1981), 170-94.

"hopeful context" of the image of the rising sun: "Far aslant across the city, over its jumbled roofs, and through the open tracery of its church towers, struck the long bright rays, bars of the prison of this lower world" (*LD*, book 2, ch. 30, p. 831). Walder points out further Christian images associated with sunshine:

The beauties of the sunset had not faded from the long light films of cloud that lay at peace in the horizon. From a radiant centre, over the whole length and breadth of the tranquil firmament, great shoots of light streamed among the early stars, like signs of the blessed later covenant of peace and hope that changed the crown of thorns into a glory. (*LD*, book 2, ch. 31, p. 862)

Such an optimistic description of the resplendent sun parallels another:

The diggers dug all through the short night . . . and on a level with the early sun, and deeper and deeper below it as it rose into its zenith, and aslant of it as it declined, and on a level with it again as it departed. (*LD*, book 2, ch. 31, p. 863)

In the light of the previous passages, the association of "entropy" and "decline" with the sun here is again out of the question. The last image in particular is based on the novelist's everyday observations of sunrise and sunset rather than on scientific authorities on thermodynamics. Or if we relate what Dickens himself was contributing in the same period while busy with *Little Dorrit* (May 1855 to May 1857), such as "The Great Baby" (4 August 1855), "Nobody, Somebody, and Everybody" (30 August 1856) and "Stores for the First of April" (7 March 1857), there is no sign of any concern with the laws of physics.

Yet Jonathan Smith has cited many articles from *Household Words* and *All the Year Round* to support his assertion that some of Dickens's literary allusions in *Our Mutual Friend* derive from the concept of the second law of thermodynamics.¹⁷⁷ He holds that such concepts were not "disseminated to the public in an abstruse, mathematically sophisticated manner but through easily conceptualized issues (like the death of the sun) or, matters of practical, and everyday importance (like air pollution, the disposal of waste, the supply of coal)," and he considers it "essential" to approach thermodynamics in the novel via the way it is dealt with in *Household Words* and *All the Year Round*.¹⁷⁸ He believes that thought about thermodynamics began as the language of the scientists, and was then somehow "successively appropriated and transformed" in Dickens's periodicals and *Our Mutual Friend* which was written in 1864-65. He suggests that the periodical articles provide "a direct link" which allow talk about Dickens's work in thermodynamic terms,¹⁷⁹ and thus sifts through the fiction looking for appropriate metaphors.

Smith's arguments are strained. For example, he reminds us of what he sees as an interesting reference from the *OED* about the word "energy," which he says physicists appropriated from common usage, giving it the specific meaning of "power actively and efficiently displayed or exerted," as in the terminology of physics in the mid-1850s. He believes that the meaning of energy is shown in the *OED* by an example drawn from Dickens: "The united energies of two horses, two men, four wheels, and a plum-pudding carriage dog" (*OMF* book 3, ch. 4, p. 510). Yet when we check the entry in the *OED*, we find it is just the simple use of the word in its everyday sense, said to be "power actively . . . displayed or exerted," used since 1665, and it is *not* especially scientific. Smith tries to trace the development of ideas about thermodynamics, assembling articles from *Household*

¹⁷⁷ Jonathan Smith in his "Experimenting with Method: Science and Victorian Literature," refers to articles in Dickens's journals to support his argument that scientific ideas have somehow been "successfully appropriated and transformed" in Dickens's novels.

¹⁷⁸ Smith 255.

¹⁷⁹ Smith 240.

Words and *All the Year Round* to show a common concern with thermodynamic issues.¹⁸⁰ This is totally unpersuasive, because the articles he selects just give general scientific information in a popular way, but do not collectively add up to showing that Dickens was influenced by any striking new discoveries in thermodynamics. Smith's approach is an attempt to find evidence to fit his pre-established theory. For example, as we have seen, there are articles about the familiar subject of geology which inevitably touch rather generally on the time-scale of the earth and life on earth, but the ones he refers to appear to have nothing to do with the questions that William Thomson had raised about the fate of the sun and its presumed eventual extinction. Nor do the periodicals provide a "direct link" between what Dickens's contributors were permitted to say about thermodynamics in his periodicals and the way he expressed himself in the novels. It is not at all like the occasional instances in *Bleak House*, for example, when the novel repeats long and distinct phrases from *Household Words*, or occasions where we have external evidence that Dickens meant his fiction and journalism to be related.¹⁸¹

We may look at some examples more closely to clarify this point. For instance, "Is Heat Motion?" (1 July 1865; *AYR* 13: 534-38) seems a promising example that Smith quotes to support his argument. In the article, the author introduces John Tyndall's book *Heat Considered as A Mode of Motion* (1863) as a work which "has been pronounced more entertaining than a novel" and appreciates Tyndall for bringing the subject "within the reach of persons of ordinary intelligence and culture." In some ways the subject is seen as "a new philosophy"; in others, ideas such as heat's being produced mechanically by friction, are referred to as commonplace. Referring back to "Physical Force" (12 March

¹⁸⁰ Articles such as "A Shilling's Worth of Science" (*HW* 1: 1507-10), "Physical Force" (*HW* 19: 354-59), "The Fire Sea" (*AYR* 10: 321-25), "Earth" (*AYR* 12: 469-74), "False Fears" (*AYR* 13: 201-4), "Respecting the Sun," (*AYR* 13: 297-300).

¹⁸¹ The end of *Bleak House*, ch. 11, closely echoes "Heathen and Christian Burial" (*HW* 1: 43-48) by W. H. Wills and George Hogarth; see John Butt, "Bleak House in the Context of 1851," *Nineteenth-Century Fiction* 10 (1955): 1-21.

1859; *HW* 19: 354) and "Fire" (January 18, 1862; *AYR* 6: 393-96), the author proclaims that he has "attempted" to popularise the newest speculations, "only scanty reference" to them has been made in popular science and "public knowledge . . . remains below the attainable level." This means, therefore, that the whole thermodynamics enterprise and its theories (if this is the "new philosophy" the author means) were far from popular. Instead of being anxious about the death of the sun, the author says that the new philosophy accounts for its unchanged power, which has gone on "for ages, without our being able in historic times, to detect the loss," though we learn that if the sun were made of coal and burned with oxygen it would not last 5,000 years. Then he argues that Tyndall is supported by Thomson and Mayer. In other words, in a long article (of over eight columns) connected with Dickens and appearing at the same time as *Our Mutual Friend*, no anxiety in the least is expressed about the future of the earth. No conclusions are drawn about the earth's fate except that its life is limited, as mentioned in "Respecting the Sun" (22 April 1865; *AYR* 13: 297-300). Smith refers to "Physical Force" (12 March 1859; *HW* 19: 354-59) which is by Edmund Saul Dixon, who sums up the theories of W. R. Grove's *On the Correlation of Physical Forces* (1846) and Alfred Smee's *The Monogenesis of Physical Forces* (1857). Perhaps strangely, Dixon had begun by being impressed with the mutual reactions of so-called "inanimate matter," and calmly alludes to the "dim shadow of the awful quiet which would exist were matter not capable of mutual action." But he thinks matter is capable of such action. The author was able to imagine a dead universe, but did not foresee it. He considered Smee's and Grove's theories as teaching reverence for "One Jehovah, the Lord of all." Of course, not everything published in *Household Words* reflects Dickens's opinion; but, if it did, we can see what his opinion would have been. Instead of being anxious, Dixon is confident in God and optimistic about the future.

Unlike the study of natural theology and Darwinism, no evidence shows that the term "thermodynamics" ever came into Dickens's language, nor did he openly reveal an interest

in the topic or own books about it. The general issue of the second law of thermodynamics is touched on in Dickens's periodicals, but not in his fiction. Attempts may be made by critics like Smith to find evidence in *All the Year Round* to fit their theory that Dickens was concerned with thermodynamics, but they are unable to bridge the gap between the open and diverse world of the periodicals and the relatively closed or specific worlds of the novels. They simply do not coincide. After all, Christian belief still supposed that the world might end relatively soon, in apocalyptic destruction, however long ago it had been formed. A slow cooling off was hardly a matter for anxiety, or more than a Dickensian quip.

(ix) The Magic and Application of Science: Technology, Analytical Chemistry, Medical Science and Public Health

The present introduction cannot cover every aspect of science discussed in *Household Words* and *All the Year Round*, but it aims to refer to ways in which use can be made of what was published in the two journals, and some of the problems involved in this survey. Articles on technological subjects, for example, present particular difficulties. One of them is simply how far some of them can be seen as "scientific" at all. Technology itself is not "science" as we have defined it; but it is neither possible nor necessary to distinguish what is science and what technology: they are interwoven or lie side by side.¹⁸² Some of the articles that are included are only partly about science. They may chart dramatic changes in industrial technology (railways, bridges, tunnels, ships, street lighting, and so on) rather

¹⁸² Ian McNeil, ed. *An Encyclopedia of the History of Technology* (1990; London: Routledge, 1996). McNeil tries to draw a distinction between science and technology. According to him, "science is the product of minds seeking to reveal the natural laws that govern the world in which we live and, beyond it, the laws that govern the universe. Technology, on the other hand, seeks to find practical ways to use scientific discoveries profitably, ways of turning scientific knowledge into utilitarian processes and devices" (p. 3). As he explains, using one of his examples, "the man who looks through the telescope, is a scientist," while "the scientific instrument maker, the man who made the telescope, is a technologist" (p. 4); yet sometimes, they may be one and the same man. The dividing line is imprecise.

than science itself, and emphasize practical applications rather than guiding principles and understanding.

Like technology, articles on chemistry in *Household Words* concentrate on utilitarian and down-to-earth aspects rather than the pursuit of scientific laws and principles. In fact, the nineteenth century is said to have been a time when the division between "pure" and "applied" chemistry became "increasingly blurred:" in many chemical firms, attempts were made to "improve the processes for producing commercially useful substances" and to seek "new exploitable materials." The systematic study of by-products, and application of theories in inorganic, organic and physical chemistry, were led by industry, and helped to form the basis of modern chemistry.¹⁸³ Many of these aspects of applied chemistry are reflected in articles in *Household Words* and *All the Year Round* about manufacturing useful substances, such as textile chemicals (dyestuffs and bleaching), fuel (coal and coal gas), and heavy inorganic chemicals (or acids and fertilizers).

In her perceptive article "Science in *Household Words*: 'The Poetic . . . Passed Into Our Common Life,'" ¹⁸⁴ Nancy A. Metz maintains that articles on the microscope and chemistry particularly correspond to what Dickens promised to show his readers in "A Preliminary Word," that "in all familiar things, even in those which are repellent on the surface, there is Romance enough, if we will find it out." According to her, Dickens saw how "science and art were not the same. . . but their borders intersected," and "they were able to meet to the benefit of both." Chemistry and the use of the microscope were typical of the kind of science that she thinks changed Dickens's view of the world, and that "came to influence his fiction in the broader way." A scientist is "the master problem-solver"; like the artist (only "working from different starting points"), he has the power to "illuminate what is

¹⁸³ McNeil, 189-90.

¹⁸⁴ *Victorian Periodicals Newsletter* 11 (1978): 152-53.

beautiful and mysterious in apparently mundane things" and can transform waste or "things we commonly think of as foul, shameful, or trivial" into useful things and poetic subjects; in short, science is a "modern mystery." She draws an analogy between the novelist's art and the achievements of the scientists. Her generalisations about the relation between *Household Words* and Dickens's fiction are doubtful, but her remarks on how articles on chemistry and the use of the microscope affected the common outlook on the nature of life are pertinent.

No doubt, Dickens had great respect and admiration for the technical and scientific achievements of his age, and those in chemistry were high among them. Dickens once wrote to Wills about the need for an article on how the state recognised scientific discoveries. He wanted one written on how the government conferred titles:

It would be a very remarkable thing to take the list of the House of Peers, the list of Baronets and Knights, and (without personality) divide the more recent titles into classes and ascertain what they were given *for*. How many chemists, how many men of science, how many writers, how many aldermen

How much intellect represented.

How much imagination.

How much learning.

How much expression of the great progress of the country--How much of Railway construction, of Electric Telegraph discovery, of improvements in Machinery, of any sort of contribution to the happiness of mankind.¹⁸⁵

¹⁸⁵ 22 August 1851, *Pilgrim* 6: 467-68. As a result, Dickens wrote "Proposals for Amusing Posterity" (*HW* 6: 505-7) suggesting that there might have been a "great Jenner or Vaccination Dukedom," the "Watt or Steam-Engine peerage," or the "Faraday Order of Merit."

Even so, scientists clearly do not figure largely in his fiction; and serious scientists or scientific ideas hardly at all. The chemist Redlaw of the *Haunted Man* is almost the sole exception, and his profession makes little or no difference to the narrative or message of the fable. If Dickens were attracted at all to the idea that scientific discoveries of this kind had a journalistic interest, we can see how uncertain he was about how to exploit them in the first number of *Household Words*. It includes a thoroughly inept and almost pointless excerpt from the *Athenaeum* expressed in turgid polysyllabic prose about how some French scientists had been able to extract minute quantities of silver from "Fucoidal plants" (i. e. seaweed).¹⁸⁶

Nevertheless, it was typical of many *Household Words* articles in wanting to show that something valuable could be extracted from common materials. Years later, there was a more thorough and intelligible article "Two Millions of Tons of Silver" (9 May 1857; *HW* 15: 443-45) by the Aberdonian physician and professor, Alexander Harvey, which refers back to the *Athenaeum* extract but makes a great contrast to it. In plain language, Harvey explains just what is meant by research into the laborious way in which silver and lead could be obtained from the sea.

A related topic which it is difficult to know how to classify is alchemy. There are many articles which refer to it, such as Dudley Costello's "Alchemy and Gunpowder" (4 May 1850; *HW* 1: 135-39), a superficial examination of how mankind has benefited from the earliest approaches to science which helped to prepare the way for more important advances. He compares alchemy with chemistry, arguing that both need the "knowledge of

¹⁸⁶ "Metal in Sea-Water" (*HW* 1: 24), which is simply borrowed from the "Scientific Gossip" in the weekly *Athenaeum*, 19 January 1850, p. 78. It was so unsatisfactory that, about twenty years later, the passage was hacked out of the stereotyped plates when the half-yearly volume was re-issued, and the gap filled by lengthening the two previous articles. The new version was published by Ward, Lock, and Tayler.

the substance or composition of bodies," and turns aside to tell the legend of Roger Bacon which is about the discovery of gunpowder and the moral questions raised by it. Yet this is not really an article on science, any more than is "The Last of the Alchemists" (13 June 1863; *AYR* 9: 378-84), which is about the "degraded chemist and alchemist" James Price, who claimed in 1787 to be able to make gold from mercury. "We are alchemists," says Master Humphrey, "who would extract the essence of perpetual youth from dust and ashes . . . and discover one crumb of comfort or one grain of good in the commonest and least regarded matter that passes through our crucible."¹⁸⁷ Alchemy is a mere fancy which *Household Words* and *All the Year Round* attempted to revive in some of their more remarkable articles; but there are also genuine chemical discoveries that might have captured Dickens's imagination.

The most celebrated article on chemistry which has a close relation with the editor is "The Chemistry of a Candle" (3 August 1850; *HW* 1:439-44), commissioned by Dickens, taken directly from Faraday's lecture notes,¹⁸⁸ and written up by Percival Leigh, a contributor with a quasi-scientific background. Leigh used his imagination to create fictional characters to teach scientific principles. Nephew Harry tells his uncle Bagges what he has learned from Faraday's lectures at the Royal Institution: how in burning a candle the dust of charcoal or carbon is consumed, how oxygen and hydrogen are mixed and burnt and their flame blown on a piece of quicklime to produce a dazzling brightness, how to separate hydrogen and oxygen from water, and so on. It is a model piece: a proper

¹⁸⁷ Nancy Metz, "Science in *Household Words*: The Poetic . . . Passed Into Our Common Life," *Victorian Periodicals Newsletter* 11 (1978): 125.

¹⁸⁸ The article was abstracted from Faraday's series of six lectures; see "Syllabus of A Course of Six Lectures on the Chemical History of A Candle, intended for a Juvenile auditory, 28th December, 1848-9th [January]," Ms. notes at R. I.; or Alan E. Jeffreys, ed., *Michael Faraday: A List of His Lectures and Published Writings* (London: Royal Institution, 1960) 49; Faraday himself used some of these notes again for Christmas lectures 1854-55. Percival Leigh's "The Mysteries of A Tea-Kettle" (*HW* 2: 176-81) is also based on Faraday's lectures.

scientific account reported in an imaginative and comprehensible way. Dickens promised Faraday he would not touch Faraday's version, "or have it touched, unless it can be re-lighted with something of the beautiful simplicity and clearness of which I see the traces in your notes."¹⁸⁹ In the same letter, he said he had commanded Wills to attend Faraday's next lecture because "a subsequent comparison of his recollection of it, with your notes, might enlighten us very much." In another letter, Dickens thanks Faraday, who had lent him a second book of lecture notes, and, alluding to Percival Leigh, said he hoped that "with the assistance of a friend and contributor who has a practical knowledge of chemistry," his journal could "convey some very small installment of the pleasure and interest I have in them, to others."¹⁹⁰

To show the "magic" and "novelty" in chemistry was a constant theme. Henry Morley's "The Work of the World" (13 September 1851; *HW* 3: 589-92), based on Liebig's *Familiar Letters on Chemistry, and Its Relation to Commerce, Physiology, and Agriculture* (1844), is a more thorough account than the earlier pieces. Like Liebig, Morley focuses on the utilitarian spirit of the subject, the application of chemistry to commercial purposes, such as how to make soda from common salt, the process of manufacturing, and how to use the by-products in making soda to make fertilizer and bleaching materials. There are more articles like this, often inspired by the Great Exhibition, including Wills's "Gas Perfumery" (28 June 1851; *HW* 3: 334) and Percival Leigh's "The Latest Intelligence from the Irish California" (13 September 1851; *HW* 3: 595). Such pieces belong, in Harry Stone's words, to the "process" articles.¹⁹¹ As he points out, they do not suggest Dickens's interest in science as a discrete discipline, and they are hardly fundamentally scientific articles, but they prove his general interest in exploring and making any possible use of the organic and material world. John Capper often wrote about the practical application of

¹⁸⁹ 31 May 1850, *Pilgrim* 6: 108.

¹⁹⁰ 6 June 1850, *Pilgrim* 6: 110.

¹⁹¹ Stone, *Charles Dickens' Uncollected Writings* 35.

chemistry in manufacture. His "Silken Chemistry" (9 April 1853; *HW* 7: 129-31), on the addition of substances such as gum or sugar to give silk weight, points out that silk spinners or weavers should seek the aid of chemists to analyse silk's relative purity, strength, elasticity, durability, structure, and the size and weight of each fibre with precision, and like the French show manufacturers the most profitable use of raw silk. Capper's "The Northern Wizard" (5 November 1853; *HW* 8: 225-28), as he called an unnamed manufacturer in Glasgow, is a striking account of an "industrial or manufacturing chemist" who makes salts, acids and bleaches used in the manufacture of cotton yarn, cotton goods and other products, in his factory or "laboratory." There is also "The Chemistry of Washing" (8 April 1865; *AYR* 13: 248-53) which links chemistry and everyday life, as the author describes the use of substances such as hypochloride of soda and chloride of lime in washing. Henry Morley's "A Puff of Smoke" (7 May 1853; *HW* 7: 234-35), a piece on tobacco inspired by lectures about cigars in the Great Exhibition, reveals that meerschaum is " $MgO, SiO_3 + HO$ " or a "hydrated silicate of magnesia." Dixon's well-written "Ozone" (7 August 1858; *HW* 18: 169-73) is based on a French specialist's book. It begins with the analytical chemist Dr. Henry Letheby's report on the sanitary state of London, turns to studies by various French scientists, and concludes with William Herschel's account of ozone, its use in medicine and agriculture.

George Dodd's "Penny Wisdom" (16 October 1852; *HW* 6: 97-101) especially earned Dickens's praise.¹⁹² The article generalises about the whole business of the manufacture of useful products from commercial waste as shown in the Great Exhibition: how to use cast iron, how to manufacture by-products from coal gas, how to make pencils out of plumbago dust from exhausted plumbago mines, and how to use apparently "waste" products in dyeing and perfumery. Dodd says that "Chemistry is indeed Nature's housewife, making

¹⁹² In this letter to Wills, Dickens says the article is "very interesting and good," 7 October 1852, *Pilgrim* 6: 774.

the best of everything." A similarly general descriptive account is seen in Thomas Stone's "Chemical Contradictions" (14 September 1850; *HW* 1: 591-94), based on the book by J. H. Pepper, a professor of Analytical Chemistry, and his lectures in the Royal Polytechnic Institution. Again, the "analytical chemist" is considered to be a kind of "unraveller of riddles" who solves "mysteries in apparent contradictions and antitheses," and simple examples of chemical change are given. "Crystals" (2 May 1857; *HW* 15: 414-19) by Robert Brudenell Carter, then a young apothecary, explains the nature of crystals and the process of crystallisation in sugar, diamonds, and rock crystal. The article mentions what was demonstrated by an exhibitor at the time of the Great Exhibition, but turns to a theological conclusion. According to Carter, crystallisation seems to show "the direct and visible working" of the "Mighty Hand" which sustains the universe. It seems that whatever evolutionary theory and biological study may have suggested, the world of chemistry suggested to Dickens and Carter that life was guided by a "mighty hand" and that it fell into a variety of forms, obeying certain "laws." This is the conclusion his contributors always come to, and is apparently what they mostly believed.

Though there are many articles in the journals full of enthusiasm and praise for the Great Exhibition, the event, in Dickens's own words, "bewildered" him.¹⁹³ For example, Robert Stephenson, author of one of the better guides to the Great Exhibition, once wrote an article about the Crystal Palace that Dickens considered to be "very well done"; yet he said he "cannot make up my mind to lend my blow to the great Forge-bellows of puffery at work" and "so heartily desire to have nothing to do with it."¹⁹⁴ Eventually, he asked Wills to cancel the article altogether. As we can see from their articles, nearly all the contributors looked at the event favourably and praised it as evidence of "progress." Yet it made Dickens feel "used up" and he had an "instinctive feeling" against it.¹⁹⁵

¹⁹³ To Mrs. Watson, 11 July 1851, *Pilgrim* 6: 428.

¹⁹⁴ To W. H. Wills, 15 July 1854, *Pilgrim* 7: 370.

¹⁹⁵ To W. H. Wills, 27 July 1851, *Pilgrim* 6: 448.

Several articles on food adulteration concern the practical applications of chemical knowledge. "The Cow with the Iron Tail" (9 November 1850, *HW* 2: 145-51), by R. H. Horne, is about the adulteration of milk. There are Charles Strange and Wills's joint pieces, "Death in the Teapot" (14 December 1850; *HW* 2: 277, on the artificial colouration of green tea) and "Death in the Bread-Basket" (28 December 1850; *HW* 2: 323, on deleterious substances added to bread), and Wills's "Death in the Sugar Plum" (25 January 1851; *HW* 2: 426-27, on poison in sweets). In *All the Year Round* "The Modern Alchemist" (27 December 1862; *AYR* 8: 380-84), "Pull Devil, Pull Baker" (10 June 1865; *AYR* 13: 474-77) and a comic fantasy, "How Professor Gaster Lectured a Ghost" (12 April 1862; *AYR* 7: 107-11) are all related to the subject. However, though the articles are about a topic Dickens paid attention to,¹⁹⁶ they only touch slightly on scientific knowledge, and are perhaps better classified with pieces on social reform. Henry Morley's "Poison" (22 March 1856; *HW* 13: 220-24) is against pharmacists being allowed to sell poisonous drugs without a licence, and in favour of a permanent force of inspectors knowledgeable in chemistry, botany and natural history. Morley's "Our Poisonous Wild Flowers" (20 September 1856; *HW* 14: 234-36) draws from a recent book on poisonous plants. "Poison-Proof" (10 May 1862; *AYR* 7: 209-10) is about experiments performed at the Chemical Discussion Association of the Pharmaceutical Society on the effect of certain poisons on different animals.

There are more important articles on the chemical nature of substances. E. A. Hart's "Minerals That We Eat: In Two Chapters" (24 May and 7 June 1856; *HW* 13: 437-42, 486-90), on the minerals people absorb from food, looks at food from the chemical and medical point of view. Yet Hart wanders aside to give a long passage on the way that salt,

¹⁹⁶ In a letter to Forster, Dickens wrote, "O what a fine aspect of political economy it is, that the noble professors of the science on the adulteration committee should have tried to make Adulteration a question of Supply and Demand!"; ?12-14 August 1855, *Pilgrim* 7: 687.

essential to animal life and able to prevent illness, should be seen as "the emblem of eternity; of repentance; of reconciliation, and of wisdom." Dixon's and Wills's "Aluminium" (13 December 1856; *HW* 14: 507-10) reports on a German scientist's process of extracting aluminium from chloride of aluminium. The discovery was again important to industry, proving that "Science had already fulfilled her part," and that it is "the turn of manufacturing Art." Dickens's contributors gradually introduced the general reader to a precise knowledge of the chemical characteristics of "Water" (12 November 1864; *AYR* 12: 326-32) and "Air" (3 and 10 December 1864; *AYR* 12: 399-402, 422-25), of phosphorescent substances in "Some Curious Lights" (28 February 1863; *AYR* 9: 16-20), and the composition of oils and fats in "Our Oil Flasks" (9 May 1863; *AYR* 9: 260-64).

What we find is that in spite of discovery, calculation and reasoned principles, Dickens (or his journals as he supervised them) wanted to see the world around as alive, intricate, inter-related, understandable through the imagination, and closely related to human life. The nature and processes of chemistry excited him because they showed such aspects. His sentiments on the subject were expressed in his 1848 review article in the *Examiner*, "The Poetry of Science." "Science," Dickens writes, "truly expounding nature, can, like nature herself, restore in some new form whatever she destroys" and "when she has freed us from a harmless superstition, she offers to our contemplation something better and more beautiful, something which, rightly considered, is more elevating to the soul, nobler and more stimulating to the soaring fancy." Chemistry, according to Dickens, is the science that "reduces the very element of water into its constituent airs, and re-creates it at her pleasure." It is magical, and has the power to "re-create." It is magical because there is something incalculable in it, and because created life comes from an unseen divine power. It is perhaps not so curious then that in the gloomy butler dubbed the "Analytical Chemist"

in *Our Mutual Friend*, Dickens seems to show a dislike of the inhuman and clinical side of science.¹⁹⁷ As often, Dickens's fact and fiction exist in different if similar worlds.

There are a few other instances. *Little Dorrit*, for instance, is marked out in this connection by having an illustration in the first number sub-titled "Under the Microscope." The plate refers to a scene at the end of Book 1, chapter two, when Miss Wade watches, scrutinizes and analyses Harriet Beadle (Tattycoram):

The observer stood with her hand upon her own bosom, looking at the girl as one afflicted with a diseased part might curiously watch the dissection and exposition of an analogous case.

The metaphor in the illustration and the text is potentially a powerful one. It was no doubt closely linked with the popular interest in microscopes frequently dealt with in Dickens's journals. But, in fiction, Dickens again uses a scientific image to express his notion that science could allow the observer to be inhuman or indifferent: Miss Wade is, indeed, a self-tormented, frustrated and unloved character; she is also "self-contained and self-reliant" who can "see and hear you with indifference." Yet this scientific metaphor is not followed up in the rest of the novel.

Microscopy was becoming domesticated in Dickens's time. There were articles on buying and using a microscope. According to Frank Buckland, "Catch-Pennies" (19 August 1854; *HW* 10: 5-6), microscopes or magnifying glasses with a magnifying power of twenty diameters could be bought for a penny each in Leicester Square, and such bargains

¹⁹⁷ According to Michael Cotsell, the analytical chemist recalls the character "Mr Alum" created by Charles Mathews (1776-1835) and may have been based on Friederich Accum (1769-1838) whose *Treatise on Adulterations of Food and Culinary Poisons* (London: Longman, 1820) drew attention to the subject; see Michael Cotsell, *The Companion to "Our Mutual Friend"* (London: Allen and Unwin, 1986) 26-27.

show the popular fascination with them. Dixon, who was especially interested in the subject, studied widely and wrote several articles about it for *Household Words*: "The World Unseen" (11 October 1856; *HW* 14: 291-96); "Microscopics" (1 November 1856; *HW* 14: 377-81); "Microscopic Preparations" (8 August 1857; *HW* 16: 132-38); "Unsuspected Neighbours" (6 February 1858; *HW* 17: 172-76); and "Border-Land" (6 March 1858; *HW* 17: 273-76). They tell the history of the microscope, give advice about where to buy one, how to prepare the paste, and describe the organisms seen under it.

Microscopes obviously did reveal a new world to those who used them. "Microscopic Fungi" (14 April 1866; *AYR* 15: 318-21), perhaps by Dixon, introduces C. Cook's *Introduction to the Study of Microscopic Fungi, Rust, Smut, Mildew, and Mould, with Nearly Three Hundred Figures by J. E. Sowerby* (1865). The contributor admires such science because it converts "ugliness into beauty": "Homely, insignificant, and even repulsive objects" when "examined, investigated, and dissected" under the microscope, are found to "consist of exquisite component parts." Even so, such pieces remain not only sure that God is concerned about the fall of a sparrow, but that he is the personal creator of an almost infinitely sub-divided world, which remains entirely under his benevolent control. In "Microscopics" (1 November 1856; *HW* 14: 377-81), Dixon says "The nearer we approach to infinite minuteness, the more we appreciate the infinite beauty . . . which marks every production of the one great creative hand." His "Unsuspected Neighbours" (6 February 1858; *HW* 17: 172-76), on the organisms that act as purifiers and scavengers in water, ends with an orthodox doxology from Psalm 104: "O Lord, how manifold are thy works; in wisdom hast thou made them All; the earth is full of thy riches. So is the great and wide sea also; wherein are things creeping innumerable, both small and great beasts." "Man Magnified" (27 September 1851; *HW* 4: 13-15) by Frederick Knight Hunt, based on Dr. Arthur Hill Hassall's *Microscopic Anatomy of the Human Body, in Health and Disease* (1849), is a well-written article based on proper scientific study. Yet when summing up his

account of the structure of a human body, Hunt says "there is an obvious code of morals plainly indicated" by the author of all things: for example, the skin and the teeth teach the need for cleanliness, and blood that is too white or red warns us against gluttony or "indolence and innutrition."

To suggest that the contributors' fascination with the microscope could help in interpreting Dickens's novels is a separate matter. Though there is no direct evidence for Dickens's own opinions, we may suppose that he shared with some of his contributors the recognition that the world is not only the one seen through the naked-eye but full of minute, dynamic, complicated organisms as revealed by microscopes.

Articles on medical science often overlap with chemistry. Eliza Lynn's "Disinfectants" (4 July 1857; *HW* 16: 9-12) written at a time when antiseptics were beginning to be studied (the subject was only better understood after Joseph Lister's work in antiseptic surgery in the 1870s) tries to explain the use of antiseptic and chemical agents in disinfection. There is a series of articles and reports on chloroform. William Overend Priestley's "Chloroform" (12 February 1859; *HW* 19: 249-52) is a sound piece on the discovery of chloroform in which the work of Professor James Young Simpson is discussed. In fact, before this, there had already been Percival Leigh's "Some Account of Chloroform" (10 May 1851; *HW* 3: 151-55), and Morley's "Chloroform" (23 April 1853; *HW* 7: 179-81), historical surveys which took up the question of its safety. "Painless Operations" (5 September 1868; *AYR* 20: 298-300) also reviews various discoveries in anaesthetics over the past twenty years in Britain and America, including nitrous oxide (discovered by Dr. Horace Wells of Hartford, Conn.), sulphuric ether (Dr. William T. C. Morton) and chloroform (Simpson of Edinburgh). Leigh's piece mentions a reluctance to use chloroform on religious grounds, but the author opts for its advantages believing its discovery will increase "the amount of human comfort and happiness."

Certain aspects of medical science including sanitary reform and hygiene are immediately related to people's everyday lives. In contrast to other topics, articles of this kind are often introspective and critical. For example, Morley's "Letter from a Highly Respectable Old Lady" (18 May 1850; *HW* 1: 186-87) partly concerns the fatal effect of white or yellow phosphorus, the cause of so-called "phossy jaw" among match factory workers. Though ironic in tone, it is based on medical reports in the *British and Foreign Medical Review*. Morley's "Old Lady" mocks the editor: "Here's your march of improvement! A new luxury, a new disease." It is a short and curious piece about sanitary reform. Morley's "One of the Evils of Match-Making" (1 May 1852; *HW* 5: 152-55) deals with the subject more thoroughly, referring to a report in the *British and Foreign Medico-Chirurgical Review* of 1848 about fifty-two cases of the disease caused by fumes from phosphorus used in making matches.¹⁹⁸ It describes the symptoms at different stages, and what the writer saw when he visited a London Lucifer-match factory. "Sanitary Science" (20 October 1860; *AYR* 4: 29-31) criticises poor sanitation in buildings made with easily rotten or poisonous materials designed by architects with no knowledge of sanitary laws and science. There are many more general accounts of public health, sanitation, drains and sewerage, and smallpox vaccination, though usually without introducing directly scientific principles. "An Important Matter" (30 June 1860; *AYR* 3: 270-74) deals with small-pox and vaccination, mentioning publications on the subject; it refers to the medical officer of the Privy Council and public-health reformer, Sir John Simon, and his inquiry into smallpox and vaccination, and tells how Dr. Jenner introduced vaccination. It also deals with the practical side of vaccination: the need for the "renewal of the vaccine matter," the operation of the National Vaccine Establishment, and compulsory vaccination. "The Life

¹⁹⁸ Rev. of *The Disease of the Workmen employed in Lucifer Manufactories, and Especially the Affection of the Maxillae, Produced by the Vapours of Phosphorus, Considered in their Chemico-physiological, Medico-chirurgical, and Forensic Relations* (Erlangen, 1847), by F. Ernst von Bibra and Lorenz Geist, *British and Foreign Medico-Chirurgical Review or Quarterly Journal of Practical Medicine and Surgery* 3 (April 1848): 446-61.

and Death of the People" (8 October 1864; *AYR* 12: 198-205) inspired by John Simon's yearly report about sanitary work as required by the Public Health Act of 1858, again discusses the matter. "Slowly and steadily" Simon has begun to pursue a single plan. The author has studied particular diseases, and examined the whole question of the importance of vaccination against smallpox. It is no casual report because the subject has actually been looked at *scientifically*--by observation, by careful use of records and statistics, by the use of reason, and by experimentation.

Many articles criticise quack medicine. "Wise Doctor Lemme" (12 February 1870; *AYR N. S.* 3: 258-61) is based on Charles Kingsley's *Madam How and Lady Why* (1870) which had just been published for young readers. The article itself is hardly scientific: instead of introducing the new book, the article compares it to the sixteenth-century *Whys and Wherefores* by a Dr. Levine Lemme, a book full of absurd accounts of various occult matters, for example, that short men are more passionate, humorous and quick-witted, because their bodies are "drier" and "catch fire more readily and burn faster than moist folks." Henry Morley's "One Cure More" (8 March 1856; *HW* 13: 191-92) condemns contemporary quacks in London who claimed that the "Movement-cure" remedy and other prescriptions could cure all sorts of illness. However, Dickens wrote to Wills to delete a reference to the water-cure: "I am sorry to see the Cold Water cure classed in Morley's article among the humbugs of the time. Firstly, because I believe that in reason there is a good deal in it. Secondly, because you were at one of the great Malvern Doctors' and my wife was at another's."¹⁹⁹ Just as Dudley Costello points out in "Old Household Words" (10 April 1852; *HW* 5: 80-83), though there had been great progress in people's scientific knowledge, those familiar with "the wonders of steam and electricity" nevertheless still believed in the bizarre and occult cures, such as those recorded in the Ayscough MSS in the British Museum, or the remedies for mad dogs' diseases in Oliver Goldsmith's *Citizen*

¹⁹⁹ 2 March 1856; *Pilgrim* 8: 64.

of the World (1762).²⁰⁰ "Infallible Physic" (3 March 1860; *AYR* 2: 448-52) distinguishes various kinds of quacks. The author takes laughable examples from many advertisements for drugs and remedies, such as those for Kinesipathy (which is "to rub and pinch the body after a peculiar fashion"), and reports on treatment by shampooing in the *Quarterly Review* [July 1859]²⁰¹. He suggests a board of censors should examine medical advertisements and help the public distinguish between them. "An American Novelty" (22 June 1867; *AYR* 17: 613-14) is written as a story to denounce quackery. The author of "At Home with the Spirits" (3 March 1866; *AYR* 15: 180-84) takes a rationalistic view of such frauds. His account of experiences of "spiritualism" over a period of twenty years praises those who have made the attempt to expose quackery. "Inhuman Humanity" (17 March 1866; *AYR* 15: 238-40) condemns the Royal Humane Society (founded to save drowning people)--which the author mocks as the "Royal Inhumane Society"--for conducting useless but cruel experiments on animals. A curious article related to gender is "M. D." (8 December 1866; *AYR* 16: 514-16), on an American physician, Dr. Mary E. Walker, who came to England to give lectures at St. James's Hall, where according to the press, the audience was rude and hostile. Such articles should be considered not for their serious science but for their contribution in advocating an inquisitive spirit and debunking quackery and superstition. This vivid reflection of the confusion and absurdity of medical treatment in Dickens's time gives them lasting historical value.

In contrast to condemnation of quacks and criticism of the medical profession, some articles are straight-forwardly informative. Morley's "Change of Air" (11 February 1854; *HW* 8: 570-75) considers the influences of different climates on the human body. George Sala's "Doctoring Begins at Home" (18 August 1855; *HW* 12: 68-72), a review of a French book translated into English as *Domestic Medicine; or Plain Instructions in the Art of*

²⁰⁰ Chapter L.XIV, "The Fear of Mad Dogs Ridiculed."

²⁰¹ "Annals and anecdotes of life assurance," by Abraham Hayward, July 1859, vol. 106, p. 58-82.

Preserving and Restoring Health by Simple and Efficient Means (1853), teaches some hygienic ideas. According to Sala, though people have begun to understand that a science such as chemistry may be "a good thing for a farmer to know," they still neglect to study the laws of health and disease. "All the World Akin" (7 October 1865; *AYR* 14: 250-52), based on some publications on cholera, explains the origin, prevention and treatment of the plague. The writer authoritatively instructs the readers to "see your doctor, be temperate, unafraid, clean" and avoid eating "especially-laxative fruits." It is practical, rather than scientific. Percival Leigh's "The Rational Doctor" (29 March 1851; *HW* 3: 13-18) is written as a conversation about gout between Mr Bagges and young doctor Newby, and there is much general discussion of medical treatment. It ends with an attack on homeopathy on the grounds that its results are inconclusive, and suggests that doctors should not only give drugs to relieve symptoms, but must trace their cause. In this amusing piece of elementary medicine, the author often uses the word "science" casually and ironically when talking about food: for example, "Among the various sciences to which our old friend Mr. Bagges had addicted himself . . . was that of Gastronomy"; and when the doctor suggests that exercise is important and a hunter can eat more than a philosopher, Mr. Bagges says "you can't pursue science on quite so much beef and ale, as you can a fox." All these articles are typical subjects for family magazines: comprehensible, amusing, and possibly useful because closely related to the reader's experience and domestic life. But it is doubtful whether they are truly scientific.

Different kinds of physiological study, some quite advanced for the time, can be found. Some articles are fairly profound, others more general. "Colour-Blindness" (12 November 1853; *HW* 8: 255-57) by James Knox and W. H. Wills, and "Colours and Eyes" (29 December 1855; *HW* 12: 521-24) by Morley, treat the study of colour-blindness by Dr. George Wilson of Edinburgh,²⁰² which was to lead to the demand for redesigning railway

²⁰² Dickens wrote to thank Wilson for sending him another new book; *Pilgrim* 8: 218.

signals. "The Vital Point" (23 January 1858; *HW* 17: 125-26), by John Robertson, discusses the investigation of the "pneumogastric nerves" by French physiologists. "Eyes Made to Order" (11 October 1851; *HW* 4: 64-66), by William Blanchard Jerrold, reports on the new invention of artificial eyes by a French physician, though this is only news about technical ingenuity and the author does not go into detail. In contrast, "Bone-Making" (8 November 1862; *AYR* 8: 209-11) about the discoveries of the importance of membranes useful in surgery, does give further explanation. The author praises such discoveries as showing "Science holding up a guiding finger to Skill when touching the brain or seat of Intelligence." "Animal Mechanics" (10 July 1852; *HW* 5: 398-400) by an unknown author, "Kelly," surveys studies of parts of the body, such as knee-joints and bone-marrow. "Vermicularities" (17 October 1863; *AYR* 10: 177-79), which discusses worms, is based on Sir Everard Home's thirteen lectures in *Lectures on Comparative Anatomy* (6 vols., 1814-28); it explains the digestive processes of worms in general, ending with the reassurance that the "animal creation must be one, since there is only one Creator." Dixon's "Vital Heat" (19 June 1858; *HW* 18: 13-18) clumsily summarises information from a recently published book by professor Jules Gavarret of the Faculty of Medicine of Paris, about how living creatures maintain their temperatures more or less independent of the life around them. In the style of M'Choakumchild, Dixon tries to cover his subject as comprehensively as he can, apparently citing every authority he can think of. Morley's half-column piece, "Our Own Temperature" (18 September 1852; *HW* 6: 11-12), is based on papers read to the Royal Society by Dr. John Davy, the Inspector-General of Army Hospitals,²⁰³ and discusses the average temperature of the human body, how it varies from morning to night, and what kind of activities make the temperature change. "Skin Deep" (21 February 1863; *AYR* 8: 562-64) describes the principles of perspiration investigated by the seventeenth century Italian physician Santorio. The author considers

²⁰³"On the temperature of man," and "On the temperature of man within the tropics," *Philosophical Transactions* (1845): 564-65 and (1850) 437-46.

him "a man of science, painfully inquiring into scientific laws," whose name deserves to be "rescued from the oblivion into which it has long fallen." "Science at Sea" (9 August 1851; *HW* 3: 468-71) by William Blanchard Jerrold is taken from James Atkinson's paper to the British Association in 1851 based on the studies of J. Curie of the French Academy of Science, which explains the reason for sea-sickness and certain facts about the phrenetic nerves.

There is a string of articles more on statistics than medical science, mostly written as medical recipes for a long and healthy life. Morley's "Healthy Figures" (21 August 1852; *HW* 5: 535-37), for example, studies the population of Geneva and the remarkable longevity of its people, and how improvements in housing, food, and habits influence life expectancy. Yet, as the author of "Life in Round Numbers" (7 May 1859; *AYR* 1: 31-35), based on a newly published book by a French physiologist, points out: "As a science, human longevity. . . has been the degraded bondslave of quacks and empirics." A series of articles--"Fat People" (19 November 1864; *AYR* 12: 352-55), "Tall People" (31 December 1864; *AYR* 12: 489-93) and "Little People" (11 November 1865; *AYR* 14: 376-80)--is based on A. J. Quételet's research into people's average weight and height. These articles are largely journalistic description. Such bits and pieces of detail do not touch on scientific study: there is no reasoning, no proof, no personal observation.

Considering the popular audience at which Dickens's periodicals were aimed, there is inevitably a great deal in them which is superficial, and it is hard to decide whether this is because scientific advances were only slowly making their mark (and even more slowly being absorbed by the public), or whether it is because of the way that they are treated. Perhaps both are true. Dickens and his contributors often had only a superficial understanding of what they were explaining. Journalism is essentially somewhat sketchy; it has to be topical and immediately attractive. This explains the presence of articles such as

"Stomach and Heart" (4 May 1867; *AYR* 17: 438-40), which refutes the old belief that the heart was "the seat of the affections," claiming that emotions come from the stomach; or George Sala's "Legs" (15 April 1854; *HW* 9: 209-12), written as a parody of Sir Charles Bell's *The Hand*,²⁰⁴ which discusses not only gout and varicose veins, but fashion and shoemakers' advertisements.

In conclusion, though we admire the advances the Victorians made in medicine, we must not exaggerate Dickens's participation in them, in spite of his sharing with some of his contributors a zeal for reform and improving living conditions. Dickens's fiction especially shows respect and admiration for the two doctors who represent the modern generation, properly qualified and dedicated to helping the poor. In *Bleak House*, Allan Woodcourt, who befriends Jo, is a Fellow of the Royal College of Surgeons, and at the end of the novel, he is appointed a medical attendant to the poor in Yorkshire. In *Little Dorrit*, Dickens writes with profound respect, and even reverence, for the modest "great Physician" who not only attends Mr Merdle and other society figures but also quietly serves the London poor:

There were brilliant ladies about London . . . who would have been shocked to find themselves so close to him if they could have known on what sights those thoughtful eyes of his had rested within an hour or two, and near to whose beds, and under what roofs, his composed figure had stood . . . Many wonderful things did he see and hear . . . yet his equality of compassion was no more disturbed than the Divine Master's of all healing was. He went, like the rain, among the just and the unjust, doing all the good he could, and neither proclaiming it in the synagogues nor at the corners of streets. (*LD*, book 2, ch. 25, p. 768)

²⁰⁴ A copy of the 4th ed. (1854) with Mrs Bell's inscription was in D's Library, Stonehouse 11.

Together with compassion, Woodcourt and Physician--Like Dr. Lydgate in *Middlemarch*-- have scientific knowledge and medical expertise as key components in their characters.

(x) Natural History

Articles on natural history often deal only with the fringes of science or its primitive stages and cannot be compared with some of the more rigorous scientific pieces, but they are common in *Household Words* and *All the Year Round*. Often they arise simply from observing nature, its flora and fauna, and especially rare and exotic species discovered abroad or species new to people in Britain.²⁰⁵ Such articles are typically descriptive, direct and often elementary. They are generally written in a familiar and personal style,²⁰⁶ or they give objective and detailed descriptions especially when they are summaries of classic works, specialist studies and translations from French. Many articles are in fact simply a mixture of adventure story and entertaining journalism combined with some knowledge of zoology or natural history, referring to ancient works on natural history.²⁰⁷ The study of natural history and biology may have led to the larger question of evolution and the laws and principles that govern the universe. But in *Household Words* and *All the Year Round*, such contributions on natural history, however, are usually merely general.

There are miscellaneous biological pieces, and zoological articles about various creatures, such as spiders, bees, sand grouse, herons, sparrows, larks, skuas, laughing gulls, flies,

²⁰⁵ For example, Catherine Hill's "Hornet Architecture" (*HW* 13: 325-26) on her observations of insects such as wasps and hornets that build all sorts of nests in Australia; Thomas Satchell's "A Spider in Disguise" (*HW* 3: 46-48), on the "hunting spiders" found in British Guiana; "A Bird-Hunting Spider" (*HW* 4: 45-46); "Strychnine" (*HW* 13: 420-24) by "Harvey" about a particular kind of tree found in Ceylon and India whose seeds contains strychnine, "Four-Legged Australians" (*HW* 7: 208-14) by Samuel Rinder on animals in Australia; "The Elephant at Home" (*AYR* 2: 129-32) on elephants in Ceylon; and "Snakes in Queensland" (*AYR* 18: 126-28).

²⁰⁶ For example, Dixon's "Domestic Pets" (*HW* 7: 248-53) only gives general and personal observations of his menagerie.

²⁰⁷ For example, see "A New Phase of Bee-Life" (*HW* 2: 353-55) by Thomas Satchell or "Bird-Fancies" (*AYR* 14: 153-57).

mosquitoes, silkworms, elephants, donkeys, deer, vipers, seals, crabs, lobsters, their specific names, habitat, and behaviour; or they may be on different branches of botany such as horticulture, agriculture and forestry, the identification and classification of plants, their internal arrangement, microscopic examination, uses, function and distribution. Without involving serious thinking or controversial ideas these are the most common kinds of article, mainly fit for family magazines. A few are interesting for their ideas and could have aroused readers' curiosity about Nature. How do certain spiders know how to make doors for their dwellings, or diving-bells to breathe in, enabling them to dive and catch their prey underwater?²⁰⁸ How is it that a certain kind of fish can leave its river and "walk" on the land? What is a "singing fish" like?²⁰⁹ How do molluscs develop pearls?²¹⁰ Nature is full of miraculous novelties, and such subjects were well chosen to attract readers' attention.

There were certain regular contributors on natural history. Among them was E. S. Dixon. After writing two articles early in 1852, Dixon started writing constantly for *Household Words* in May the same year, and about the same time there appeared Henry Morley and W. H. Wills' "A Flight with the Birds" (10 July 1852; *HW* 5: 381-84) which is a review of Dixon's book, *The Dovecote and the Aviary, being Sketches of the Natural History of Pidgeons and Other Domestic Birds in a Captive State, with Hints for Their Management* (1851). As well as birds, Dixon also wrote on other animals, on insects, and on horticulture in a fluent if pedantic style.²¹¹ He borrowed a great deal from French books. John Robertson, who specialised in botany and sea-side studies, is another example of someone who often wrote about his special interests.²¹² Yet Dixon and Robertson

²⁰⁸ "Mechanics by Instinct" (*HW* 6: 278-81) by Mrs. Hoare.

²⁰⁹ "Old Fish" (*AJR* 2: 516-17).

²¹⁰ "Creatures of the Sea" (*AJR* 20: 8-11).

²¹¹ "The Phalansterian Menagerie" (*HW* 8: 64-69), "Wings and Toes" (*HW* 10: 31-37) "The World of Insects" (*HW* 13: 511-16), "Stickytoes" (*HW* 16: 31-34), "Michelet's Bird" (*HW* 19: 140-44), and "Michelet and Insects" (*HW* 19: 280-86).

²¹² He wrote numerous articles about it including "Under-Water Existence" (*HW* 14: 342-47), "Seaside Eggs" (*HW* 14: 126-30), "Sea-Gardens" (*JTW* 14: 241-45), "The Purple Shore" (*HW* 14: 391-95), "An

frequently give a jumble of facts taken from a torrent of reference books, with involved explanations, using Latin and Greek terminology and Linnaean classifications, and citing troops of famous but remote authorities.

It is necessary to discriminate between articles about zoology and simple entertaining snippets about current events such as the arrival of the first hippopotamus in Britain, monkeys and elephants at the London Zoo,²¹³ or various shows or exhibitions.²¹⁴ Dickens himself wrote two light-hearted but totally "unscientific" pieces about the zoo,²¹⁵ and had also sent his sub-editor to see its secretary.²¹⁶ In February 1857, Dickens wrote an interesting letter to Forster describing what he had happened to see in the Zoo. The serpents being fed with live birds and guinea pigs he considered a horrible sight.²¹⁷ His articles and this letter show that when thinking about the Zoo, he seemed not immediately to associate it with science; his concern was with the humane treatment of animals. This is also the case with R. H. Horne's "A Zoological Problem" (8 November 1851; *HW* 4: 156-57), a light-hearted piece about a snake which swallowed its blanket. In contrast, "Poisonous Serpents" (6 November 1852; *HW* 6: 186-88), by Richard Owen, is rather more significant. It was the first of the three "familiar papers on Natural History" Owen wrote for *Household Words*.²¹⁸ Initiated by an accident in the zoo, when one of the reptile-keepers was bitten to death by a Cobra-de-Capello, Owen's article gives a succinct description of the structure of the snake's poison-fangs, a chemical analysis of the fatal fluid, and corrects false reports in other newspapers. Horne's "More Dumb Friends" (24

Immeasurable Wonder" (*HW* 16: 118-20), "The Shell-Moth" (*HW* 17: 205-6), and "The Blue Dye Plant" (*HW* 17: 436-38).

²¹³ For example, R. H. Horne's "Elephants. Wholesale and Retail" (*HW* 3: 229-31), "Old Friends with New Faces" (*HW* 10: 429-31) by Dudley Costello, and Richard Owen's "Justice to the Hyaena" (*HW* 6: 373-77).

²¹⁴ For example, an auction of animals in the Surrey Zoological Garden described by Frank Buckland in "A Zoological Auction" (*HW* 12: 570-72) and the department of Guiana's exhibition at the Crystal Palace mentioned in Thomas Satchell's "Animal and Vegetable Disguise" (*HW* 4: 92-94).

²¹⁵ "The 'Good' Hippopotamus" (*HW* 2: 49-51) and "The Friend of the Lions" (*HW* 13: 61-63).

²¹⁶ To Mrs Gaskell, 18 February 1854; *Pilgrim* 7: 278.

²¹⁷ To John Forster, ? 13 February 1857; *Pilgrim* 8: 281.

²¹⁸ To Richard Owen, 19 October 1852, *Pilgrim* 6: 779-80.

April 1852; *HW* 5: 124-27), referring to many books on natural history, is a semi-scientific facetious piece on animals' "linguistic powers." Horne's "The Hunter and the Student" (1 May 1852; *HW* 5: 157-62), based on a lecture by Richard Owen,²¹⁹ distinguishes between naturalists who observe and preserve and hunters who only hunt and slay. Dickens thought the subject "a very good one."²²⁰ This piece can be compared to "Gamekeeper's Natural History" (10 September 1859; *AYR* 1: 473-76) which argues that gamekeepers who have spent their lives "observing living things, and studying their ways" rather than "reading other men's thoughts," know more about the habits and customs of wild animals than a professor who never goes into the field. It also criticises students who may have read a French writer's work on natural history without having even an elementary knowledge of the food or habits of ordinary animals. The writer thus urges people to learn from "open air natural history" such as that written by "Audubon, and White of Selborne, and Gould, and more of it and deeper of it" rather than "from stuffed animals."

There is a difference between general articles such as "Popular Names of British Plants" (30 January 1864; *AYR* 10: 534-39) and "Plant Signatures" (6 February 1864; *AYR* 10: 557-61) about how plants are named, and articles about specifically botanical study such as "Clocks Made of Flowers" (22 October 1859; *AYR* 1: 606-8), an account of the "periodicity" of plants, or "The Great Sower" (13 October 1860; *AYR* 3: 9-11), about the functions of seeds. "A Botanist's Adventure" (15 September 1866; *AYR* 16: 227-32) tells the legend of a botanist who found a kind of herb to make a sort of mysterious tea that can kill vipers, and the tragedy of a snake charmer; interesting but unscientific. Some articles are excluded from the following summaries even though their titles may seem to suggest natural history. They include "Bosio's Stupendous Flower" (24 February 1866; *AYR* 15:

²¹⁹ Owen, rev. of *A Hunter's Life in South Africa*, by R. G. Cumming, *Quarterly Review* 88 (1850): 1-3; see also N. A. Rupke, *Richard Owen: Victorian Naturalist* (New Haven: Yale University Press, 1994) 80-81.

²²⁰ To R. H. Home, 18 April 1852, *Pilgrim* 6: 640.

152-54) about a mysterious passion-flower mentioned in some literary works, "Serpents at Sea" (15 January 1870; *AYR N. S.* 3: 152-55) dealing with the ancient belief in sea-serpents (shown to be only gigantic seaweed), Henry Morley's "Supernatural Zoology" (22 September 1855; *HW* 12: 187-90) on ancient superstitions about plants, birds, beasts, fishes and stones in *Ortus Sanitatis* (1499), and Dudley Costello's "Bird History" (19 July 1856; *HW* 14: 7-12) recording obsolete accounts of mythical birds from ancient works. Articles of this kind were purely for entertainment, convey no scientific thinking, and, despite their titles, are not even on the borderline of natural history. In a sense, they are evidence that Dickens's contributors did not write exclusively about new discoveries in science, but occasionally deliberately turned their backs on them to write about past beliefs.

Similarly there are some naturalist's anecdotes, such as Eliza Lynn's "Ralph the Naturalist" (17 March 1855; *HW* 11: 157-62) about a naturalist's love affair, and the story of "Madame de Corneillan" (11 July 1863; *AYR* 9: 466-68) who devoted herself to the acclimatisation of a new silkworm that fed on the leaves of the ailanthus-tree. In contrast, Horne's "Snails" (29 May 1852; *HW* 5: 240-44) is a more satisfactory example which begins with the story of William Slitherhouse (a retired clockmaker, who turns to the study of snails). It is scientifically significant because, in the article, Horne also finds the opportunity to relate information about how snails are distributed on the earth, their different species, different pattern of shells, eggs and so on. "An Amazonian Naturalist" (30 July 1864; *AYR* 11: 592-96) introduces Henry Walter Bates who lived for nine years on the borders of the river Amazon, and whose book on the natural history of the Amazons, is said to have been written "with a view towards solving the problem of the origin of species," based on his observation of eight hundred different creatures, including parasites, bird-catching spiders, ants, and monkeys.

Sometimes, contributors keep their articles simple on purpose. For example, in "Sensible News of a Sea-Snake" (3 June 1854; *HW* 9: 373-74), Frank Buckland says that it would be "cruel to our readers" to "enter into a debate about the sea-serpent," and that he will only write something lightly instructional. In fact, this is a common attitude of those who deal with natural history. Thus, many articles are mainly related to a general interest in the created world and how it works: they are not even remotely related to the influential advances in the interpretation of the biological universe. They are usually not investigative but observational. For example, Buckland's "A Dish of Fish" (18 February 1854; *HW* 9: 16-17) touches on the connection between the form of fish and their need to adapt to nature. Contributors aim to arouse a general curiosity about nature, especially from accounts of current exhibitions. They may be like John Oxenford, the author of "More Splendid Than a Badger" (19 August 1854; *HW* 10: 18-20) who pays a penny to look at an animal said to have "the head and ears of a Fox, the body of a Badger." As he puts it, "The crowds are ever anxious for information, and ever ready to seek for it," and the curious creature "may have set them thinking on something beyond the narrow limits of the spot in which they vegetate," and may even indirectly lead to the founding of a horticultural or zoological garden or library. Such articles are mainly concerned with entertainment, as in Frank Buckland's "Intellectual Fleas" (5 July 1856; *HW* 13: 599-600), or his "A Whale in Whitechapel" (21 March 1857; *HW* 15: 272-75), inspired by a show in a tent in the East End of London. The remains of the dead whale (a Rorqual, or razor-back) had been brought from Norfolk, and this leads him into a descriptive account of whales.

In contrast to the great majority of pro-science contributors, the author of "The Intelligence of Plants" (23 April 1870; *AYR N. S.* 3: 488-91) is oddly against Linnaeus and those who maintain that plants do not "feel"; the author argues that some plants are sensitive to the slightest touch and are endowed with the capacity for joy and sorrow, as often described in poetry. He says, "Whether I am scientifically and philosophically right or

wrong, I take a pleasure in believing that" and claims to "go with the poets rather than with the scientific men." He continues:

Science may laugh at all such notions, but Science, though a very great and learned lady, does not yet know everything. Her elder sister, Poetry, often sees further and deeper into things than she does. Did not Shakespeare in the *Tempest*, foreshadow the possibility of the electric telegraph more than two hundred years before Wheatstone? Did not Dr. Erasmus Darwin, long in advance of James Watt and Robert Stephenson, predict the steam ship and the locomotive engine? Did not Coleridge, in the *Ancient Mariner*, explain the *modus operandi* of the then unsuspected atmospheric railway?

Of course Coleridge did not make this inexplicable comparison; but the author takes descriptions of plants' emotional reactions from Erasmus Darwin's "The Loves of Plants" (Part II of *The Botanic Garden*, 1791), to support his point about the living instincts of plants, their intelligence and energy. This is an example of the kind of argument that poetry surpasses science.

Some articles make practical and rational suggestions: about producing cheaper food, fisheries, cultivating silkworms, and animals and plants with commercial value. For example, "Dear Meat and Cheap Fish" (30 December 1865; *AYR* 14: 537-41), initiated by the wish to protect and cultivate salmon, gives details about the salmon's habits, natural history, and how it propagates. "Confectioner's Botany" (10 August 1861; *AYR* 5: 462-64) not only tells how to cultivate "Vanilla Aromatica" from Mexico, but also describes other natural substances used by confectioners such as angelica, caraway seeds, peppermint, ginger and nutmeg. "The Pitcher-Plant" (8 August 1863; *AYR* 9: 563-65) is about the plant's ability to relieve the symptoms of fever and how it has been used as a remedy for

small-pox in Halifax, Nova Scotia. The chemical analysis of the different parts of the plant is given. "Scale Insects" (6 December 1862; *AYR* 8: 307-9) is about making dyes from scale insects or cocci (the parasites of orange peel known to cause damage to the fruit); chemists have discovered a way of cultivating them to make the colour vermilion. "The Blue Dye Plant" (24 April 1858; *HW* 17: 436-38) is also about discoveries of new plants for making dyes. These articles are utilitarian: they only make observations of nature in order to propose suggestions about the use of natural resources.

Conclusion

My introduction has drawn mainly on the articles in *Household Words*, largely as a matter of convenience, because of the known authorship of contributions to the earlier journal. There was, however, no significant shift in direction on the transition to *All the Year Round*, as far as scientific articles are concerned. More, perhaps, was published on engineering and technological achievements in *Household Words*, which was dominated by the spirit of the Great Exhibition. *All the Year Round* leans toward astronomy and often aspects of science, where there were new developments to take account of.

Some of the main conclusions that arise from reading *All the Year Round* seem to be the same when we turn to *All the Year Round*. The journalism Dickens published was sometimes peculiar and always various. We cannot argue from any single article that it *must* represent the editor's or "conductor's" view. If we do, we shall have to admit that he had some extraordinary ideas and had, for example, a bad grasp of mathematics: (89.9% and 11.1% add up to an impossible 101%, for example, in "Water," 12 November 1864, 12: 326-32). *All the Year Round* is still wildly over-confident in repeating eccentric French

scientific theories, such as those about repeated Floods ("Deluges," 21 April 1860, *AYR* 3: 40-47), or the Moon ("Respecting the Sun," 22 April 1865, *AYR* 13: 297-300).

On the particular question of "natural selection" versus divine design, *All the Year Round* continues to be steadily in favour of a Creator. In spite of fair consideration being given to Darwin, most contributors make it clear that they believe in a God who has designed and created the universe. This "Sovereign Master" controls the development of species ("Before the Deluge," 13 January 1866, *AYR* 15: 7-11), a single "Creator" governs animal development ("Vermicularities," 17 October 1863, *AYR* 10: 177-79), and the authority of the Bible sets at rest the "unflattering" possibility of Man's close relationship to the great apes ("An Ugly Likeness," 1 June 1861, *AYR* 5: 237-40). If this were not what the contributors or their "conductor" believed, it is certainly the assumption on which they address their readers. It is true that it may not follow that Dickens's novels were written on the same assumption, but whatever the case selective comparisons between his fiction and this or that piece of journalism should not be made (as they have been) as if it were certain that both were written from the same standpoint.

Altogether, therefore, this thesis is not meant in any sense to be a conclusive study of Dickens and Science. It rather aims only to open the subject and direct the reader to what can be learned from an inquisitive use of Dickens's periodicals. In fact, the value of looking at what they offer is to see that as well as being informative, they may also reflect contemporary complacency and vacancy about science. The question of what part science played in Dickens's fiction is elusive, and has confused many contemporary critics and commentators. For example, in his recent lecture "On Giant's Shoulders" addressed to the Edinburgh International Science Festival, 7 April 1999, Melvyn Bragg spoke about Darwin's acquaintances, readily including Dickens as one of them. When I asked about his evidence, he referred to John Meurig Thomas's account of Michael Faraday's public

lectures at the Royal Institution.²²¹ Without hesitation, Bragg held the idea that both Dickens and Darwin went to Faraday's talks on science, and that the two must therefore have met. Bragg, relying on Thomas' description of the scene at Faraday's evening lectures, says in his book: "You had Charles Dickens occasionally, you had Charles Darwin frequently, you had Charles Wheatstone, a great scientist, invariably listening to him on Friday nights."²²² In fact, Thomas does not say this,²²³ and as we have seen there is no evidence for it. Dickens makes no mention in his letters of going to any such scientific lectures, merely saying in a letter to Faraday that his sub-editor Wills had done so.²²⁴ Even if he did attend any of Faraday's lectures, there is no reason to think that he was acquainted with Darwin just because they both may have been in the same hall. Lord Bragg is a popular advocate of science in the media, but his mistake and misleading deduction show the danger of loose scientific popularisation. There is no evidence of any direct acquaintance and correspondence between Dickens and Darwin. A general imaginative interest in science is simply not enough: we need a reliable knowledge of the history of science, some scientific knowledge, an inquisitive spirit and respect for evidence. The incident illustrates some of the problems of interpreting Dickens's journals.

²²¹ John Meurig Thomas, *Michael Faraday and The Royal Institution: The Genius of Man and Place* (Bristol: Hilger, 1991).

²²² Melvyn Bragg and Ruth Gardiner, *On Giants' Shoulders* (London: Hodder, 1998) 139.

²²³ Thomas 3; his text reads:

Though of a retiring, almost reclusive nature, and profoundly religious, Faraday was a leading figure in Victorian England. Prince Albert befriended him and among those with whom he interacted were the painters Turner and Constable, the writers Dickens and Ruskin, and the eminent biologists and champions of evolution Charles Darwin and T H Huxley.

²²⁴ In his letter to Faraday dated 31 May 1850, Dickens says "I should take it as a great favor if you could allow me (in the event of my being unfortunately unable to come myself) to introduce my Sub Editor to your next lecture [1 June]"; *Pilgrim* 6: 108-9. In addition to this, Dickens mentions Faraday's public lectures in his letter to Chandos Wren Hoskyns on 14 December 1863: "I have read your Model Lecture . . . Such heaps of intolerable rubbish of conceited words purporting to be hideous in my sight, but for Sydney Smith, Owen, and Faraday," *Pilgrim* 10: 326. We have no direct evidence of Dickens attending Faraday's lectures, but Dickens did meet Faraday at Benjamin Lumley's garden party on 19 June 1850; *Pilgrim* 6: 113n.

We have already looked at what can be learned about Dickens's knowledge of science suggested by his reading and his Library. Much can be inferred from the only piece that he wrote himself: his review of Robert Hunt's work on "The Poetry of Science." One may trawl through the pages of the *Pilgrim* edition of the *Letters* to pick up casual allusions. But there is still much to be learned from Dickens's journalism. Such material needs to be interpreted with discretion, and there is no easy way into the subject other than actually reading what he published. It is hoped that the following summaries give a sketch-map to enable various routes to be followed. They may be helpful for further work on the interaction between science and literature, they may remind readers of the limitations of studying Dickens from articles in his journals, and they may highlight the importance of developing a suitable methodology to investigate other special aspects that they deal with.

HOUSEHOLD WORDS

The heading to each of the following summaries records its title, author, date of publication, the volume and page reference, and the column-length. The identification of the authors is based on the studies by Anne Lohrli on *Household Words* and E. A. Oppenlander on *All the Year Round*. The column-lengths are given because they were originally noted in the *Household Words* office-book for purposes of payment, and in few instances a discrepancy between those entries and their actual length has also been noted.

METAL IN SEA-WATER

[Unknown author] 30 March 1850; 1: 24; 1/2 col.

An extract is given directly from the "Scientific Gossip" of the *Athenaeum*, 19 January, 1850, p. 78. This tells how some French scientists, Malaguti, Durocher and Sarzeaud, have announced that they have detected minute amounts of copper, lead and silver in sea-water. They have also found silver in fucoidal (seaweed-like) plants on the coast of St. Malo, in sea-salt, muriatic acid, and "the soda of commerce." Traces of silver were also found in "terrestrial plants." It concludes that if the discoveries are confirmed, "we shall have advanced considerably towards a knowledge of the phenomena of the formation of mineral veins."

[When *HW* was reprinted in the half-yearly volume form by Ward, Lock and Tyler about twenty years later, this piece was cut out from the stereotype plates, and the gap filled by lengthening the previous article, "A Bundle of Emigrants' Letters."]

THE TRUE STORY OF A COAL FIRE: CHAPTER I.

[Richard H. Horne]; 6 April 1850; 1: 26-31; 11 cols.

A fanciful story in three parts, about a young man who, in a dream, is taught a lesson by being carried back to the period of antediluvian forests when coal was formed. He is taken all over the world to see giant forests "destined to follow the law of transmutation," which will one day turn them to coal. His guide, a coal-black elf, explains that "these vast trees and plants, this richly poisoned atmosphere, this absence of all animal life of man, and beast, and bird, and creeping thing, is all arranged in due order of progression."

Pilgrim 6: 36, to R. H. Home, 12 February 1850: "How goes on the coal rig?"

Pilgrim 6: 60, to Percival Leigh, 10 March 1850: "We have another story now in hand, which is a dream; and I think it would be better to imply that it was said he had been thinking for himself a little, and had cleaned his spectacles and looked about him, and so forth."

THE TROUBLED WATER QUESTION

[W. H. Wills]; 13 April 1850; 1: 49-54; 10 cols.

It starts as a dialogue between the narrator and his friend Lyttleton, about the London Water Supply, because Lyttleton is going to speak at "the Great Water Supply Congress" to be held at the end of March. To investigate the situation, they visit the Grand Junction Company's works at Kew Bridge where an engineer shows them the filtration system. They hear that other companies do not properly filter their water and that the supply of water after delivery to London is badly maintained. They compare the composition of distilled water with Dr. Robert Christison's* analysis of spring water and conclude that suitable ingredients in drinking water are eight to ten grains of sulphate of magnesia or soda to the imperial gallon [Christison pointed out that "water which contains less than about 800th of salts in solution cannot be safely conducted in lead pipes without certain precautions" in his

"On the Action of Water upon Lead," *Transactions of the Royal Society of Edinburgh* 15 (1844): 265-76]. They acquire a great deal of information. At the meeting, Lyttleton appeals for efficient control of the water supply, and proposes that the law should force landlords to supply filtered piped water to every house.

Pilgrim 6: 69, to Henry Austin, 20 March 1850: "And will you kindly look at the enclosed rough Proof, and tell me whether there is anything challengeable in it. It is by the Sub [W. H. Wills], aforesaid."

ILLUSTRATIONS OF CHEAPNESS: THE LUCIFER MATCH

[Charles Knight]; 13 April 1850; 1: 54-57; 5 1/2 cols.

It traces the history of fire-lighting from the tinder-box to matches. The process of obtaining fire in domestic houses in England used to be laborious and expensive. The account is not purely scientific, but it does explain that phosphorus can easily be lit with light friction and that chlorate of potash will explode on slight friction to give combustion. This discovery has led to the production of matches. Matches are seen as "a blessing . . . that can scarcely be measured by those who have had no former knowledge of the miseries and privations of the tinder-box"; and the appearance of the penny boxes of Lucifers and Congreves is "a real triumph of Science, and an advance in Civilisation." Further details of the manufacture of a lucifer match and some economic principles including Adam Smith's theories are described.

Pilgrim 6: 59, to Charles Knight, 9 March 1850: "I read the Lucifer match as I was coming up from Brighton, and am greatly delighted with it."

Pilgrim 6: 73, to Charles Knight, 26 March 1850: "The Illustrations of Cheapness are *most admirable*. We have opened number 3 with the Lucifer Match, and I assure you it comes out gloriously."

SHORT CUTS ACROSS THE GLOBE

[William Weir and W. H. Wills]; 13 April 1850; 1: 65-68; 4 3/4 cols.

Different arguments are used to urge the construction of the Panama Canal: it would benefit travel, commerce and the economic development of South America. Moreover, there are no "insurmountable engineering difficulties" because British engineers have already demonstrated their abilities in the construction of tunnels for railways, the Croton aqueduct and the Britannia tubular bridge. Humboldt's* remark about the subject is referred to.

THE TRUE STORY OF A COAL FIRE: CHAPTER II.

[Richard H. Horne]; 13 April 1850; 1: 68-72; 9 1/2 cols.

The young man continues his dream journey down the coal mine seeing the hard dangerous life of miners. He goes under the sea into subterranean shafts and experiences first-hand the intolerable and dangerous working conditions suffered by the miners, including young children and women. Finally he is rescued from an explosion caused by fire-damp. There are footnote explanations of choke-damp (carbonic acid gas) and fire-damp (hydrogen gas).

ILLUSTRATIONS OF CHEAPNESS.--A GLOBE

[Charles Knight]; 20 April 1850; 1: 84-87; 6 cols.

James Ferguson's* globes have become useful instruments for educational purposes. Readers are told how a globe is made by Messrs Malby & Son of London. Globe-making

is a craft which supplies something relatively cheap that previously had only a few "scientific purchasers." Because of the advance of education, there has been increasing demand, as new purchasers and schools represent a "portion of society which is seeking after knowledge, or desires to manifest some pretension to intellectual tastes."

Pilgrim 6: 73, to Charles Knight, 26 March 1850: "Odd enough, I was in that Parker Street the other day, and looking through the little window at that identical globe-maker! I was conning in my mind, as I came away, some faint idea of describing him as a traveller who was for ever going round the world, without stirring out of that small street, but I never thought of him in his far better capacity as an Illustrator of cheapness."

THE FIRE BRIGADE OF LONDON

[Richard H. Home]; 11 May 1850; 1: 145-51; 13 cols.

The many beneficial uses and destructive powers of fire are described. It can not only "boil the pot" and "lick the dust before the feet of Science," but also cause conflagrations and explosions. The article gives a dramatic, eye-witness account of the London Fire Brigade as they attend a big fire, rescuing victims and property. The evolution of fire-engines is also described including details such as how the London Fire Brigade and the Fire-escapes of the Royal Society operate. A statistical account of London fires is also given.

SHORT CUTS ACROSS THE GLOBE: THE ISTHIMUS OF SUEZ

[William Weir and W. H. Wills]; 11 May 1850; 1: 167-68; 3 1/2 cols.

Like its companion article urging the construction of the Panama Canal ["Short Cuts across the Globe" (13 April 1850; *HW* 1: 65-68)], this one explains the many benefits of constructing the Suez Canal. The most important benefit is the improvement of commerce between Europe and India. The geography of the isthmus is described in detail because it presents problems, but the "advanced state of marine architecture and engineering ought surely to be able to cope with them."

LETTER FROM A HIGHLY RESPECTABLE OLD LADY

[Henry Morley]; 18 May 1850; 1: 186-87 2 1/4 cols.

This satirical article appears to be a complaint against modern inventions such as the lucifer match which can cause phosphorus poisoning (bone cancer) in match-makers as already reported in the *British and Foreign Medical Review* some years ago ["Report on the Progress of Toxicology, in Relation to Medical Jurisprudence, Medical Police, Chemistry, and Pharmacy, for the Year 1843-4," by Alfred S. Taylor and Review of *On the Diseases of the Jaws, with a Brief Outline of Their Anatomy and a Description of the Operations for Their Extirpation and Amputation, with Cases and Illustrations*, by R. O'Shaughnessy & Superintendent of the Gurrnhattah Dispensary (Calcutta, 1844)]. It is written as a letter addressed to "the Conductor" by an old lady who has had eighteen children, of whom thirteen "died young." In fact, with reference to two recent *HW* articles (on lucifer matches and the London water supply), the writer argues that sanitary reformers should not be complacent about new inventions ("A new luxury, a new disease") and that they should persevere with their wide-ranging improvements in sanitation and water supply.

THE PLANET-WATCHERS OF GREENWICH

[Frederick Knight Hunt]; 25 May 1850; 1: 200-4; 9 cols.

Greenwich Observatory is a "citadel of science" which "is devoted to the prosecution of a science whose operations are inconsistent with the bustle, the interruptions, the talk, and the anxieties of popular curiosity and examination." Inspired by an article in the *Edinburgh Review* ["National Observatories--Greenwich," April 1850] the narrator has visited the Observatory to report on its towers, telescopes, the "counting-house" and the people who work there, the old instruments of Flamstead* and Halley*, and more recent ones. A machine is described that registers the force and direction of the wind, and another to measure rainfall. We hear of the Time Ball in the turret, its importance and accuracy in showing the time. The Observatory is, the author says, "not a *show* place, but an eminently practical establishment," and the astronomers and their work are more important than the buildings. The daily operation of the Observatory is described. In spite of the superstitious belief of some ignorant people that astronomers are not only masters of astronomy but also masters in astrology who can tell past and future, the author optimistically predicts that astronomy will help us to know the future history of the heavens.

GREENWICH WEATHER WISDOM

[Frederick Knight Hunt]; 1 July 1850; 1: 222-25; 7 cols.

The author talks about the origin of the Greenwich observatory. "Greenwich is a practical place, and not one prepared for show." At first, the establishment is small and humble; but it contains many astronomical instruments and many important observations and discoveries are carried out there. "Science, like virtue, does not require a palace for a dwelling-place." He visits the observatory and describes what he sees there. He also

explains how the magnets work, and how to produce photographic pictures of astronomical objects and to use some apparatuses such as the thermometer and barometer to take records of their observations. An anecdote about a Mr. Glaisher who did experiments in the observatory is told.

THE FIRE ANNIHILATOR

[Richard H. Home]; 15 June, 1850; 1: 277-82; 11 3/4 cols.

Mr. John Diggs, a sugar-baker who owns a workplace and warehouse with highly combustible stock, is brought to a demonstration of a new "Fire Annihilator (or fire-extinguisher)" at the London Gas Works, given by a Mr. Phillips. He uses models to demonstrate one of the main arguments of his lecture, that water is not efficient in putting out fires but may actually increase their intensity. Fire and water are, in fact, made of the same elements, and what is needed to extinguish fire is a suitable gaseous vapour. Apparently this can be provided by Phillips' new machine. The author then describes what it looks like, and what it is made of, and explains that fire is composed of oxygen and hydrogen, in a proportion of eight to one, the same as water, which can be found "if you decompose . . . water by a voltaic battery." The article continues with other comments on the fire service and how the new Fire Annihilators can be used. Mr. Diggs is still not convinced until he sees an eleven-year-old boy use one to put out a burning pool of tar and naphtha. Diggs is finally persuaded to have an automatically self-acting fire annihilator fixed in his warehouse.

ADDRESS FROM AN UNDERTAKER TO THE TRADE (STRICTLY PRIVATE AND CONFIDENTIAL)

[Percival Leigh]; 22 June, 1850; 1: 301-04; 5 cols.

The narrator, supposedly an undertaker, expresses his disapproval of the Interments Bill which has just been brought into Parliament. Contemporary scientific research has demonstrated to sanitary reformers the dangers to health of overcrowded city graveyards: "Science . . . is hammering into people's heads truths" and has "taught" and "informed" people and made them realise more about Nature; "Science is likely to make people dread them [graveyards] a great deal more than Superstition ever did, by showing that their effluvia breed typhus and cholera." If the Bill is enacted, it will bring the arrangements and costs of funerals, as well as the supervision of city graveyards, under the control of the Board of Health. Consequently, dishonest and corrupt undertakers (such as the narrator himself) will lose money and be put out of business.

"SWINGING THE SHIP." A VISIT TO THE COMPASS OBSERVATORY

[Frederick Knight Hunt]; 27 July 1850; 1: 414-18; 9 1/4 cols. [should read 8 1/2]

Some shipwrecks have been caused by the errors in compasses. Official inquiries were carried out in the Compass Observatory (two miles and a half from the Greenwich Observatory) to find out the cause of the deviation. The author describes what he sees in the "sanctum of science" where compasses are examined and how the instruments are arranged. He sees how a ship's compass is fixed.

THE CHEMISTRY OF A CANDLE

[Percival Leigh]; 3 August 1850; 1:439-44; 9 cols. [should read 10]

Harry tells his uncle Bagges what he has learned from Faraday's lecture to children at the Royal Institution about the science of a burning candle. He says that when a candle is burnt, the melted wax is sucked up through the wick, becoming vapour. The flame is hollow, "a little shining case, with gas in the inside of it and air on the outside." When there is not enough air or the wick gets too long, some of the vapour inside the flame comes out through the flame in the form of smoke. A candle throws a good light because it consumes its own smoke, which would otherwise be a cloud made up of small bits of charcoal or carbon dust. When oxygen and hydrogen are mixed and burnt and their flame blown on a piece of quicklime, it is dazzlingly bright. Carbon or charcoal is the cause of brightness in all lamps, candles and other common lights. Harry then explains how hydrogen can be made, how water may come from flames, and that hydrogen and oxygen are parts of water. They can be separated using a galvanic battery whose two wires if properly connected will "instantly take the water to pieces." He explains the qualities of oxygen, which in air is mixed with other gases such as nitrous gas and carbonic acid gas, and carbon. After hearing Harry, his uncle says he is very glad to find the young man so fond of study and science and decides to give him a galvanic battery on his birthday.

Pilgrim 6: 106, to Michael Faraday, 28 May 1850: "It has occurred to me that it would be extremely beneficial to a large class of the public, to have some account of your late lectures on the breakfast-table, and of those you addressed, last year, to children. I should be exceedingly glad to have some papers in reference to them, published in my new enterprize 'Household Words'. May I ask you whether it would be agreeable to you,—and, if so, whether you would favor me with the loan of your notes of those Lectures for perusal?" [The notes for the "late lectures" Dickens borrowed are for the ones given 27

April-1 June 1850, "On some points of domestic philosophy--a fire, a candle, a lamp, a chimney, a Kettle, ashes."]

Pilgrim 6: 108-9, to Michael Faraday, 31 May 1850: "I think I may be able to do something with the Candle; but I will not touch it, or have it touched, unless it can be re-lighted with something of the beautiful simplicity and clearness of which I see the traces in your notes I deeply regret now, not having heard the lectures to children, as it would have been a perfect delight to me to have described them, however generally./ I should take it as a great favor if you could allow me (in the event of my being unfortunately unable to come myself) to introduce my Sub Editor to your next lecture; for a subsequent comparison of his recollection of it, with your notes, might enlighten us very much."

Pilgrim 6: 110, to Michael Faraday, 6 June 1850: "Very many thanks for your second precious book of notes. I hope, with the assistance of a friend and contributor who has a practical knowledge of chemistry, to be able to convey some very small installment of the pleasure and interest I have in them, to others."

THE WATER-DROPS: A FAIRY TALE

[Henry Morley]; 17 August 1850; 1: 482-89; 13 1/2 cols.

This fairy tale for adult readers uses information derived from chemists, the Board of Health and official reports on the sanitary conditions of poor and working class people in London. Much of the information is based on the findings of analytical chemists. There are details of a filtration system for the Thames, how to maintain clean drinking water, establish running water and provide a sewerage system.

A SHILLING'S WORTH OF SCIENCE

[Thomas Stone]; 24 August 1850; 1: 507-10; 6 1/2 cols.

For a shilling, an exhibition in the Royal Polytechnic Institution in Regent Street shows important principles of science in a way that appeals to the public. One hall displays steam-engines, hand-loom and other machines, including working models of boats and steam-engines. Lectures are announced such as one on Voltaic Electricity by Dr. G. H. Bachhoffner* with experiments showing the relationship between magnetism and electricity, light and heat. There is a gallery with a tank holding 10,000 gallons of water and a diving bell. The tank has a man in a diving suit and helmet explaining their purpose--their use in repairing docks and landing-piers, and making breakwaters. In a museum of natural history can be seen electric fish, including the famous "Gymnotus Electricus or Electrical Eel," which has been brought from the River Amazon and studied by Faraday,* about whose research much is said. He has studied the amount of its electric discharge and discovered its ability to give different shocks to animate and inanimate bodies. The author mentions that Alexander Williamson* had given a paper about it to the Royal Society. Other electric fish include Torpedo and Silurus, whose organs were first examined by the anatomist, John Hunter.* The article ends by saying that "The progress of science has already shown the identity between heat, electricity, and magnetism" and that these different forms of force can be converted from one to the other. This discovery is one which may solve physiological problems. The exhibition allows everyone who attends it to claim a share in knowing about these new scientific discoveries.

THE LABORATORY IN THE CHEST

[Percival Leigh]; 7 September 1850; 1: 565-69; 8 cols. [should read 8 3/4]

Mr. Bagges talks to his nephew Harry about respiration. Harry tells his uncle that when food is digested, it becomes a fluid that is gradually mixed with blood to nourish the body. He then explains the organization and operation of the breathing apparatus--the heart and lungs that generate heat and distribute it over the body. The lungs act as an air-sponge with many cells sucking in or expelling air, and with veins bringing dark blood from the body into the lungs and arteries carrying out scarlet blood from them, but the heart has two sides, with an artery carrying dark blood from the right side into the lungs, and four veins taking away scarlet blood from the left side. We inhale nitrogen and oxygen, and breathe the two out with carbonic acid. Iron in the blood helps it absorb oxygen. When the oxygenated scarlet blood has been conveyed all over the body, its oxygen combines with hydrogen and carbon and is burned up. Then the blood absorbs this carbonic acid, darkens, and returns to the lungs. Finally the carbonic acid and water escape as breath. This process of respiration is a perpetual form of "combustion," and an adult consumes about fourteen ounces of carbon every day. Harry also gives his uncle the advice that "spontaneous combustion does happen sometimes; particularly in great spirit drinkers," and "want of exercise and too much nourishment must make a man either fat or ill." Finally he explains that one's body can adjust to heat under different situations and concludes that the body is "a wonderful factory."

CHEMICAL CONTRADICTIONS

[Thomas Stone]; 14 September 1850; 1: 591-94; 5 cols.

The author begins this article by saying: "Science, whose aim and end is to prove the harmony and 'eternal fitness of things,' also proves that we live in a world of paradoxes." Thus he considers the scientific lecturer as "a better sort of unraveller of riddles" who can solve the mysteries in apparent contradictions and antitheses. Many examples are given

from elementary science. If some potassium is placed on water, the water will appear to ignite. It is said that fire appears to spring spontaneously from water when oxygen and hydrogen chemically combine in a thunder-storm. According to the author, the analytical chemist "sadly annihilates" all poetry with his "scientific machinations." Another example is when phosphorus combines with hydrogen to produce phosphuretted hydrogen in matches which ignite spontaneously when meeting the air. He then mentions Sir David Brewster's* explanation of the phenomenon that two rays of light can bring darkness, and two waves of sound can cancel each other. J. H. Pepper,* a professor of Analytical Chemistry, has been giving lectures in the Royal Polytechnic Institution on the phenomenon of chemical contradictions and writing about it. The author mentions further examples. These lead on to a sympathetic reference to Dr. Samuel Hahnemann's* system of Homoeopathy based on the principle of certain contraries (for example, rubbing a frost-bitten limb with snow) and the use of medicines which appear to cause the same symptoms as the disease [Hahnemann's doctrine is that "every (dynamic) disease is best cured by that medicine which is capable of producing in the healthy body similar symptoms, or a similar disease," in other words, "similia similibus curantur"--"like are cured by like," see "Homoeopathy, Allopathy, and 'Young Physic,'" *The British and Foreign Medical Review* 21 (1846): 225-65]. Dr. Hahnemann is seen as either "a very great quack or a very great philosopher."

ATLANTIC WAVES

[William Blanchard Jerrold]; 28 September 1850; 2: 22-24; 5 cols.

On a stormy day in 1848, on a ship from Boston to Liverpool, an enthusiastic professor, later revealed to be William Scoresby,* is described taking measurements of the waves in the Atlantic. The results of his observations of the highest waves, such as the average

altitude, the distance and interval of time between waves, width from crest to crest, and their velocity, are given.

SPIDERS' SILK

[William Blanchard Jerrold]; 12 October 1850; 2: 65-67; 3 1/4 cols.

The article looks back at the remarks of two rival French experimentalists at the beginning of the eighteenth century, a Monsieur Bon and René Antoine Ferchault de Réaumur,* about using spider's thread to make silk. Bon believed that the thread from cocoons of female spiders could be a useful new fibre, while Réaumur actually counted the fibres that came from the papillae of a spider with a microscope; he disagreed with Bon, arguing that silk spun from silkworms could sustain more weight and that many spiders were habitual cannibals. Even though Leuwenhoek [Leeuwenhoek, Antony Van]* asserted that "a hundred of the threads of a full-grown spider were not equal to the diameter of one single hair of his beard," a writer in *Lardner's Cyclopaedia* thought that his measurements went far beyond the limits of reality. Bon's experiments are considered "valuable" and the objections of Réaumur are "reasonable in some respects" but "not at all conclusive." Readers are told that a sample of cloth made from spider's thread is owned by the Royal Society, and that more will probably be exhibited in the Great Exhibition.

THE MYSTERIES OF A TEA-KETTLE

[Percival Leigh]; 16 November 1850; 2: 176-81; 10 cols.

At one of Mr. Bagges's "scientific tea-parties," his nephew Harry again recapitulates Faraday's lectures for children and young people. Harry tells his uncle about some scientific

laws, such as those concerning the expansion of fluids and gases by heat, how water is boiled by convection, or by means of the movement of a fluid--when the water is heated, currents are formed by rising hot currents and colder currents going downward to take their place, and that the boiling point of water depends on atmospheric pressure.

Pilgrim 6: 230, to Michael Faraday, 11 December 1850: "Will you do me the favor to accept the accompanying book--a poor mark of my respect for your public character and services, and my remembrance of your private kindness in so generously lending me your valuable notes./ Concerning which, let me say that I have them in safe keeping, and will shortly return them. The gentleman who has them to refer to, still tells me when I ask if he has done with them, that they are not so easily exhausted, and that they suggest something else."

WINGS OF WIRE

[Frederick Knight Hunt]; 7 December 1850; 2: 241-45; 9 1/2 cols.

Electric telegraphy is a science that has involved "watching, deep study, thousands of experiments, suggestions, and reasonings; numberless plans and models. . . of thinkers in many countries, in many countries in many generations." One of the results of this collaboration, the telegraphic office of the South-Eastern Company at Tonbridge, is described. The author illustrates the principle that an electric current deflects magnetised needles which point to letters on dials, so that a message can be spelled out. The company's superintendent, Charles Walker,* shows him how to send an article from *HW*, R. H. Horne's "The Cow with the Iron Tail" (9 November 1850; *HW* 2: 145-51), to Dover and explains the rules for decoding the despatches. Details of the "code" are given, but much is left unexplained. Some miscellaneous anecdotes are given about the use of the telegraph.

Finally, the author explains that the telegraph is more widely used in America because of the great distances involved.

[CHIP:] DEATH IN THE TEAPOT

[Charles Strange and W. H. Wills]; 14 December 1850; 2: 277; 1 col.

A correspondent, Mr. Slivers, is quoted as revealing that an unnamed chemist in Manchester has performed a series of experiments proving that ordinary green tea is often artificially coloured by particles of Prussian blue, yellow turmeric, and white French chalk: the first two make black tea leaves look green, and the latter makes them look pearly. The article refers back to "The Cow with the Iron Tail" (9 November 1850, *HW* 2: 145-51), on the adulteration of milk.

[The title is a jocular allusion to 2 Kings 4.40: "So they poured out for the men to eat. And it came to pass, as they were eating of the pottage, that they cried out, there is death in the pot. And they could not eat thereof."]

THE HUNTERIAN MUSEUM

[Frederick Knight Hunt]; 14 December 1850; 2: 277-82; 8 1/2 cols.

During a visit to the Hunterian Museum at the College of Surgeons in Lincoln's Inn Fields in London, the author comes into "contact with some things that moved upon the earth before the Flood" and sees "innumerable forms in which life has been." According to him, the most curious things are "relics of the huge monsters who roved in the primeval wilds of our earth long before the Flood," and those gigantic bones of extinct monsters "whose existence is now one of the romances of geology and of the animal world."

The author describes what the museum contains and gives a clear account of its history. It includes specimens from previous collectors, but needs more space to exhibit its modern collections. Stories are told such as how a specimen of frozen mammoth was discovered by a Mr. Adams, [in 1799 and presented by Sir Joseph Banks* in 1808, see Arthur Keith, *Illustrated Guide to the Museum of the Royal College of Surgeons, England* (1910), p. 80] and how the museum was founded by the self-educated physiologist John Hunter* and offered to the College of Surgeons after his death. The author suggests that Dr. Neil Arnott,* the President of the College, should "plead the cause of science to Lord John Russell," the prime minister. He also comments that other countries fund the sciences, but in Britain, the government gives only a small amount of money: "the public voice has often to be raised again and again before a scanty dole" is given to the museum.

Finally, he writes about the skeletons of the Irish giant O'Byrne [Charles Byrne, died in 1783; his body was bought by John Hunter]; the Sicilian Dwarf [twenty inches tall who died in 1824], a child with two skulls; the illustration of a French surgeon's postmortem examination which found scientific and historical evidence about Napoleon's last fatal illness; and the story of a famous mummy, Mrs. Van Butchell, preserved at the end of the eighteenth century by her husband, a surgeon and famous quack. Thus, while the author is aware that "to the scientific" the museum gives opportunities for study, he is most interested in showing that it is for "the simplest of unlettered visitors."

[CHIP:] DEATH IN THE BREAD-BASKET

[W. H. Wills and Charles Strange]; 28 December 1850; 2: 323; 1 col.

Bakers add to flour substances such as alum to improve the appearance of bread, but, according to Dr. Andrew Ure,* alum is harmful and unnecessary.

THE IRISH CALIFORNIA

[Percival Leigh]; 4 January 1851; 2: 348-53; 7 3/4 cols. [should read 8 3/4]

"By chemistry, treasures are detected in rubbish--are derived from apparently useless refuse and offal." A Mr. Owen realised that Irish peat was a more valuable product than people realise, and together with a chemist, Mr. Rees Reece, patented a process to extract chemicals from peat. The process can potentially bring great prosperity to Ireland. The article describes in detail the constituents of peat and the processes that can refine it into different products including salt, oils, spirit, vegetable wax or sperm, and gases. These products are valuable for their many commercial uses in medicine, chemistry, manufacturing, domestic lighting. The author concludes that people in Ireland should "thank Mr. Rees Reece and Mr. Owen for the opulence which those gentlemen will have conjured out of the bogs by the beautiful magic of chemistry, aided by capital."

A NEW PHASE OF BEE-LIFE

[Thomas Satchell]; 4 January 1851; 2: 353-55; 4 1/2 cols. [should read 3 1/2]

This is an account by a natural historian who, like Charles Waterton,* is a good observer. While on an expedition accompanying Indians in South America, he notes the delicate architecture of a small bright-grey bee's nest in a tree. The bees have devised an entrance concealed in the bark to allow them to pass. It is "designedly crooked and jagged at the edges," connected at one end with the outer bark, and opened and closed with a

spring. Within the doorway is an ante-chamber where there is "a porter," then the entrance hall with two tunnels inside the core. The author also mentions the kind of parasitic insects, ichneumons, which are kept out by the door but which sometimes attach their eggs "to the pellets of pollen carried by the bees."

LIGHTHOUSES AND LIGHT-BOATS

[Richard H. Horné]; 11 January 1851; 2: 373-79; 13 1/2 cols.

The account is based on Alan Stevenson's* *A Rudimentary Treatise on the History, Construction and Illumination of Lighthouses* (1850). It begins with a passenger's experience of being at sea and seeing the light of the North Foreland near the dangerous Goodwin Sands. Afterwards, he visits the lighthouse and sees the lamps, reflectors and other apparatus for the supply of oil. It explains the machinery for the revolving "light" and the developments of other systems devised to obtain the greatest amount of light. At first the use of reflectors increased the luminous effect of fixed lights 350 times and 450 times of revolving lights. The "catoptric" system using copper reflectors, including the nine distinctions (the fixed, the revolving white, the revolving white and red, the revolving red with two white, etc.), and the "dioptric" system, or refracting system suggested by Fresnel,* are described; others, such as dia-catoptric and cata-dioptric combinations, are mentioned in passing. Though both systems have their advantages (one is more powerful and safe, the other, more stable), the dioptric is generally preferred for being more economical in oil. The apparatus used in the lightship is a large lantern of copper framework and plate-glass, "protected outside by some wirework, and fixed at a mast-head." Finally described is the erection of lighthouses. The history of building the Tour de Corduan is given as an example. An account from John Smeaton's* *A Narrative of the Building and a Description of the Construction of the Eddystone Lighthouse* (1791) is

also referred to. More examples are given including the lighthouses in Scotland and Ireland. The rest of the article is about charges for tax and maintenance.

THE CORAL FISHERY IN THE MEDITERRANEAN

[Henry G. Wreford]; 11 January 1851; 2: 379-83; 6 1/2 cols.

The author based his article partly on a visit to Capri and partly on printed sources. Most of the article explains the history of the Italian coral fishing industry and how coral is collected, but a brief paragraph gives information on how coral is the crust of a species of sea-worm, how it grows and multiplies, and how it requires sunlight to increase.

PHYSIOLOGY OF INTEMPERANCE

[Thomas Stone]; 25 January 1851, 2: 413-17; 9 cols.

In the context of a fictional dinner party, one of the guests, "the Doctor," explains the harmful effects of drinking excessive amounts of alcohol. After explaining the chemical constituents of alcohol, he describes the physiology of how it is digested, absorbed, and dealt with by the liver. He also explains how "delirium tremens" can result, and how alcohol can damage the brain, circulation and nervous system.

[CHIP:] DEATH IN THE SUGAR PLUM

[W. H. Wills]; 25 January 1851, 2: 426-27; 2 cols.

A young girl had eaten Burnt Almonds, a kind of sweetmeat, and died painfully in two weeks. Her father wrote to Dr. Letheby,* one of the most eminent toxicologists, and sent him the sweetmeat for analysis. The colouring matter the sweetmeat contained is poisonous sulphate of barytes. According to Dr. Letheby's analysis, it also contained lead which was a lethal poison. It might have been the result of a careless process in manufacturing confectionery. The article urges the government to exercise a vigilant inspection over the manufacture like the French.

[CHIP:] THE TRUE REMEDY FOR COLLIERY EXPLOSIONS

[S. R.] 25 January 1851; 2: 427; 1 col.

The author argues with the proposal in "A Remedy for Colliery Explosions" (*HW* 2: 323-5) by proposing a system of gradually rising air passages to remove the gas. But the means of making mines "perfectly safe" is a chemical agent that can absorb or neutralise carburetted hydrogen gas. This agent has not yet been discovered, but "if our Faradays and Brandes* can effect it, they will do more good to their fellow creatures, by such a discovery, than any that has yet been made."

THE CHEMISTRY OF A PINT OF BEER

[Percival Leigh]; 15 February 1851; 2: 498-502; 7 3/4 cols. [should read 8 1/2]

The article is a lecture given by James Saunders, a plumber and glazier and chemist, to the Metropolitan mechanics' Institution about chemical aspects in the process of making beer: different kinds of water used and what chemical elements it might contain, the ingredients used and their chemical elements, the changes of chemical elements in the

process of malting, brewing, and fermenting. Finally he mentions that some manufacturers put in certain drugs to increase the fuddling power of beer that could cause death.

A PLEA FOR BRITISH REPTILES

[Henry Morley]; 8 March 1851; 2: 573-76; 7 1/4 cols.

This is a concise, comprehensive description of all the reptiles in Britain, together with an explanation of their basic anatomy and physiology. The three orders of reptiles--lizards, snakes and adders, and frogs and toads, are identified and discussed in detail. Harmless newts are mentioned. The author believes that if readers become informed about reptiles, they will no longer dislike and fear them.

A TIME FOR ALL THINGS

[Richard H. Home]; 22 March 1851; 2: 615-17; 4 1/4 cols.

"Different periods of the world have been signalised by different struggles of art or science, or other intellectual endeavour." The author laments that only a few British scientists have been internationally praised, while there are great British astronomers, physiologists, geologists and botanists who have not been sufficiently recognised. Natural history and chemistry are sciences that have been neglected by institutions and that should be given more encouragement. He mentions several eminent British chemists, but complains that because Britain lacks enough schools of chemistry, Germany and France surpass Britain in this field. Yet, "in the engineering sciences, we are fully entitled to take the highest place among all nations." The article ends by encouraging engineers and other

scientists to turn their attentions to solving the sanitary problems of the day, including city burial grounds, the provision of clean water, and pollution in the Thames.

THE RATIONAL DOCTOR

[Percival Leigh]; 29 March 1851; 3: 13-18; 9 cols.

Mr. Bagges suffers from gout, and has just been treated by a young Dr. Newby, whom he often meets at the Royal Institute at Friday evening lectures. Before this, he had been attended, with little success, by a Dr. Labell. Bagges invites Newby to dinner. The doctor says that there is no certain cure for gout: he gives him mercurial pills to treat his inactive liver, but with other cases he may use calomel, ipecacuanha, antimony, or even a steam-bath without any medication. In fact, cures are brought about by nature, and the treatment only allows nature to act, since, in his words, curing a disease is "to influence and regulate the natural operations." There is much general discussion of medical treatment. The account ends with an attack on homeopathy on the grounds that doctors should not only give drugs to relieve symptoms, but must trace their cause. It also attacks the government that allows such imposture from its "utter contempt of medical science, and a total disregard of the rights of the medical profession."

A SPIDER IN DISGUISE

[Thomas Satchell]; 5 April 1851; 3: 46-48; 5 1/2 cols.

Many previously unknown species have lately been found in British Guiana including the "hunting spiders" of Demerara. The author describes his own observations: some are plant-coloured to deceive their prey. This is a kind of mining-spider (of the genus *mygale*)

which can make holes two or three feet deep in the ground with invisible trap-doors to protect it. Small web-weaving spiders, observed by William Swainson* in Brazil, can make a spring-hinged lid to hide behind from danger. The author himself saw a species of spider which looked just like the seeds on a kind of parasite, twisted round a large bignonia. The spider deceives the fly by looking like the seeds. Even though a fly can distinguish between fragrant real seeds and the false ones, it might still be trapped when, after enjoying the strong honeyed liquid, it failed to see clearly or lost its sense of smell. He conjectures how mother spiders manage to hide their eggs from birds. To him, the "complicated relations of plant, bird, and insect" show the "beautiful harmonies between different kingdoms of Nature" depicted by St. Pierre, and the spiders' artistically woven structured threads enable them to "obey the primary mandate of the Creator--"Increase and multiply." He sees that good and natural actions are "rewarded" and the bad and unnatural "punished." From merely observing, the author deduces the nature of the Creator, and then stops short, having reached his own "assigned limits."

MR. BUBS ON PLANETARY DISTURBANCES

[Charles Thomas Hudson]; 12 April 1851; 3: 58-60; 4 1/4 cols.

Although Lord Rosse's telescope [constructed by the third Earl of Rosse]* "cannot put a man in the moon," the author suggests that readers should imagine "one in the sun." He supposes that the man in the sun should be called "Mr. Bubs," "an inquisitive, patient, pains-taking mortal," more interested in distant things than what he can find close at hand. His attention is turned to the planets, and particularly to Mars, and he is anxious to learn about Mars' movements in space. He tries to imagine the planets as "Solar Policemen," walking or travelling in their "ecliptic planes." He follows the circle round the sun along which Mars seems to move, and thinks about how time can be measured on Mars. On

going to sleep on the planet for fifty days by earth time, he finds on waking that his solar watch shows a different time from that on Mars. He concludes that Mars' orbit is elliptical not circular, and considers other ways in which its movement is governed. He finds, for example, that it is affected by gravitation, and the attraction of other heavenly bodies. Finally, he notes the difficulty of estimating the Earth's motion, because light and weather will cause "Errors of Parallax" and "Errors of Aberration."

THE PALACE OF FLOWERS

[James Hannay]; 26 April 1851; 3: 117-20; 6 1/4 cols.

The author gives a general description of a visit to Kew Gardens, where it is said "Science obtains knowledge, sentiment, and delectation." He describes the Gardens and their "warm houses," gives an account of the Gardens' history, and explains how "seeds and specimens reach Kew" where they are cultivated under correct climatic conditions. The establishment is organised by the director, Sir William J. Hooker,* and is "highly valuable to science and the general prosperity of our race." A sun-dial erected in 1831 commemorating Dr. James Bradley's* astronomical discoveries of aberration and mutation made at the old Observatory of Kew, is also mentioned.

THREE MAY-DAYS IN LONDON, III: THE MAY PALACE

[Charles Knight]; 3 May 1851; 3: 121-24; 7 cols.

The article aims to advertise the achievements and wonders of the Crystal Palace. Part of the focus is on the importance of scientific innovations in developing the three materials used in the construction of the building: glass, iron and wood. For example, "if Science had

not been at work in every direction for the last fifty years--Political, as well as Chemical and Mechanical Science--the four hundred tons of sheet-glass could not have been produced." Among the notable contents are the scientific instruments and many articles of "mechanical genius," such as steam-hammers, hydraulic machines and steamboat engines. Such symbols of scientific and technological progress are likened to the work of "the mighty Spirit of the universe" which "is one and the same in His manifestations."

SOME ACCOUNT OF CHLOROFORM

[Percival Leigh]; 10 May 1851; 3: 151-55; 8 1/2 cols.

Science is "continually developing its capabilities," and making the globe more habitable; life has been improved by such helps and appliances as steam, electricity and most importantly, chloroform. Surgeons aim to act safely, speedily and "pleasantly": anatomy, physiology and dexterity of hand have enabled them to achieve the first two, while the discovery of how to use chloroform by Dr. James Young Simpson* of Edinburgh and ether by Dr. Charles Thomas Jackson* and W. T. G. Morton* in America, have helped them to achieve the last. Though there have been objections to chloroform as unsafe, after experimenting, Dr. Simpson declared in 1847 that chloroform is safe to use. An account is given of the discoveries of Eugène Soubeiran* in 1831, Justus Freiherr von Liebig* in 1832 and Jean B. A. Dumas* in 1835, along with the chemical nature, density, and production of chloroform. A reluctance to use it on religious grounds is mentioned, but the rest of the article is about its advantages. "The discovery of chloroform is one of the many proofs which we are daily receiving of the advantage which is derived from the modern method of applying the intellect to the investigation of natural science, instead of abusing it in visionary speculations." As the author says, "Who knows to what extent the revelation of Nature's secrets may progressively increase the amount of human comfort and happiness?"

[CHIP:] MR. BUBB'S VISIT TO THE MOON

[Hughes]; 17 May 1851; 3: 187-88; 1 1/4 cols.

After visiting the Sun, and before going to the Great Exhibition, Mr. Bubbs takes "a nice quiet ride in the moon" to see "what fun it is." The moon is "about four hundred times nearer to the Earth than the sun," being "two hundred thousand miles" away. The hills there are about "four or five miles high" because the moon's diameter is only a quarter of the earth's. Bubbs says that if the earth [a mistake for "the sun"] were cut in half "like an orange," and the whole interior matter scooped out, it would be so large that the moon could still orbit the earth without impediment. He then explains that the sea level is high where it is nearest to the moon and also high on the opposite side. He does not believe in animal magnetism, but sees the effect of magnetism in the moon's tidal attraction of water on earth and understands the theory of tides. Had Bubbs lived two hundred years ago and made these discoveries then, he would have "made as great a discovery as Newton."

[In the articles about Mr. Bubbs, the spelling of his name is inconsistent: "Bubs," "Bubbs" and "Bubb" occur sometimes in the same article, such as this one and 3: 228.]

THE WORLD OF WATER

[Henry Morley]; 24 May 1851; 3: 204-09; 10 1/2 cols.

The article begins with general information about the sea, such as the fact that the proportion of sea to land is "twenty-seven miles of water . . . for every ten miles of land" [meaning "square miles"?], and about the sea-bed which "consist[s] of hills and dales, springs, mountains and volcanoes," and the vast variety of creatures in the sea. It quotes Joseph Beete Jukes's* *Narrative of the Surveying Voyage of H.M.S. Fly . . . in Torres Strait, New Guinea, and other Islands of the Eastern Archipelago, during the Years*

1842-46, &c., 2 vols. (1847) which tells of the coral reefs north-east of Australia, and mentions strange names "quaint to the unscientific reader." Morley appreciates that Nature's work has many purposes, unlike the single purpose of a man-made machine. He then explains how currents and tides erode land, and how fossils can be found in the earth and even under the sea. To show how the movement of the earth causes currents at sea, it is suggested that a model of the earth's rotation can be made "if we stick a knitting needle through the centre of an orange and rotate the orange on the needle." There are constant and periodical cold and warm currents, affected by winds, tides, and melting ice. Details are given about important tides and currents all around the world, including Britain. A footnote mentions Thomas Stephenson, civil engineer and the architect of Skerryvore lighthouse, and his report ["On the Force of the Waves"] at the British Association meeting in 1851. Morley concludes by promising to write a forthcoming article in *HW* on winds.

THE WIND AND THE RAIN

[Charles Dickens and Henry Morley]; 31 May 1851; 3: 217-22; 10 cols.

The recent winds have not yet blown down Sir Joseph Paxton's* Crystal Palace in Hyde Park (as some people had forecast would happen). After descriptive preliminaries we are reminded of the previous article "The World of Water" (*HW* 3: 204-09) which explained that winds are caused by inequalities in temperature. Hot air rises at the equator and passes to the north and south poles in upper currents. At a lower level, cold air passes from the poles to fill the spaces left, while both are affected by the rotation of the earth. They make the north-east and south-east trade winds. We are told how rain is formed: the constant rising of vapour from water and every moist body, and its inevitable fall once it cools. There is much information about the relation between temperature and prevailing winds in different parts of the world; and the article deals with the nature of "rainy seasons,"

monsoons, hurricanes, typhoons and local storms, ending with a descriptive paragraph evidently added by Dickens [see *Uncollected Writings* 1: 285].

[CHIP:] MR. BUBBS AND THE MOON

[W. H. Wills]; 31 May 1851; 3: 228; 1/4 cols.

Mr. Bubbs is said to have written to correct a misprint in the article "Mr. Bubb's Visit to the Moon" (17 May 1851; *HW* 3: 187-88). As he explains, it should have read that if the sun were cut in half, scooped out hollow, and the earth put inside it, the moon would still easily be able to go round us. He blames the printers for the mistake, but the sub-editor of *Household Words* says that the mistake "originated" in Bubbs' "own manuscript."

THE TRESSES OF THE DAY STAR

[Charles Knight and Charles Dickens]; 21 June 1851; 3: 289-91; 5 cols.

John Gould's* collection of humming birds is exhibited at the London Zoo. The passion for collecting and preserving rare objects of nature has raised natural history into a science. It has enlarged the domain of the useful and the beautiful. It has also popularised the work of people such as Alexander Wilson* and John James Audubon.* Gould began his career by stuffing birds at Eton, did serious work for the museum at the Zoo, and then became a successful naturalist who published (with the help of his artist wife) *A Century of Birds from the Himalaya Mountains* (1832), *Birds of Europe*, 5 vols. (1832-37), *Birds of Australia*, 7 vols. (1840-48). At the time of writing (1851) he was working on *Birds of Asia*, 7 vols. (1848-83), and *A Monograph of the Trochilidae, or Family of Humming Birds* (1861).

The exhibition is described. The twenty-four cases of Gould's collection include 320 species, only 10 of which were known to Linnaeus. Gould is said to have acquired these specimens from all over the world. "Properly to describe one case would occupy several pages," so we are asked to have "an unscientific glance" at a few. Specific examples are mentioned. Humming birds are so called because of the rapid vibration of their wings. A remark by Buffon is quoted which leads to a description of their muscular wings. It is considered remarkable to have such a "quiet collection" within a mile or so of the Great Exhibition of industry. In the end, the authors recommend a study of "the work of the Divine hand in these little birds."

[CHIP:] GAS PERFUMERY

[W. H. Wills]; 28 June 1851; 3: 334; 3/4 cols.

In response to "The Pen and the Pickaxe" (24 May 1851; *HW* 3: 193-96) which says that the Gas company drains all its refuse into the Thames, a correspondent writes to deny this and say that, in fact, the residue of coal used in making gas consists of coke, tar and ammonia; then the procedure of how this can be used to make perfume is described. The lime used in purifying gas is impregnated with ammonia, and although it smells disgusting, it can be used as fertilizer for agriculture. The coke can be used to heat greenhouses and conservatories, and as fuel by the poor. Finally the ammonia is turned into smelling salts and sold by chemists, or used for other purposes. From the same ammonia a perfume like violets is extracted to scent soap.

THE GREAT EXHIBITION AND THE LITTLE ONE

[Richard H. Horne and Charles Dickens]; 5 July 1851; 3: 356-60; 8 1/2 cols.

The Great Exhibition is contrasted with the exhibition of the Chinese Junk, Keying. Although the account is not directly about science, it touches on it indirectly by making a contrast. Many products in the Great Exhibition are technological and practical, such as the lighthouse apparatus, models of railways, iron bridges and so on; so are those in the Little Exhibition, with its models of junks and boats, self-supporting bridges and houses. But in general, the whole attitude of the West is more scientific (as shown by its advanced products) than that of the East, where "the three Chinese divinities of the Past, the Present, and the Future" are "represented with the same heavy face." For example, compared to the great Electric Clock, the four hundred day clock, the waterproof clock, and a money-calculating machine in the Great Exhibition, the Chinese Exhibition presents only "a very curious porcelain box in the form of a crab, with movable eyes and feet." The Chinese still tell the time by having a watchman hit a bell with a mallet, burning a candle, or running sand or some liquid into a vessel. Surgical instruments, artistic works and musical instruments are compared and contrasted. The two exhibitions can be seen as "a comparison between Stoppage and Progress, between the exclusive principle and all other principles, between the good old times and the bad new times, between perfect Toryism and imperfect advancement."

[Dickens also wrote "The Chinese Junk," *Examiner*, 24 June 1848]

SCIENCE AT SEA

[William Blanchard Jerrold]; 9 August 1851; 3: 468-71; 4 1/2 cols.

The narrator believes he has learned the cause of sea-sickness and how to prevent it from James Atkinson's* paper ["On Sea-Sickness and Its Prevention"] presented to the British Association for the Advancement of Sciences in 1851. Atkinson's account is based

on a piece by M. J. Curie presented to the French Academy of Science. Curie explains the reason for sea-sickness as "the upward and downward movements of the diaphragm acting on the nerves of the brain" and recommends a way to cure it by following the billow's movements in breathing. The involuntary swinging and riding (in a moving carriage or on a boat) cause nausea. Therefore, he suggests that, sitting on board, one should hold a tumbler filled with liquid and try to prevent spilling it. In order to keep the glass horizontal, one's hand, arm and body will go through various movements--sawing, planing, pumping, throwing a quoit--and the passenger will feel as if he were performing them of his own free will. Thus nausea can be prevented. The narrator is convinced. He believes Curie is right about the phrenetic nerves. Then, on board a boat, he asks for a glass of water "for a scientific purpose," and feels "decidedly better." He announces that Atkinson's method is "decidedly a triumph," though he is regarded as "a very eccentric seaman" by the steward, and captain because in order to follow Atkinson's instructions, he must "roll about like a drunkard."

[CHIP:] VERY LONG CHALKS

[Charles Thomas Hudson]; 9 August 1851; 3: 472-73; 2 3/4 cols.

The author tries to make astronomical distances (such as that of the sun from the earth) more easily comprehensible to the ordinary reader, and asks such questions as how can it be of any use to say that the sun is nearly a thousand times larger than Jupiter, if one does not know how large Jupiter is. He goes on to explain light years, arguing that even a faint conception of what "huge and incomprehensible numbers mean" is better than "complete ignorance."

ICE

[W. H. Wills and Henry Morley]; 16 August 1851; 3: 481-84; 7 cols.

The author describes how ice-houses, for preserving ice, are made in different parts of the world, and how ice has been collected and kept at Chatsworth in Derbyshire. He then asks, "What is ice?" and answers with general knowledge about its freezing point, the temperature at which freezing begins, and its density. The article ends by quoting from Professor Ansted's* *Ancient World* (1847) [Ansted's book was in Dickens's Library], a description of the discovery of a mammoth about 1799-1806, at the mouth of the Lena in Siberia.

Pilgrim 6: 422 to W. H. Wills, 4 July 1851: "Paxton suggested to me, through Evans, a good subject. Ice, and why should its use be confined to great towns. How useful to the Farmer, for his butter and so forth--how easily an ice-house is constructed--and why *don't* [sic] he construct one, and have it filled on odd winter's days when his men are lounging about the stable door"; see also *Pilgrim* 6: 450.

OUR PHANTOM SHIP ON AN ANTEDILUVIAN CRUISE

[Henry Morley]; 16 August 1851; 3: 492-96; 8 cols.

The article is about time-travelling through the geological past when creatures we know only as fossils were alive. It is an imaginary cruise into the age of the Graptolites (a Silurian fossil which looks like writing on shale). If Mr. Wyld [see "The Globe in a Square" (11 July 1851; *HW* 3: 370-72) which is about James Wyld's "Great Globe"] had lived a hundred thousand years ago, he would have had to construct a model of the earth with the land and sea differently placed from where they are now. It refers to the Glyptodon and Megalotherium of South America, the Mylodon, the Macrauchenia, and the Diornia of

New Zealand. Monkeys, tigers, elephants, and mastodons were once found in England. Prehistoric creatures are described, such as those we can learn about from Hugh Miller's* *The Old Red Sandstone* (1841).

THE FLYING ARTIST

[Bayle St. John]; 6 September 1851; 3: 557-61; 6 1/2 cols.

A German inventor, Karl Herwitz, is said to have had "a marvellous talent for conceiving novel machines, often of practical utility," but his "soul was set upon perfecting a flying machine." He submits plans for a new machine to the Court of Konningen, where he is living with a large family, but is kept waiting for a decision while they all starve. He is helped by an Englishman. At last he turns to making use of his skill as an artist instead, and his fortunes change. Eventually he returns to the Court with the Englishman to reclaim his plans, which he has sold to a business firm represented by his friend, and continues to earn his living as an artist. A concluding moral to the story is drawn: help is willingly given to anyone who is practical rather than a "mere visionary."

Pilgrim 6: 475, to W. H. Wills, 31 August 1851: "I had no proof of the Flying Artist, until it was in the No. It is objectionable, I think, for reasons I will point out to you when I come to town."

[CHIP:] SEALS AND WHALES

[James Knox]; 6 September 1851; 3: 562-64; 4 1/2 cols.

Pointing out that many readers would only know about the seal (Latin name, "Phoca") through having read Scott's *The Antiquary* (1816), the author aims to "trace the records of

the *Phoca* through the denser chapters of the scientific compiler, and the Arctic voyagers." Most of the article discusses the whaling industry and the commercial value of seals, while the last paragraph describes the species of seals, their anatomy, physiognomy, and habits.

FORCE AND HIS MASTER [VERSE]

[George Meredith]; 13 September 1851; 3: 588-89; 1 1/2 cols.

The Giant power of Force is called on to serve his Master against his enemies, but warns that his mission is "to create," though he has "equal powers to destroy." If he is instructed to bring death, then of all his victims his Master "will be the first."

THE WORK OF THE WORLD

[Henry Morley]; 13 September 1851; 3: 589-92; 7 3/4 cols.

Apparently simple scientific discoveries may be important and have far-reaching consequences. This can be seen from Liebig's* *Familiar Letters upon Chemistry, and Its Relation to Commerce, Physiology, and Agriculture* (1843). The first example cited by the author is Nicolas Leblanc's* discovery of how to make soda from common salt. This itself required the development of the manufacture of sulphuric acid, helped by the discovery of nitrate of soda in Peru, from where it is imported. The cheaper production of sulphuric acid has brought improvements in glass manufacturing and the use of potash as a form of fertilizer. A by-product of sulphuric acid is muriatic acid, from which chlorine can be obtained, which is valuable in bleaching, as well as having other practical uses. Other branches of science, such as astronomy and geology, might claim to be equally useful.

The "real workers of the world" are scientists, researchers and inventors who make these advances, who show "quiet earnestness," as can be seen in what Liebig* says of Charles Giles Bridle Daubeny* and his quest for phosphate of lime in Spain. The scientific inquirer needs freedom of intellect, as Galileo demanded. The achievements of scientists can be contrasted with the mere "phantasm of glory" on "the battle-field."

[CHIP:] THE LATEST INTELLIGENCE FROM THE IRISH CALIFORNIA

[Percival Leigh]; 13 September 1851; 3: 595; 1 1/2 cols.

The article follows an earlier one on peat entitled "The Irish California" (4 January 1851; *HW* 2: 348-53), and gives the results of a report by Sir Robert Kane,* director of the Museum of Irish Industry. It gives a table of his results compared with those previously reported, showing what chemical and oils can be abstracted from peat. The director had given a cautious welcome to the possibility that the process might be made profitable: an idea supported by the article.

LIGHT AND AIR

[Henry Morley]; 20 September 1851; 3: 612-16; 6 1/2 cols.

The author attempts to explain changes made by light in the appearance of the sky, the nature of rainbows, why the sky seems blue, and the colours of the sunset. He explains the angles of reflection and incidence, and the nature of absorption and refraction, referring to the *Correlation of Physical Forces* (1846) by William Robert Grove.* He describes how light is made up of the prismatic colours, violet, indigo, blue, green, yellow, orange, and red. Air reflects light, especially its blue rays; but when the sun's rays pass through a greater

depth of atmosphere in the morning and evening they are inclined to appear red rather than blue. Further explanations are given of autumn sunsets, how the sky can show coming weather, why stars twinkle, and rainbows.

MAN MAGNIFIED

[Frederick Knight Hunt]; 27 September 1851; 4: 13-15; 4 1/4 cols.

The article is based on Dr. Arthur Hill Hassall's* *Microscopic Anatomy of the Human Body, in Health and Disease*, 2 vols. (1849). It picturesquely describes the appearance of skin, hair, fat and teeth seen through the microscope. It also speaks of blood and its components--white and red globules. Summing up the structure of a human body, the article concludes that "there is an obvious code of morals plainly indicated" by "the author of all things": for example, teeth and skin need careful cleaning, and blood that is too white or red warns us against gluttony or "indolence and innutrition."

[Hassall's book is dedicated to Thomas Wakely (1795-1862) who was admired by Dickens (see Forster 1: 131), was a reformer, the founder of the *Lancet*, 1823-, in which he issued the results of analyses of food-stuffs in general consumption. His uncompromising attack on food adulteration led to the adulteration act of 1860].

[CHIP:] A BIRD-HUNTING SPIDER

[Thomas Satchell]; 4 October 1851; 4: 45-46; 3 cols. [should read 2 1/4]

At the end of the seventeenth century Madame Merian* published in Holland the results of her studies of insects and vegetables in Surinam. Her writings were said to include "many inaccuracies and seeming fables" but also valuable things unknown to

European naturalists at that period. One of her illustrations was of a large spider carrying off a humming-bird. Linnaeus* called the spider (belonging to the genus *Mygale*) "avicularia" (bird-eating). The author himself once saw a huge forest spider snatch a fledging humming-bird to eat, thus confirming Madame Merian's account. He humorously concludes that one of Nature's laws is "Eat the eater."

[CHIP:] EYES MADE TO ORDER

[William Blanchard Jerrold]; 11 October 1851; 4: 64-66; 2 3/4 cols.

"Science has so far come to the aid of human nature" that people will come to have wigs, artificial teeth, artificial noses, artificial limbs etc., indistinguishable from real ones. Auguste Boissonneau of Paris has invented artificial eyes with plastic caps individually modelled on his patients' diseased eyes [described in "Recherches sur l'histoire des yeux artificiels," *Bulletin de la Société de Médecine de Gand* 12 (1843): 125-49]. They are fitted by "scientific workmen"; and the result is that the artificial eyes no longer look fixed and dead but move freely.

[CHIP:] ANIMAL AND VEGETABLE DISGUISES

[Thomas Satchell]; 18 October 1851; 4: 92-94; 2 1/4 cols.

We often find a likeness between animals and plant life. In South America there is a "Tiger Bird," "Tiger Fish," and "Tiger Wood," all yellow-coloured and similar in shape to the jaguar. Many plants can be found that resemble insects, or vice versa. There is the bee-orchis, for example, whose flower is like the bee; and there is an oval beetle that looks like

hemlock seed. Many insects from Guiana similar to plants and seeds can be seen in the section at of the Crystal Palace, where the productions of Guiana are exhibited.

BALLOONING

[Richard H. Horne]; 25 October 1851; 4: 97-105; 16 cols.

This article gives a history of man's attempts to fly. At first, he tried to do so with the help of "machinery" such as feathered wings, and then he turned to balloons with the help of chemistry. The first inventor of the balloon is said to be Joseph Black,* who filled a large envelope with hydrogen in 1767. Then the Montgolfier brothers* united theory and practice in their hot air balloons, with encouragement from the Academy of Science, Pilâtre de Rosier*, and the Marquis d'Arlande. How they improved their balloons, with the discoveries of Professor Jacques Charles* and many others, is described. A vivid account of the experience of ballooning is given. Finally the author turns to talk about parachuting and balloon accidents, drawing on Charles Green's* experience, and looks at the future of ballooning.

Pilgrim 6: 508-509, to W. H. Wills, 6 [October] 1851: "In Horne's ballooning, always insert 'Mr.' before 'Green.' Also insert 'Mr.' before 'Poole,' and call him the well-known Author. At the end of the third paragraph from the commencement, instead of 'fanatical sentence was carried into execution',--read 'Sentence of the Holy Catholic Church was carried into Christian execution.'"

THE TRUE TOM TIDDLER'S GROUND

[Henry Morley]; 27 December 1851; 4: 329-32; 5 1/2 cols.

The article is about the uses that peat can be put to, commercially, by its large-scale use for fuel, as a source of charcoal, and for sanitary purposes.

NEW DISCOVERIES IN GHOSTS

[Henry Morley]; 17 January 1852; 4: 403-6; 6 3/4 cols.

The article begins by talking in a large way about the new discoveries that can be made through science; but then gossips about man's latent powers. It turns to a book by Baron Reichenbach* [*Researches on Magnetism, Electricity, Heat, Light, Crystallisation, and Chemical Attraction, in their Relation to the Vital Force* (1850), translated by Dr. William Gregory]* about people who are "sensitive."

CHOICE SECRETS

[Henry Morley]; 21 February 1852; 4: 521-24; 6 cols.

The article is about so-called the scientific beliefs of the remote past drawn from Hans Jacob Weckir's* *Eighteen Books of the Secrets of Art and Nature, being the Summe and Substance of Natural Philosophy, Methodically Digested* (1661). Superstitions such as "scientific information on the subject of Angels and Devils," or old beliefs about telling the fortune by stars are described. Finally the author suggests that we must now take this kind of old book away.

THE CAMERA-OBSCURA. A SUNDAY MORNING LECTURE [verse]

[Richard H. Horne]; 20 March 1852; 5: 11-12; 1 3/4 cols.

A poet is at the seaside looking at scenes through a camera obscura. It gives him a "strange pleasure, like a novel sense/ Derived from Art and Nature--Science, Sight--/ Which God permits, in His munificence." The device enables him to see the world with different eyes: "It is a new planet-surface we behold."

Pilgrim 6: 640, to F. M. Evans, 10 April 1852: "You know perhaps that he [R. H. Horne] has written some remarkable Poems in H. W.--as the Electric Telegraph, the Christmas Carols, the Camera Obscura, and so forth."

MORE DUMB FRIENDS

[Richard H. Horne]; 24 April, 1852; 5: 124-27; 6 1/4 cols.

This is about communication between animals. It refers to William Henry Harvey's* *The Sea-Side Book; Being An Introduction to the Natural History of the British Coast* (1849) which mentions the non-linguistic communication between creatures, Jonathan Couch's *Illustrations of Instinct, Deduced from the Habits of British Animals* (1847) which explains a common understanding of certain primitive sounds among all creatures, a description of blackbird imitating a cock in *Loudon's Magazine of Natural History and Journal of Zoology, Botany, Mineralogy, Geology and Meteorology*, and Pliny's observation of the way young nightingales imitate the elder bird's song. Yet Thomas Brown [perhaps Rev. Thomas Brown (1791-1875; *Boase*), author of English dictionaries and grammar books] holds that the linguistic power of mankind comes from imitation rather than linguistic instinct. The author, Horne, then quotes from his own "charming book *The Poor Artist; or Seven Eyesights and One Object*" (1850) about varied kinds of vision and organs of taste in different species.

Pilgrim 6: 636, to R. H. Home, 6 April 1852: "Wills had faithfully reported to me concerning the Poor Artist. I am only delighted to have an opportunity of referring to so excellent a book."

ONE OF THE EVILS OF MATCH-MAKING

[Henry Morley]; 1 May, 1852; 5: 152-55; 7 cols.

A review-article in the *British and Foreign Medico-Chirurgical Review* [Review of *The Disease of the Workmen employed in Lucifer Manufactories, and Especially the Affection of the Maxillae, Produced by the Vapours of Phosphorus, Considered in their Chemico-physiological, Medico-chirurgical, and Forensic Relations* (Erlangen, 1847), by F. Ernst von Bibra and Lorenz Geist, April 1848] reported fifty two cases of a disease caused by fumes from phosphorus used in making matches. Before 1848, that there have been recorded one hundred and fifty cases in the twenty years since making Lucifer matches began. Symptoms at different stages of the disease include tooth-ache, scrofula, and jawbone decay. It is sometimes fatal. The writer for the medical review had reported a visit to a London Lucifer-match factory where workers wore sponges on their mouths and there was a system of ventilation to prevent the illness; even so fourteen cases of the phosphorous disease were reported in the factory. The author then visited another isolated factory, run by Messrs. Bell and Black at Bow (where there is more space and air than in crowded town factories) and where the workers are healthy. He goes on to discuss how the demand for matches varies at different times in the year, and how this affects the quality of match bought by customers.

THE HUNTER AND THE STUDENT

[Richard H. Horne]; 1 May 1852; 5: 157-62; 10 1/2 cols.

Books on zoological subjects may be separated into two classes: books by those who hunt and kill, and books by those who observe and study--the former has the passion to chase and to destroy, the latter, the pleasure of preserving. The author tells stories to illustrate this distinction. He classes Gordon Cumming [Roualeyn George Gordon-Cumming (1820-66; *DNB*), Africa lion-hunter] and Sir William Cornwallis Harris* as hunters, while Gilbert White* of Selborne, Professor Owen,* the Rev. Leonard Jenyns* (the author of *Observations in Natural History*, 1846), and Rymer Jones,* the latter. The compiler of the recently published *Zoological Notes and Anecdotes* (1852) [William White Cooper*] quotes an account of giraffe hunting from William Cornwallis Harris's [(1807-48, *UC*), traveller] *Portraits of the Game and Wild Animals of Southern Africa* (1840) who calls it a "spirit-stirring adventure." Harris's experience of killing a harmless giraffe is ruthlessly described. Yet the author wonders that those such as Harris who have the excitement of the chase, should have the self-controlled enthusiasm of the scientific observer and student of nature, and at the same time, should also have feelings for the animals. On the other hand, he regard Jenyns as a follower of White: both have the "out-of-door" naturalists' qualifications such as indefatigable search and observation, and the "in-door" naturalists' laborious and patient examination. He goes further telling stories from books by Jenyns,* Jones's,* Thomas Bell* and one called *The Poor Artist* (1850) about animals saving life.

Pilgrim 6: 646, to R. H. Horne, 18 April 1852: "I think the subject a very good one..., but have no ambition to take it from you; having already several on my list. Will you therefore pursue it?"

STONE PICTURES

[George A. Sala]; 8 May 1852; 5: 176-81; 9 1/4 cols.

It is the story of the inventor of Lithography, Aloys Senefelder, whose life was a struggle. The narrator at first mentions other inventors such as the inventor of waterproof material, Macintosh, Daguerre,* Claudet, the inventor of the safety-lamp, Sir Humphry Davy* and people whose lives are filled with legends, including Newton, Franklin, and the inventor of camera obscura, Benjamin West. Then account is given of how Senefelder discovered the limestone, the chemical principle of lithography, and the process of producing stone-picture.

SNAILS

[Richard H. Horne]; 29 May 1852; 5: 240-44; 7 cols.

William Slitherhouse, a retired clockmaker, turns to the study of the natural history of snakes. He observes the creatures in his own garden, studies the authority, Lovell Augustus Reeve's* book [*The Conchologia Iconica Nomenclator* (1843-78)] and pamphlet, *On the Geographical Distribution of the Bulimi, a Genus of Terrestrial Mollusca; and on the Modification of Their Shell to the Local Physical Condition in which the Species Occur*. Information about how snail families are distributed over the globe, different species, different patterns of the shells, their eggs and so on. He then imagines going to the Phillipine Islands to make discoveries and collections, like the conchologist Hugh Cuming* had done before.

SUBMARINE GEOGRAPHY

[Henry Morley]; 29 May 1852; 5: 246-48; 5 3/4 cols.

In 1849, the vessel "Fancy" was employed by Lieutenant Maury* to carry out his investigations into the winds and the waves. He also studied the temperature of the ocean with "deep-soundings." In the next year, a Commander Plate was to do the same north of the Equator. Though his ship was damaged by the sea, there were some results, including proof that some supposed rocks in the official charts did not exist, and the discovery of a current moving in a direction opposite to that on the surface. Later expeditions proved satisfactory. The author also mentions other deep-sea soundings in 1851 and gives details of the results. He urges the British government to explore the Indian Ocean. He believes that accurate knowledge of currents in the Pacific could help to shorten the voyage from Calcutta or Hong Kong to London.

WHAT IS TO BECOME OF US?

[Edmund Saul Dixon]; 26 June, 1852; 5: 352-56; 9 3/4 cols.

It is about coastal erosion in North Norfolk where the land is eaten away by the sea. The author argues that something should be done about it: coastal defenses may be built in the form of groins or lower cliffs with a seaward-facing stone wall, and other measures may be taken. The author looks at the threat from erosion from the geological point of view. He is aware of the geological changes in the nineteenth century, and able to describe the cliffs in geological terminology.

A FLIGHT WITH THE BIRDS

[Henry Morley and W. H. Wills]; 10 July 1852; 5: 381-84; 6 1/2 cols.

The article is a review of Edmund Saul Dixon's *The Dovecote and the Aviary: Being Sketches of the Natural History of Pidgeons and Other Domestic Birds in a Captive State, with Hints for Their Management* (1851), a book on guans, curassows, cassowaries, emus, mostly birds from south Africa and Australia. It explains why they are difficult to acclimatise in Europe. "Science has shown to our wondering eyes in a very remarkable manner, the actual form and structure of bird which has never been seen." A gigantic and perhaps extinct bird, the *dinornis*, is mentioned. A huge bone of such a bird from New Zealand has been brought to the College of Surgeons and examined by Professor Owen* who built up from such bones an idea of the extinct animal. He concluded that the bones had marrow instead of air like other birds, and hence it could not fly. The narrator jokingly says that if a real live *dinornis* can be found and brought to the Zoo, it would arouse great excitement and the hippopotamus could retire.

ANIMAL MECHANICS

[Kelly]; 10 July, 1852; 5: 398-400; 4 cols.

Dr. Neil Arnott's* *Elements of Physics; or, Natural Philosophy, General and Medical, Explained Independently of Technical Mathematics*, 2 vols. (1829) is about the structure of the human body; it explains, for example, that the knee-joints are held together by about sixty pounds weight of atmospheric pressure. Yet he did not explain the relation between the fact that every inch of the body's surface sustains fifteen pounds pressure, and that between the articulating surfaces of bones there is no elastic medium to counteract it. Soon after Arnott's book was published came Sir Charles Bell's essay, "Animal Mechanics." Both

works are valuable contributions to "the Mechanical School of Physiology" (derived from Baglivi) . . . which combines the principles of physical and biological science. There is some discussion of the relation between the two fields, and the author complains that: "Science suffers from this want of reciprocal commerce between its votaries." Arnott and Bell have shown that long bones are like hollow cylinders, but they failed to show their purpose and the structural use of the marrow. An observer of the cosmos and thinker about the creation of the world named Ephraim Jenkinson, has long puzzled over the use of the marrow and found that it serves to increase the rigidity of the bone and increase the bone's ability to resist strain. The principle is the same as the law of hydrostatics that a pressure exerted on any part of a mass of fluid is immediately transmitted through every other part. The article compares animal bones with those of birds; the air cavities lessen the pressure of gravity on the birds and support their lungs in supplying aerated blood. The article concludes by wondering if these "natural contrivances" could be adapted to mechanical use.

[CHIP:] HEALTHY FIGURES

[Henry Morley]; 21 August 1852; 5: 535-37; 4 cols.

The study of Edouard Mallet [(1805-56; UC), *Du recrutement de la population dans les petits démocratiques avec esquisse historique et statistique sur l'admission d'étrangers et la naturalisation dans la république de Genève* (Geneva, 1851)] about the population of Geneva from 1549 to 1833, already published in *Annales d'Hygiène Publique*, has been translated into English in the journal of Statistical Society. It shows the remarkable longevity of the people of Geneva, and how improvements in house, food, and habits have changed the average duration of life.

[CHIP:] OUR OWN TEMPERATURE

[Henry Morley]; 18 September 1852; 6: 11-12; 1 1/2 cols.

The article reports on two papers about the temperature of humans, read to the Royal Society by Dr. John Davy,* the Inspector-General of Army Hospitals, ["On the temperature of man," and "On the temperature of man within the tropics," *Phil. Trans.* (1845): 564-65 and (1850) 437-46]. The average temperature of a human body is 98.4 degrees Fahrenheit; in the morning, the temperature is above average but gradually cools down to average, and before bed-time it is below average in England. The rules are reversed in the tropics because of the differences in air temperature and physical activity. Davy found that mental exercise, such as writing or study, and drinking wine and eating, can also influence our temperature.

[CHIP:] FAIRY RINGS

[Henry Morley]; 25 September 1852; 6: 34-35; 2 1/2 cols.

"Science, some years ago, used to be only another word for prose": whenever an unusual phenomenon was observed, science would provide rational explanation. Science has now "blotted out the scenes created by fancy." For example, it is found that Rainbows are mere "refractions of sun's rays from the agitated spray"; and that the Fairy Rings are caused by electric sparks and fungi. The author finds the interplay of electricity and fungi poetical: "Science . . . is in fact more poetical than all the nine Muses put together." Experiments by Crosse and others demonstrate how electricity can initiate vigorous growth in vegetation and also give rise to fairy rings. As supporting evidence, the author mentions an anecdote reported in no. 59 of the *Quarterly Review* (30 October 1823, p. 15) in which Dr. Timothy Dwight* describes how a thunderbolt in Virginia simultaneously killed a man

and struck a tree ["Travels in New England and New York"]. When the corpse was examined, "it was found that the tree was delineated upon it in miniature; the surrounding part of the body being livid, but that which was covered by the tree of its natural colour." Dwight admits that this seems "improbable and unphilosophical," but the author says that the anecdote confirms the theory of Crosse and others that an intervening object can stop the flow of electricity.

[CHIP:] WHOLESALE DIVING

[Edmund Saul Dixon]; 9 October 1852; 6: 76-81; 9 1/2 cols.

The author has visited the French inventor, P. A. Payerne* to see his diving boat at Cherbourg. It is built of iron, in the shape of a crustacean with an air-bladder. Its appearance and function are described: it "floats by means of the compressed air contained in the reservoir at each end, aided by the air in the central chamber" and it sinks when water is injected by means of a forcing pump and ballast. "It is the principle of ballooning applied to the ocean, instead of to the atmosphere." Sufficient oxygen for the divers can be produced by using quick-lime and potash mixed with alkaline solution. Dr. Payerne once did experiments on the purification of air at the London Polytechnic Exhibition in 1842. Payerne's invention of the diving boat led him to discover how to clear air of an excess of carbonic acid. The diving boat is judged to be an improvement on the diving bell, and the author predicts that the diving boat might be the first stage in the development of a "submarine locomotive steamer."

PENNY WISDOM

[George Dodd]; 16 October 1852; 6: 97-101; 8 1/2 cols.

Modern manufacturing processes produce a great deal of waste, and commercial refuse is being re-cycled to create many useful products as shown in the Great Exhibition. The author links together observations about iron: how iron has been used in Germany to make children's "slates" or "paper" for books; how fuel can be saved in smelting iron, as reported by Palmer Budd to the British Association at Swansea, 1848 ["On the Advantageous Use Made of the Gaseous Escape from the Blast Furnaces at the Ystalyfera Iron Works"] and at Edinburgh, 1850 ["Notices and Abstracts of Communications to the British Association for the Advancement of Science at the Edinburgh Meeting, July & August 1850"]; and how the best steel for rifles comes from old horse-shoes. The by-products from making gas from coal include such things as smelling salts, benzole, varnish and naphthaline, already discussed in "[Chip:] Gas Perfumery" (28 June 1851; *HW* 3: 334). William Brockeden* uses plumbago dust from an exhausted plumbago mine in Cumberland to make pencils. Hugh Lee Pattinson* is able to extract silver from lead, the silver being used in the manufacture of tea services and similar objects. Other examples of various by-products are chlorine for bleaching, produced from sulphuric acid, and the use of "small coal" when coal of better quality is not available. There are many more descriptions of how much can be made from apparent "waste," including the discovery by the jurors of the Great Exhibition (Warren De la Rue,* Dr. August Wilhelm Hoffmann,* and Dr. Lyon Playfair*) that unscrupulous chemists used oils, acids and chemicals to produce perfume sold as the distillation of fruit and flowers. Making sugar from beet is a further example. The author observes that "Chemistry is indeed Nature's housewife, making the best of everything." His miscellaneous and descriptive account concludes by quoting from one of Playfair's lectures on chemistry.

Pilgrim 6: 774, to W. H. Wills, 7 October 1852: "insert Penny Wisdom (which is very interesting and good) in its stead." [It is to replace the first instalment of Horne's "A Digger's Diary" (29 January 1853; *HW* 6: 457-62)].

POISONOUS SERPENTS

[Richard Owen]; 6 November 1852; 6: 186-88; 6 cols.

On 21 October one of the reptile-keepers at the London Zoo was bitten by a Cobra-de-Capello and died. The structure of the poison-fang is described, including how muscles operate to convey the poison, and the speed of its action once a victim has been bitten. Chemical analysis of the fluid produced by the snake shows that it consists of nothing more than mucus, water and salts of saliva which in themselves are not poisonous when taken into the stomach but which prove fatal to the brain and nervous system. Dr. Patrick Russell* in his *An Account of Indian Serpents*, 2 vols (1796-1801) mentions that poisonous snakes who bite their own species do not fatally harm each other; he also gives some remedies. The author corrects false reports of this fatal accident that were published in the *Morning Advertiser* and a medical journal. He relates in detail the correct account that appeared in the *Times* (13 October): the coroner's inquest revealed that the keeper's carelessness was the result of intoxication.

Pilgrim 6: 376, to Professor Richard Owen, 7 May 1851: "Both your proposals are most delightful to me, especially the Zoological one. A perfect storm of letters of introduction rising in all quarters of the earth and bursting on my devoted head, obliges me to take a house at the seaside, and let this until the Exhibition is over. But we shall pitch a gipsy tent at the Household Words office next week, and I shall then come round to you and bring Mrs. Dickens along with me."

Pilgrim 6: 779-80, to Professor Richard Owen, 19 October 1852: "I am just home again for the winter, and saw Forster last night. He perfectly overwhelmed me with delight by telling me you had intimated to him that you might sometimes find leisure to write some familiar papers on Natural History, yourself, for the Journal."

Pilgrim 6: 790, to Professor Richard Owen, [?19-30 October 1852], referring to "Poisonous Serpents."

MECHANICS BY INSTINCT

[Mrs. Hoare]; 4 December 1852; 6: 278-81; 4 1/2 cols.

Spiders knew how to make doors for their dwellings before human beings did. The French naturalist Ferdinand Berthoud* has described how a species of aquatic spider is also able to make a diving-bell, like a purse filled with air which is closed, except for an opening just big enough for the small spider. Berthoud discovered how spiders living underwater can breathe, dive and catch their prey: "Her Maker has taught her how to solve a problem which would have baffled the genius of Newton." It is suggested that the spider's diving bell may have inspired Robert Fulton's* idea for constructing submarines in 1804, but Fulton's invention had to wait for completion until P. A. Payerne invented the diving boat (see "Wholesale Diving," 9 October 1852; *HW* 6: 76). The author gives other examples from Berthoud of the wonderful instincts to be found in the animal world: a kind of bird called the "Rupubcan Sparrow" at the Cape of Good Hope can build a square nest with two hundred compartments in a tree, where its family and companions live together like communists with their own social order; a species of heron makes a nest resembling Roman arches; and animals that inhabit the arid sands of Africa have known for centuries how to excavate soil to find water. Ferdinand Berthoud,* on a mission to Algeria in 1848, discovered how by using its sense of smell a hyaena could find water in the desert. The account ends by referring to a pet hyaena sent to the London Zoo which could still recognise its master when he returned many years later.

JUSTICE TO THE HYAENA

[Richard Owen]; 1 January 1853; 6: 373-77; 8 3/4 cols.

A hyaena with impressively powerful jaws at the London zoo is described. At the Hunterian Museum, the author [Owen himself] meets the Hunterian Professor of comparative anatomy, Richard Owen, who examines a hyaena's skull and teeth and compares hyaenas from different countries. Owen calls the bones above the cheeks "zygomatic arches," and draws attention to the biting muscles. The dental system of the hyaena is described, including its flesh-teeth and tubercular teeth which are like a lion's. But the lion is compared to the eagle, and the hyaena to the vulture because its prey is not usually living. Detailed accounts are given of its toes, claws, ears, and colour. Finally we hear about its general behaviour; and that hyaenas are like winged scavengers who clear away what larger carnivores have killed and left half-eaten. Hyaenas sometimes eat human flesh. Earlier studies are mentioned, including stories of hyaenas said to be as obedient and teachable as dogs. An account from the *Zoological Proceedings* (1833, p. 76) is quoted about an Indian hyaena in the zoo which was "as gentle as a spaniel."

Pilgrim 7: 124-5, to W. H. Wills, 5 August 1853: "'Justice to Bears.' The name won't do. We have already had 'Justice to the Hyaena.'"

WHAT SAND IS

[Edmund Saul Dixon]; 15 January 1853; 6: 422-27; 10 cols.

There are different kinds of sand, such as the desert sands on the Isthmus of Suez, the silver sand of Berkshire, the greasy sand on the French coast between Capes Blanez and Grisnez, micaceous sands, golden sands, green sands (which consist of silicate of iron from the Isle of Wight) and so on. In general, sands are formed from broken shells and rocks. The author looks at sea sand from the Norfolk coast that contains a variety of mineralogical materials such as cornelian, quartz, silex, and microscopic creatures. He says that readers will see a "second course of sea-side gossip" on the history of the sandy beach in Norfolk.

He talks about the movement of the sea and the tide in forming sand and estimates three miles an hour as the rate of the current that carried sand eighteen miles away from its original location. He suggests that no sand would be found in outer space or on a new planet, because it takes so long for winds, rains and rivers to grind down sand. Interestingly, sand made from shells can be hardened into marble and display traces of waves, rain-drops, and the footsteps of birds. Yarmouth was originally sand in the sea which gradually rose above water and became dry land. The excavations for draining the town in 1851 revealed its sandy stratum. John Warden Robberds'* *Scenery of the Rivers of Norfolk* (1834) has proved that the wind has caused recent changes there. The rest of the article is on Great Yarmouth--historical accounts of its formation, the migration of herrings, the famous herring-boats (Yarmouth yawls) and the shrimp boats. The article is a sequel to "What is to Become of Us?" (26 June 1852; *HW* 5: 352-56), on the erosion of England's coastline.

INFORMATION AGAINST A POISONER

[Henry Morley]; 15 January 1853; 6: 427-30; 6 1/4 cols.

Malaria was first identified by the Italian physician, Giovanni Maris Lancisi,* in 1695. It exists only in hot climates and is produced by marshes, fens and badly-drained ground. Dr. William Ferguson* has proved that malaria can exist without either decaying vegetable matter or vegetation, that it can be spread by the wind, and that it seems to lose its effectiveness over water, as when people travel by sea. While many of Ferguson's findings and anecdotes are included, Morley says that his article is based on information given in lectures on malaria by a Dr. Watson [J. Forbe Watson (1827-92; *UC*), wrote on India].

SELF-ACTING RAILWAY SIGNALS

[Henry Morley]; 12 March 1853; 7: 43-45; 4 cols.

The author explains the technical invention of "Crowley's Safety Switch and Self-Acting Railway Signals" by Jonathan Crowley which makes use of a simple electro-magnet, and compares it to Joseph Whitworth's* invention of signals about which Morley had written in "Need Railway Travellers Be Smashed?" (29 November 1851; *HW* 4: 217-21). The new invention simply consists of a small lever fixed to the rail and connected to an electro-magnet which can close all switches or junctions coming into a station at the approach of a coming train. It is possible to release the switch, while the train is in the station, if any carriages need to be added. The device, in the station itself, powered by a voltaic battery, could also operate danger signals at the station. The switch and signals are clearly described. The slight expense of adopting Crowley's device would be much less than the present tremendous cost of compensating passengers injured in the many accidents now caused by the neglect of railway signals.

PHOTOGRAPHY

[Henry Morley and W. H. Wills]; 19 March 1853; 7: 54-61; 13 1/2 cols.

"English photographers have thrown as much light of their own on the new sciences as any of their neighbours." The article traces the development of photography from the experiments of Sir Humphrey Davy* to the discovery of how to fix images illuminated by light onto glass and other substances made by Fox Talbot* in England and, simultaneously, by Louis Daguerre* and Nicéphore Niepce* in France. The process of accelerating the preparation of the photographic plate by dipping it in a vapour bath of chloride of iodine and then chloride of bromine was invented and patented by Claudet* and announced at the

Royal Society and the Académie des Sciences. The chemical processes involved in taking and developing a photograph are described, together with the applications of photography to the stereoscope and the contributions of a Mr. Mayall, Professor Wheatstone* and Sir David Brewster.*

SILKEN CHEMISTRY

[John Capper]; 9 April 1853; 7: 129-31; 3 1/2 cols.

Silk for dealers or manufacturers is adulterated by the addition of substances such as gum or sugar to give it weight. In Britain silk spinners or weavers have not sought the aid of chemists because of their indifference to science; but in France, chemists have been able to analyse silk's relative purity, strength, elasticity, durability, structure, and the size and weight of each fibre with precision, and have shown manufacturers the most profitable use of raw silk. In many parts of the continent, there are "conditioning houses" which officially assay silk; for example, in France in 1841 the weight-limit which silk loses by the conditioning process was set at 11 %. A similar system has now been introduced in London, and the author describes a visit to an institution in Broad Street Buildings in the city: "Science has established herself where humbug so recently sat enthroned." Like their French counterparts, these offices test the silk, measuring its humidity (11 %), the amount of foreign matter in it (up to 32 %), its length (400 yards), and its fineness, elasticity, and lustre. British manufacturers, instead of working in the dark and by chance, can now work "by chemical rules of undeviating correctness."

CHLOROFORM

[Henry Morley]; 23 April 1853; 7: 179-81; 3 cols.

A recent sudden death because of chloroform in a London hospital raises the subject dealt with earlier in "Some Account of Chloroform" (10 May 1851; *HW* 3: 151-55). A historical survey is given of anaesthesia. In the nineteenth century, many attempts were made to find a compound more satisfactory than ether, but no one succeeded until Dr. Simpson of Edinburgh published his paper on chloroform. Simpson "stands alone as the establisher of Chloroform in the position which it now holds in the medical profession." The author then takes up the question of the safety of chloroform as shown in recently published tables for the past five years, explaining that the data show that mortality in major surgical operations has been much reduced. Like the railways, chloroform is a blessing, but both need to be used with care. In his final paragraph, the author criticises the irrational superstition in some people that chloroform might kill them.

FOUR-LEGGED AUSTRALIANS

[Samuel Rinder]; 30 April 1853; 7: 208-14; 12 cols.

The author has returned to England after a long residence in Australia, and for the benefit of intending emigrants, gives a vivid account of the native animals, intermingled with personal anecdotes drawn from his time as a shepherd, and his experience of Tasmania, New Holland, and New South Wales. Most of his article focuses on several species of marsupials, animals native to Australia. He disclaims being a naturalist, but gives very detailed descriptions of the animals, confidently uses Latin names, refers to authorities such as Cuvier and Owen, and ends by mentioning the existence of fossil remains, including those of mammoth elephants.

A PUFF OF SMOKE

[Henry Morley]; 7 May 1853; 7: 234-35; 2 1/4 cols.

The article is about tobacco, but it is noted because it describes the material used to make meerschaum pipes in the language of the chemist, "MgO, SiO₃ + HO" meaning "hydrated silicate of magnesia." This is the first time a chemical formula appears in *Household Words*. The process of smoking and the mouth-piece of amber are described. Readers are told that there are lectures about cigars in the Great Exhibition. The author also surveys tobacco smoking in other countries, snuff-taking in Ireland and Scotland, and describes the manufacture of cigars in Cuba and London.

A CENTURY OF INVENTIONS

[George Dodd]; 18 June 1854; 7: 376-70; 7 1/4 cols.

This is a review of the latest edition of *A Century of the Names and Scantlings of Such Inventions* (1663) by the Marquis of Worcester. The reviewer considers the inventions to be "the practical application of science to useful purposes," and among those he mentions are Charles Babbage's* calculating machine, the electric telegraph, Robert Fulton's* torpedo, different kinds of cannon and guns, automated figures and steam engines.

OVER THE WATER

[Edmund Saul Dixon]; 23 July 1853; 7: 483-88; 10 cols.

The article describes the successful balloon journey by the French aeronauts Jean Pierre Blanchard,* and John Jefferies* from France to England in 1785. The flight is discussed in

the context of the balloon ascent of the Montgolfier brothers* two years before, and reports how Blanchard and Jefferies devoted themselves to the study of aerostatic science. Further details about the course of this balloon and other flights can be found in Jefferies' letter in the *Annual Register* (1785) and Colin Mackenzie's *One Thousand Experiments in Chemistry, with Illustrations of Natural Phenomena, and Practical Observations on . . . Processes . . . pursued in the . . . Cultivation of the Useful Arts* (1821). Dixon also mentions Blanchard's wife, herself a famous aeronaut, who died during her sixty-seventh ascent in 1819. The article is not about aeronautics but details anecdotes about aeronauts. *Pilgrim* 7: 124, to W. H. Wills, 5 August 1835: "In the first place the No. is an awfully and solemnly heavy one--and, if you have any kind of means to that end by you, must really be lightened. I read it last night, and had a Nightmare. I doubt if anything so heavy (except stewed lead) could possibly be taken, before going to bed."

THE MIND OF BRUTES

[Edmund Saul Dixon]; 13 August 1853; 7: 564-69; 11 cols.

Alphonse Toussenel's* *L'Esprit des bêtes* (Paris, 1853) is "one of the most remarkable works on natural history." In his book, Toussenel aims to supply "an enormous gap in science." His philosophy about the origin of animals and his belief that God decides the destiny of his creatures are described. Information about moles, rats, bats and their characteristics is given from the book.

BROTHER BRUIN

[Edmund Saul Dixon]; 20 August 1853; 7: 577-82; 11 1/4 cols.

The article continues to give information about bears, based on Alphonse Toussenel's* *L'Esprit des bêtes* (Paris, 1853). How bears hunt, eat, and mate, and some of their peculiar characteristics, such as their dislike of blood, are discussed.

Pilgrim 7: 124-25, to W. H. Wills, 5 August 1853: "In the first place the No. is an awfully and solemnly heavy one--and, if you have any kind of means to that end by you, must really be lightened. I read it last night, and had a Nightmare. I doubt if anything so heavy (except stewed lead) could possibly be taken, before going to bed./ 'Justice to Bears.' The name won't do. We have already had 'Justice to Hyaena.' 'BROTHER BRUIN' would be a capital name, I think--thus introduced:/ 'The bear symbolises savage and primitive equality, and is therefore the aversion of the aristocracy.' Such is the clue to ursine facts, according to *Passional Zoology*, which subject, and M. Toussenel's treatment of it, we now resume . . . it wants to be made clearer all the way through, that it is M. Toussenel who is speaking, and not *H. W.* conducted by C. D."

THE STEREOSCOPE

[Henry Morley and W. H. Wills]; 10 September 1853; 8: 37-42; 10 1/2 cols.

"There is a good deal of romance to be found even in the details of pure science," and the invention of the stereoscope is "one of the most beautiful little discoveries that grace the science of our day." Professor Charles Wheatstone's* discovery of the stereoscope had been alluded to in Herbert Mayo's* *Outlines of Physiology* (1827), and Wheatstone himself in 1838 described in detail both the stereoscope and his theory of binocular vision in his paper read to the Royal Society, and at the Newcastle meeting of the British Association, 1838 ["On Binocular Vision; and on the Stereoscope, an instrument for illustrating its phenomena"]. His invention was highly praised by Sir David Brewster* and Sir John Herschel* as both beautiful and useful. Almost immediately, and with the help of

Fox Talbot,* the stereoscope contributed to the rapid development of daguerreotypes (including in 1839 Armand Fizeau [Fizeau]* and Antoine Claudet's* work on a single-image process using mercury vapour and an iodinesensitized silvered plate, first invented that year by Louis Daguerre*), and other applications made by Quetelet* and Brewster.* A detailed account is given of how Wheatstone developed his instrument and for what purposes, and of the notion of stereoscopic vision (how each of our eyes sees the same object from two different perspectives). In fact, the authors must have found it hard to explain something so technical, and keep it interesting. The picturesque touches, the elaborate descriptions of Wheatstone's experiments (such as a demonstration of the vision of cubes in mirrors and that of two colours and optic axes), and the embellishment in the opening passage do not make for clarity or liveliness.

Pilgrim 7: 124-26, to W. H. Wills, 5 August 1853: "In the first place the No. is an awfully and solemnly heavy one--and, if you have any kind of means to that end by you, must really be lightened. I read it last night, and had a Nightmare. I doubt if anything so heavy (except stewed lead) could possibly be taken, before going to bed The 'Stereoscope' is dreadfully literal. Some fancy must be got into the No. if John writes an article for it himself (I mean our John [Dickens's servant, John Thomson]: not Forster). I should have thought the greater part of it written by McCulloch [John Ramsay McCulloch, the statistician], edited by Rintoul [Stephen Robert Rintoul, a journalist known for exact journalism]."

A BRILLIANT DISPLAY OF FIREWORKS

[George Dodd]; 10 September 1853; 8: 45-48; 6 1/2 cols. [should read 7 1/2]

At one of the London pleasure gardens offering firework displays the author meets a pyrotechnic expert who explains many "important principles in chemistry, optics and

dynamics." He describes the principle of fireworks. "Explosion itself . . . is a chemical phenomenon" that happens on the combustion of the three major inflammable ingredients of fireworks (nitre, charcoal and sulphur) when combined with other substances such as metal filings and various chemicals. The said substances turn into gases, which need much more space, and the violent displacement of the air creates a noise and an explosion. In addition to the laws of chemistry, an account of the "laws of dynamics or mechanical movements" involved in pyrotechnics is given. The rest of the article is a brief history of fireworks, describing how they are manufactured in London.

OLD BONES

[Francis Trevelyan Buckland]; 24 September 1853; 8: 83-84; 2 3/4 cols.

Some old bones fairly recently disinterred from gravel in front of St. John's College, Oxford, were at first said to be "a giant's"; but a Professor of Geology who bought them said that they were an ancient elephant's, like some found earlier near Oxford and London. A similar discovery made in 1862 at the Banwell Bone Caves in Somerset, included the remains of savage animals as well as elephant and deer. The remains were preserved and exhibited by William Beard* in a museum which the narrator visited.

A RUSSIAN STRANGER

[George Dodd]; 24 September 1853; 8: 91-94; 5 1/2 cols.

Malachite is carbonate of copper which has acquired its beautiful appearance by being formed as a sedimentary deposit, in drops similar to stalactites and stalagmites. Sir Roderick Murchison's* theory is that the carbonate was once a liquid which gradually

became solid by slowly dropping. Siberia and Australia have the only known deposits. An analogous substance is turquoise: like malachite, it is found in small quantities embedded in other rock, it owes its colour to copper, and it was at one time either liquefied or made molten by heat.

AIR MAPS

[John Capper]; 8 October 1853; 8: 128-33; 9 cols.

The author refers to an earlier article, "Submarine Geography" (29 May 1852; *HW* 5: 246-48), which described the American government's project of mapping the ocean floors to provide current navigation charts. At the same time, American scientists (working together with British scientists) conducted atmospheric observations to chart the variable winds around. The "scientific proceedings" from the project were presented at a public meeting at Lloyd's some time ago in which Lieutenant Matthew Maury* of the American navy reported on the project; and an air map giving a complete chart of currents has recently been published in Britain. Thanks to the knowledge of winds, the length of voyages between Britain and Australia can be cut by at least a third. Moreover, with detailed information about winds, scientists will be able to understand better such subjects as soil fertility, rainfall, and other atmospheric events. For example, Professor Christian Ehrenberg* has been able to trace the source of "African rain-dust" to South America. A lengthy explanation of why the trade-winds globally follow certain currents in the atmosphere and form "wind-roads" is given. It is partly because of the land masses in the northern hemisphere and the preponderance of ocean in the southern.

Pilgrim 7: 156, to W. H. Wills, 25 September 1853: "I return the No. (much in want of press-corrections), and have done what I could to it." This article must therefore have had D's approval.

THE MODERN PRACTICE OF PHYSIC

[Henry Morley]; 22 October 1853; 8: 169-73; 9 cols.

This satiric account of the quality of contemporary physicians, is written as if told by an experienced doctor or apothecary, "Dr. Point," whose chief success lies in his modest prosperity and ability to afford a brougham. He contrasts the careers of former fellow-medical students who have similarly devoted themselves to getting on, with the careers of more serious-minded doctors who have taken an interest in being "scientific": patients of scientific doctors may fear being made "the subject of experiments." More importantly, doctors who have devoted themselves to scientific research have not made money, and patients consequently do not consider them "respectable." One of the rich, respectable doctors explains the distinction: "it is a question between science and pudding. I am not great-minded enough to remain poor for the love of my profession." A religious reputation pays even better.

A GREAT SCREW

[John Capper]; 22 October 1853; 8: 181-84; 6 1/2 cols.

The earliest attempt to make a screw-propeller was by a London merchant in 1794. Then in 1836 a farmer near London patented a new device which proved immediately successful. Screw propulsion by steamships began to be introduced by Edward H. Hargraves* in the 1830s, and was soon adopted in the British royal dockyards and then in the U. S. A. Though Hargraves did not discover screw propulsion itself, by popularising its use for swifter travel, he indirectly encouraged the use of much speedier screw-propelled steamships. "It is an undoubted fact that the most valuable additions made to our stores of screw-knowledge, have come from men uneducated for, and unconnected with, any

branch of practical engineering." Without going into technicalities, the author explains how screw propulsion works, and its great advantages over sails or paddles. Screw-propelled ships have greatly improved communications between Britain and her colonies especially Australia whatever route is followed.

[CHIP:] OXFORD FOSSILS

[Francis Trevelyan Buckland]; 29 October 1853; 8: 209-10; 2 1/4 cols.

The article is about three so-called "fossils" in the Clarendon Museum at the University of Oxford: a huge lump of Roman cement found in the Thames; the skeleton of an ancient British woman stained with ruddle (a red dye); and the "Sunday Stone," with layers coloured black and white alternately, taken from the drain-pipe of a colliery in the north of England.

THE NORTHERN WIZARD

[John Capper]; 5 November 1853; 8: 225-28; 6 3/4 cols.

A visit to an enormous unnamed factory in Glasgow which manufactures industrial chemicals is described using the metaphor of magic. "Mr. Wizard" is an "industrial or manufacturing chemist" who makes salts, acids and bleaches used in the textile industry, brewing, sugar refining, iron manufacture, metal work, and many other industries. He exports his products all over the world. The author visited and gives vivid eye-witness descriptions of his "laboratory." First, he sees rough sulphur with nitre or saltpetre is burned to make sulphuric acid, of which half a million tons are produced every year. In one chamber, there is a furnace in which common salt is blended in a process leading to

the production of tons of sulphate of soda (or Glauber Salts) used in medicine. Elsewhere, saline materials are combined with lime and coal-dust to make washing soda. He sees the production of soda-ash for making soap and glass, and the production of muriatic acid. He concludes with a tribute to the "mind" to which all are indebted for the "science" which made these advancements possible.

COLOUR-BLINDNESS

[James Knox and W. H. Wills]; 12 November 1853; 8: 255-57; 3 1/2 cols.

A paper on colour-blindness by Professor M. Elie Wartmann* ["Memoir on Daltonism (or Colour Blindness)"] published in 1826 has just been translated into English and published in *Scientific Memoirs* (1846). The chemist and the biographer of Henry Cavendish,* Dr. George Wilson* of Edinburgh, has also turned his attention to the subject and distinguished different types of colour-blindness: the inability to discern any colour; to discriminate between shades of composite colours (brown, grey and neutral tints); to distinguish between primary colours (red, blue, and yellow) or colours between these and the secondary and tertiary colours (such as green, purple, orange and brown). Anecdotes about people with colour-blindness are given, including the difficulties of colour-blindness in medical practice and railway signaling.

Pilgrim 8: 218, to Professor George Wilson, 4 November 1856; Dickens wrote to thank the professor for sending his new book on the five senses, *Researches on Colour-Blindness* (1856).

[CHIP:] THE HISTORY OF A COAL CELL

[Ernest Abraham Hart]; 10 December 1853; 8: 354-55; 2 1/2 cols.

A cell, according to the botanist, is "a little closed vesicle, the basis of all the varied vegetation of the world." Every living being depends on cells. Compacted plant organisms become coal which, when burnt, gives heat, light, carbonic acid gas and carbon needed for animal growth. The author concludes:

there can be no doubt that in digging up the coal, men are furnishing the means under a natural law, which they unconsciously obey, of the increase of their species. We cannot refuse to see in this an instance of the beautiful adaptation of the laws of nature to created beings; of the complete subservience to man of the great organic laws of the universe; of their instrumentality in promoting his comfort; and the necessity he is under of acting in accordance with and support of those laws.

AN UGLY NURSLING

[Henry Morley]; 24 December 1853; 8: 406-08; 4 1/2 cols.

The narrator has caught a catarrh, or cold. He describes its cause, symptoms and treatments. The remedy suggested by Dr. C. J. B. Williams* is mentioned: give the patient only solid food, thus depriving him of liquid which the doctor believes is the source of the liquid that might go into nose and the lungs. The author distinguishes between a mere cold and influenza. Influenza can cause epidemics: those of 1833 and 1837 were as fatal as cholera epidemics. There have been many speculations on the cause of influenza, but it remains mysterious. The account turns to "hay asthma," which affects some people during the hay-making season.

LIVES OF PLANTS

[Ernest Abraham Hart]; 21 January 1854; 8: 483-86; 5 1/2 cols.

The author supplements his earlier article, "The History of A Coal Cell" (10 December 1853; *HW* 8: 354-55), with an account of the life of cells in plants. "It is unfortunate for the general diffusion of the great truths of science, that learned men have always amused themselves by throwing dust in the eyes of the unlearned; clothing the history of their investigations in pedantic and technical language." It is "quite indefensible that interesting and elevating subjects should be rendered unintelligible and repulsive to the mass of readers who have not time to master the slang of each branch of science," and an "arbitrary vocabulary, itself requiring special study." The progress of science unravels many mysteries, and the discovery of some common laws helps to explain what appears confused and unconnected. For example, with the help of the microscope, botanists now know that the basis of all vegetation is the cell and can thus go on to understand laws of production and growth. The account explains how plants obtain nutrition--chemical elements in the form of carbonic acid, gas, air, water, and ammonia; how some physical laws such as the law of gravitation take place in the growth process, as in the movement of sap; and how sun and water help plants turn chemical elements into sap. Throughout the article, the author praises "nature's great Master" and "the Mighty Designer." He concludes "We must tread here with reverential step; for we have reached the utmost boundaries of human science, and stand in the presence of the Almighty Maker of all things, with whom alone rests the power of creation or annihilation."

HALF-A-DOZEN LEECHES

[George Dodd]; 21 January 1854; 8: 492-95; 6 cols.

Among the odd facts about leeches is that they have been used as barometers. An article in the *Lancet* three or four years ago recorded the experiments of a surgeon who registered the movements of leeches in water during changes in climate and temperature. Edward Jenner* believed that leeches could serve as barometers and wrote a couplet on the subject. The experiments of a Swiss naturalist are mentioned and there is a description of an apparatus to record the movements of leeches in bottles.

SCIENCE AND SOPHY

[Henry Morley]; 28 January 1854; 8: 505-08; 7 cols.

A review of the popular introduction to natural history and science by Aimé Martin,* *Letter to Sophie*, translated from *Lettres à Sophie sur la physique, la chimie et l'histoire naturelle* (Paris, 1809). The ideas of Newton, Buffon, Lavoisier and many other scientists are explained. Natural history, including mineralogy, botany and biology is described as a world of sensibility, wonder and harmonies. An example of how science can be discussed in an engaging way is Martin's explanation of radiation. She deals with it in the context of the colours of nature, and explains that white, for example, is the colour of early spring flowers, of polar bears and snow because white least encourages radiation and thus helps plants and animals to retain heat. The author concludes that the book has the power "to awaken intellect, to educate the head, the heart, and the soul."

BOTTLED INFORMATION

[George Dodd]; 4 February 1854; 8: 529-32; 8 cols.

Because sailors need to know the strength and direction of ocean currents, and the relevant winds, Captain Becher,* editor of the *Nautical Magazine*, started collecting ten years ago all the records of bottles picked up. He was able to draw up a chart of the Atlantic Ocean currents between the latitude of the Orkneys and Guinea. His first bottle-chart attracted the attention of the Arctic explorer, Sir John Ross,* and the coastal surveyor, Commander Fishbourne, who were led to formulate a different course which made possible a quicker passage. Becher published an enlarged bottle-chart in November 1852.

CHANGE OF AIR

[Henry Morley]; 11 February 1854; 8: 570-72; 4 1/2 cols.

The author explains what determines "climate" (latitude and longitude, soil quality, topography) and discusses the effects of different climates on people's health. He gives an extremely general account of the influence of light, heat and moisture on the human body. Focusing on England, he mentions the five best climates for invalids specified by Sir James Clark,* and concludes by asserting that "the study of climate really provides a wide field for minute and philosophical investigation."

BIRTH OF PLANTS

[Ernest Abraham Hart]; 18 February 1854; 9: 1-4; 6 cols.

"The Vegetable World" has three purposes: to give animals nutrition, to regulate climate, and, "the most sublime and exalted mission," to be "the material interpreter of the spiritual; the veil which conceals but yet declares the mighty Author and Sustainer." Poetic,

romantic and religious language are used to describe scientific process. For example, naturalists have investigated how a volcanic island rising from the ocean turns into land covered by vegetation and how nature can "cast out death and implant the germs of life." In nature "everything has a meaning and a purpose." The author quotes anecdotes about plant reproduction from classical authors and later authorities, admiring the stories because they are "romantic," and contrasting them with contemporary scientific descriptions of the same processes: "Alas, that earnest truth-loving Science should step in to crush this graceful fabric of the imagination, to strip this history of all its glowing passion, and all its mystery of almost human love!" Science provides "all-embracing principles," is "the highest truth" and "the highest poetry," because the "truths which science substitutes for the visionary beauties of the human imagination, far transcend the invention of the greatest masters of poetry." For example, the "minute vegetable cell" is an agent of reproduction, and a flower's seed-buds are formed to be germinated by globular pollen cells. Such scientific discovery "has imposed order upon a shapeless chaos of confusedly observed phenomena." Further information is given about germination, the structure of a seed, how the cells of the embryo plant develop, how the albumen and starch of a seed and carbonic acid gas act in its nutrition, and how insects, wind, water and gardeners also play an important part in the process of reproduction.

[CHIP:] A DISH OF FISH

[Francis Trevelyan Buckland]; 18 February 1854; 9: 16-17; 3 3/4 cols.

The author relates miscellaneous anecdotes--both scientific and anecdotal--about fish. He begins by observing that the body and teeth of animals and fish always conform to the individual's way of life. He discusses the appearances and habits of pike, tench, and carp; and then explains how some fish catch their prey by subterfuge (the Devil or Angler fish),

or without pursuit but by such means as used by the "Torpedo fish." On the question of the age to which fish live, an example is given of an enormous eel which died of old age, the remains of which are still kept in the Ashmolean Museum at Oxford. Finally readers are told how men catch fish, attracting them by deception, using bread on a string, or even using a hammer to strike them!

OIL UPON THE WAVES

[George Dodd]; 18 March 1854; 9: 98-100; 4 1/4 cols.

Before Benjamin Franklin's* experiments with oil on waves, there were other observations on the subject. Pliny's *Natural History* says oil can calm the sea and allow us to see clearly through it. This was known by and was useful to the divers and fishermen of Lisbon, and travellers and naturalists have mentioned it. For example, Sir John Pringle,* "one of the lights of the Royal Society," thought fishermen could detect shoals of herrings in Scotland because the water above was smooth and oily. Benjamin Franklin* began experimenting with the phenomenon in London in 1757 and repeated his experiments with varying degrees of success. He concluded that when air passes over water with any degree of velocity, friction makes waves; and though oil poured on the surface cannot prevent deep, full waves, it stops small waves and prevents them becoming bigger. These facts could be put to good use by captains, sailors, fishermen, life-boat workers, divers and engineers.

PLANT ARCHITECTURE

[Ernest Abraham Hart]; 25 March 1854; 9: 129-32; 6 cols.

Goethe found that in a plant, flowers and fruit repeat the structure of the foliage, and that as leaves climb upward on the stem they constantly change shape until, reaching the apex, they combine to produce flowers and fruit. Seven stages of leaf-development are distinguished and a general account is given of each stage. There is unity in diversity: the leaf is a unit of the plant as the vertebra is a unit of the animal body. As well as a plant's having a design, on looking through a microscope we see the organism of the vegetable cells which constitute it. There are, for example, the outer layers of flattened cells and a resinous coating to protect the plant from rain and dust, though in aquatic plants this outer protective layer is not developed. In the interior of the plant, the cell is elongated into a strong hollow column, like a cylinder or a prism. The cell is "a living organism," subject to chemical and organic action. It receives its nourishment by continually absorbing and eliminating moisture through its cell walls. There are also channels for the nutritive fluid to extend to the impervious layers which can prevent the plant sap from drying up. Between cells, there are little openings to exhale vapour. There are places in the plant to store various secretions such as globules of oil, starch, sugar, granules of green, yellow, red, and blue pigment, and bunches of crystals. The author explains the whole organism of a plant, and says that within the cell there are forces at work such as "Light--Heat--Attraction--Gravitation--Electricity-- . . . compelled to obedience by the resistless laws of their Great Author, at whose decree the vegetable cell appears as the artificer of the organic creation."

A CALL UPON SOPHY

[Henry Morley]; 8 April 1854; 9: 174-76; 3 3/4 cols.

The author revisits Sophy in order to be "instructively amused" by the scientific facts presented by Aimé Martin* in his *Lettres à Sophie sur la physique, la chimie et l'histoire naturelle* (Paris, 1809) already reviewed in "Science and Sophy" (*HW* 8: 505-8). The book

gives everyday anecdotes about echoes in order to explain how sound waves are reflected in the air. He describes the concept of "light-years" to explain the distances between the sun, earth and stars. Other scientific topics discussed in simple language are the migration of birds, phosphorescence, and the function of oceans and tides. Some scientists including Gottfried Leibnitz [or Leibniz], * William Herschel* and Johannes Kepler* are referred to.

BUSY WITH THE PHOTOGRAPH

[George Dodd]; 29 April 1854; 9: 242-45; 7 cols.

The account supplements two previous articles "Photography" (19 March 1853; *HW* 7: 54-61) and "The Stereoscope" (10 September 1853; *HW* 8: 37-42). William Talbot* has succeeded in developing a kind of "etching" that can be made by a "contact print" in which sunlight traces the shape of a flat object on a prepared plate. A metallic plate makes the best surface, and the process of engraving on a steel plate is described in detail. The author suggests the many fields where photography can be employed: for example, astronomy, commerce, textile design, military intelligence, and to provide evidence in courts of law.

NATURE'S CHANGES OF DRESS

[Ernest Abraham Hart]; 13 May, 1854; 9: 304-06; 5 1/2 cols.

There are 92,930 known kinds of plant in different parts of the world. Hart explains how plants have adapted to different climates and zones. They are like Nature's dress on the earth's surface: the tropics are clothed with dense vegetation, while the extreme north is hardly dressed at all. Plants in the tropics serve to reduce the temperature. Examples of specific plants in some regions are given, and the important roles of heat and soil described.

These two elements bring together plants of a similar kind in what botanists call "social bands." In the end, man's labour should also gradually have an effect, and even save Greenland from being an entirely uninhabited waste.

[CHIP:] SENSIBLE NEWS OF A SEA-SNAKE

[Francis Trevelyan Buckland]; 3 June 1854; 9: 373-74; 2 cols.

Charles Peach,* "an accurate and intelligent" naturalist, is said to have told us about "a rare serpentine fish" brought ashore by fishermen near Wick in the north of Scotland. Presumably this all comes from a newspaper account. "Competent authorities" are said to agree that the specimen is a large "gymnetrus," or snake-like "riband-lath or deal fish" about sixteen feet long. The author describes it and speculates how many such fish might exist off the British coast.

WASTE

[John Capper]; 10 June 1854; 9: 390-93; 5 cols.

"Thanks to science and commercial competition, there is a constant tendency in manufacturing countries to economise residuary and waste products. Science has shown how the mere parings of daily industry may be transformed into important elements of utility; how the refuse of the smithy, the foundry, the stall, the farm-yard, the slaughter-house, the gas-factory, has in itself, a value before undreamt of." The article is concerned with the savings that could be made if other materials were used than those usually imported. It is mainly about the chemical industry and applied chemistry for commercial purpose.

DONE TO A JELLY

[George Dodd]; 24 June 1854; 9: 438-40; 5 cols.

The first person to devise how to extract gelatine from bones was the French chemist, Denis Papin.* He invented a vessel like a pressure-cooker which enabled water to boil at a much higher temperature than 112 degrees Fahrenheit. After boiling bones in his "digester," Papin obtained "a gelatinous extract which became a tremulous solid when cold." In a lecture on the results of the Great Exhibition, Professor Owen* remarked that "the most signal progress in the economical extraction and preparation of pure gelatines and glues from the waste remnants of the skins, bones, tendons, ligaments, and other gelatinous tissues of animals, has been made in France" ["The Raw Materials from the Animal Kingdom," *Lectures on the Results of the Great Exhibition of 1851* 1 (1852), 75-131]. The rest of the article is a description of the manufacture and use of gelatine.

THE LEARNED SAILOR

[Henry Morley]; 1 July 1854; 9: 458-62; 8 cols.

In the past, when a lad went to sea, no more "science" than how to sail was expected of him than of a London cab-driver. But times have been changing with "the advance from barber-surgery to an age producing Jenners and John Hunters." Nowadays a sailor needs scientific knowledge, and an understanding of monsoons, winds, tides and currents, as shown in Matthew Maury's* *Wind and Current Charts of the North Atlantic and Sailing Directions* (1849-54). The article mentions some of the information discussed in an earlier article also based on Maury's work, "Air Maps" (8 October 1853; *HW* 8: 128-33). The author explains what Maury has achieved, and his wish to co-operate with the Royal Society, which led to the 1853 international conference on meteorology in Brussels. The

author also refers to Robert Methven's *The Log of a Merchant Officer, Viewed with Reference to the Education of Young Officers and the Youth of the Merchant Marine* (1854) and to Sir William Reid's* *Storms* (1838) in which Methven's efforts are praised as "the increasing application of science to practical navigation calls for new acquirements in the sea commander." Dr. Lyon Playfair* also declares that there is no profession that needs more knowledge of the fundamental truths of physical geography, astronomy, mathematics, mechanics, magnetism, meteorology and the laws of health, than that of the seaman, and that "scientific knowledge" is "the condition for true success" in every trade and profession. Methven argues that a sailor needs preliminary training to the age of fifteen in basic algebra, geometry, logarithms, trigonometry, Latin and modern languages, and if possible, he should by then have read Edward Riddle's* *Navigation and Nautical Astronomy* (1824). The living conditions of ordinary seamen should be improved, and ships should have a deck-house and chart-house convenient for writing the ship's log, practising navigation and reading works such as *Household Words*.

Pilgrim 7: 266, to Dr. Lyon Playfair,* 5 February 1854: "I am very much obliged to you for your thoughtful remembrance in reference to the enclosed leaf from our good friend's Log" [Methven's *Log of a Merchant Officer* for which Playfair wrote the Editorial Preface].

Pilgrim 7: 186, to Miss Georgina Hogarth, 4 November 1853: "Then we and the Emerson Tennents (who were aboard) and the captain [Robert Methven], the doctor, and the second officer went off on a jaunt together to Pisa, as the ship was to lie at Leghorn all day."

SEA VIEWS

[Henry Morley]; 15 July 1854; 9: 506-10; 7 1/2 cols.

Philip H. Gosse* who helped establish the Marine Aquarium in the Zoo has just published a book, *The Aquarium* (1854). The author explains that to set up a marine vivarium is to imitate the natural situation. In the ocean, plants and animals "play into each other's hands": animals take oxygen and carbonise it, making carbonic acid; plants take the carbonic acid and de-carbonise it making oxygen. In addition to this, the sea's movement also helps to purify its surface. He then describes the characteristics of some sea creatures such as cannibal fish, shrimps and prawns, what to keep in an aquarium and how to arrange it.

A BUNDLE OF CROTCHETS

[George Dodd]; 22 July 1854; 9: 533-36; 7 cols.

Like a previous article, "A Century of Inventions" (18 June 1853; *HW* 7: 367-71), this article looks at some ingenious inventions, some of which have been patented, but not necessarily put into use. All the examples concern modes of transport. Hardly scientific, yet practical, are proposals to have cab-meters like present-day taxi-meters, or better-designed omnibuses. There is the portable boat, the carriage drawn by kites, and other aerial machines. Brief details are given of a new design for an "atmospheric railway." There is the proposal for making a Channel tunnel by submerging an iron tube large enough to take a double railway track, the train first descending on a downward slope by its own impetus, before being drawn up by a cable. A cross-channel Aerial Pontoon Railway Suspension Bridge is a different matter, since its sections are to be kept aloft by hydrogen balloons and yet take the weight of a railway line. Lastly, a Thames Central Railway is proposed, which could carry a raised line down the centre of the Thames supported in a "light and graceful" manner. The author is largely sceptical, but leaves it to his readers to decide how far the schemes are probable and desirable.

CATCH-PENNIES

[Francis Trevelyan Buckland]; 19 August 1854; 10: 5-6; 3 cols.

According to "an eminent microscopist," microscopes with a magnifying power of twenty diameters can be bought for a penny each in Leicester Square. They are so cheap because they are made from pillboxes, with lenses of Canada balsam (a drop of transparent gum which sets and act as a lens), instead of the more expensive glass. Elsewhere are other "penny-catchers," including a man who charges a halfpenny to look through a homemade microscope, a travelling glass blower, and an inventor of a cheap spit for roasting meat. What these "catch-penny" bargains show is that there is a market in London for cheap instruments and a popular interest in them. The doubt is, whether what the purchasers buy is as good as the examples demonstrated.

Pilgrim 7: 391, to W. H. Wills, 7 August 1854; in this letter, Dickens suggests to Wills that this piece should be "without the Chip heading."

MORE SPLENDID THAN A BADGER

[John Oxenford]; 19 August 1854; 10: 18-20; 4 cols.

People can easily be fooled into believing in the existence of bizarre or mythical creatures. In a country town, the author and the inhabitants see a crier who charges his audience a penny each for a look at a travelling collection of curious animals said to be from South America and South Africa, including one with "the head and ears of a Fox, the body of a Badger," and "the tail of a Tortoise-shell Cat." The animals turn out to be nothing special, the most "splendid" being in reality no more than a deformed badger. The author muses on how such fraudulent showmen can arouse public curiosity in natural history: as he puts it, "The crowds are ever anxious for information, and ever ready to seek

for it," and he speculates that the curious creatures "may have set them thinking on something beyond the narrow limits of the spot in which they vegetate." He then surveys ancient accounts of deformed and mythological creatures given by Aristotle, Pliny and others. He concludes that because naturalists have proved how absurd it is to believe in fabulous creatures, it is vain to seek for such specimens nowadays except in the travelling exhibitions of fraudulent showmen.

Pilgrim 7: 391, to W. H. Wills, 7 August 1854; the editors note that the article's present title was revised from the original "The Splendid Badger."

WINGS AND TOES

[Edmund Saul Dixon]; 26 August, 1854; 10: 31-37; 12 cols.

This is a summary of Alphonse Toussenel's* *L'Esprit des bêtes* (Paris, 1853-55), which contains "curious fancies about quadrupeds" mentioned before. The present article focuses on the physiology and anatomy of birds. "The bird is a model ship constructed by the hand of God," says the author, "the bones of highflyers, as well as their feathers, are tubes filled with air." It describes the balanced development of organs in birds (for example, the length of the wings of birds such as frigate-birds, swifts, or humming birds, corresponds to their feet and legs, feathered feet and legs are mostly short, and birds good at walking are not good flyers). Then it deals with their good sense of sight, touch, hearing, and their relatively feeble sense of smell and taste. Toussenel has divided birds into three classes: "Oar-foots, the Stilts, and the Vélocipedes." Anecdotes about different species are included, and there is a discussion of such matters as why there is a "law of equilibrium" in comparative anatomy, and how sexual characteristics differ.

Pilgrim 7: 395-6, to W. H. Wills, 12 August 1854: "A much better No. [26 August 1854] than the two or three last . . . I am not sure whether we have used the title, *A Flight with*

the Birds [HW 5: 381-4, by Morley and Wills]. If we have, call the paper *Wings and Toes*. But the name I have given it is a much better one if I have not used it before."

CORNISH STONE

[George Dodd]; 9 September 1854; 10: 92-96; 7 3/4 cols.

Different kinds of stone such as granite, serpentine, rock crystal, porphyry, jasper and marble can be found in Cornwall. As granite is the most notable, there is a detailed description of its many uses, the places to which it is shipped, and how it is quarried. The geological formation of the granite hill called Cheesewring is explained: it is not made of several stones heaped together, but is a solid mass worn away by erosion. It is also rich in chalcedony (a rock-crystal that can be cut into "Cornish diamonds"), porphyry, green stone, red jasper, colourful marble, and madreporite marble. The Lizard peninsula is half made up of serpentine, which contains magnesia. It is explained how it was formed. Sir Henry Thomas de la Beche's* *Report on the Geology of Cornwall, Devon and West Somerset* (1839) is wrong in saying that nothing but small blocks of serpentine can be obtained in the Lizard district. Serpentine is now in considerable demand for decorative purpose. The Great Exhibition of 1851 showed many specimens of stone from Cornwall. Among them, serpentine and steatite are the most valuable, but the former is harder, more durable, and more colourful.

[CHIP:] COLOURING

[Henry Morley]; 23 September 1854; 10: 138-40; 4 cols.

The account is taken from Michel E. Chevreul's* *De la loi du contraste simultané des couleurs* (Paris, 1839), or *The Principles of Harmony and Contrast of Colours* (1854) which has just been translated into English. Chevreul's research on the effect of colours on each other had shown certain laws: how complementary colours can be blended to produce white, for example, that blue, yellow, and red can be mixed together to produce a perfect white, that two complementary colours can be blended to produce a third one, and that human vision can also reflect such changes. The principle of a relation between colours can be applied to avoid bad taste in internal decorating and furnishing. In the original work Chevreul speaks of "the science of colouring," but Morley is not altogether convinced.

CRABS

[Dudley Costello]; 7 October 1854; 10: 176-81; 10 cols.

The author refers to a previous article, "Lobsters" (29 July 1854; *HW* 9: 567-69). The present article discusses the nature, various species, specific names, distribution, and behaviour of crabs. The miscellaneous information ranges from studies in natural history to crabs as food. The author has obviously read widely on his subject and refers to ancient and contemporary works, such as Charles de Rochefort's* *Histoire naturelle et morale des Iles Antilles* (Rotterdam, 1658) or *The History of the Caribby-Islands* (1666), Aristotle's *History of Animals*, Pliny, Lyell's* *Principles of Geology*, 3 vols. (1830-33), and many others on natural histories of exotic countries, but his style is lively and light-hearted.

Pilgrim 7: 417, to W. H. Wills, 21 September 1854: "Costello really good."

Pilgrim 7: 421- 22 and 427, to W. H. Wills, 24 and 29 September 1854; these letters show that the No. was considerably revised before publication.

[CHIP:] A SCIENTIFIC FIGMENT

[Edmund Ollier]; 23 December 1854; 10: 453-56; 7 cols.

"With all its love of demonstration, Science sometimes dreams as strange dreams as Poetry itself." The boundary between science and superstition is sometimes blurred, as by Ptolemy who was a great discoverer and fabulist, or those would-be wise men such as astrologers, alchemists, and "disciples of the divining rod." The account focuses on the widespread beliefs that heat and moisture are the two great principles of physical life, and the lower order of beings can be produced by the action of sun on moist clay, and vivified by Divine warmth and energy. The belief is extensively discussed, and some famous literary allusions are referred to, such as the growth and generation of Caliban, "hags, imps, devils and abortions" in Shakespeare's *Antony and Cleopatra* (I, ii, 188), the creation of the serpent in Ovid's *Metamorphoses* and his translator George Sandys's annotations, and the serpent Python in Milton's *Paradise Lost*. The idea was more or less "confirmed" by Bacon who held that many living creatures are produced solely from "putrefaction" and Dr. Erasmus Darwin's* belief in spontaneous generation, thought also to coincide with Shakespeare's allusion. Other literary examples given include the story of Dr. Faustus and Shelley's *Frankenstein*. The author's own attitude is ambivalent and ambiguous: though he seems to know that ancient accounts of "spontaneous generation" are wrong, he says "the marvel of existence expands before us as we advance in our inquiries" and "the phantoms of fable grow tame before the living verities of God."

[CHIP:] LONG LIFE OF LOCUSTS

[John Bate Cardale]; 17 February 1855; 11: 67; 1/4 col.

Referring to a previous account, "The Roving Englishman: Locusts" (*HW* 10: 478-80), the narrator describes his own experience of catching a locust twelve years ago in Albury Heath. He washed it in a solution of camphor, and then applied prussic acid repeatedly, but failed to kill the insect.

[The office book records no payment for this item. Cardale was a solicitor and Dickens's neighbour in Tavistock Square.]

THE ROYAL BALLOON

[Edmund Saul Dixon]; 17 March 1855; 11: 149-53; 8 cols.

The author visits a French churchyard near Boulogne where there is a monument to two French balloonists, Pilâtre de Rosier* and Pierre Ange Romain* who died in 1785 while trying to cross the English Channel in a balloon they made. He interviews a witness who saw the flight and disaster, sees some relics of the event in a museum at Boulogne and tries "solving the problem of their fall." Referring to "Over the Water" (23 July 1853; *HW* 7: 483-88), the article describes how they designed the balloon in secret. A detailed account of its construction is given, including the fatal flaw in design which led to its soon catching fire. It failed because Romain and Pilâtre combined a gas-balloon and a Montgolfier fire-balloon, with the hydrogen-gas balloon floating above the Montgolfier fire-apparatus.

WHEN THE WIND BLOWS

[John Capper]; 24 March 1855; 11: 188-91; 5 3/4 cols.

The account is based on Commander Henry Piddington's* *Sailor's Horn-Book of the Law of Storms* (1848), an explanation of the meteorological laws governing storms. Capper refers to the Maritime conference at Brussels in 1853, already mentioned in his own article, "Air Maps" (8 October 1853; *HW* 8: 128-33). The account is mostly from the practical point of view of what a seaman should do in a cyclone.

STARVATION OF AN ALDERMAN

[Henry Morley]; 31 March 1855; 11: 213-16; 6 cols.

This is a review of "the latest scientific work upon the mysteries connected with the preparation of food" by the analytical chemist, Dr. Arthur Hill Hassall.* His *Food and Its Adulterations* (1855) compiled his Reports of the Analytical Sanitary Commission which had been published in the *Lancet* from 1851-54. It gives "a chemical and microscopical comprehension of the solids and fluids consumed by all classes of society." Hassall's findings are presented in the form of an amusing story of a London Alderman who asks his daughter to take charge of cooking for the household. The daughter reads Hassall's book and is horrified to learn of the chemicals, bacteria and poisonous substances contained in all her family's food and drink. When she explains to her father about the microscopic and chemical constituents in adulterated food, the family decide to starve rather than risk illness and poisoning. The author urges legislation to prohibit dishonest grocers and food manufactures.

ELECTRIC LIGHT

[George Dodd and (or) John Capper]; 14 April 1855; 11: 251-54; 4 1/2 cols.

The earliest forms of electric light were too costly to be available for everyday use, and they also had many imperfections. Dr. William Watson* is said to have found a way of making the two points of carbons which transmit electricity self-regulating, so as to produce a continuous and steady light. To reduce the cost of electricity, the Maynooth battery was designed: it was made of cast-iron and zinc which were separated by a porous diaphragm of potter's biscuit-ware; the iron was then excited by saltpetre and sulphuric acid diluted by water, or by diluted nitrous acid so that the zinc was acted on by diluted sulphuric acid. The result was a light of great intensity. From the Maynooth battery, Watson developed the "chromatic battery" and converted the waste solutions from the battery into commercial material. The waste products could be used to make chemical dyes the value of which was greater than the cost of the batteries. It is astonishingly added that electricity could therefore become a "costless article"! The article goes on to describe other possible industrial uses of waste products, including coke and bleach. Once electric light has become a cheap or "costless" commodity, it could serve countless purposes: fog signals for railways and ships; semaphores at night between ships and between sea and land; in many manufacturing processes; and in engines for transportation.

IMPORTANT RUBBISH

[John Capper]; 19 May 1855; 11: 376-79; 5 cols.

Reference is made to "Penny Wisdom" by George Dodd (16 October 1852; *HW* 6: 97-101), an article on the way in which "art and science have been brought to bear upon things before thought worthless." Here the author describes the waste slag left after smelting iron ore. Dr. W. H. Smith of Philadelphia has evidently given a lecture to the "Society of Arts" on how to make use of the waste slag (slag of iron furnaces) in much the same way as Nature makes igneous rock ["The Utilization of the Molten Mineral Products

of Smelting Furnaces," *Journal of the Society of Arts* 3 (1855): 335-34]. Smith is said to have been engaged originally in research on how electricity might affect "the human frame," but was induced to study mineral matter and make this discovery. Readers are assured that if molten slag is cooled gradually and run into moulds, it becomes an extremely hard material with the solidity and strength of the best marble and can thus be used for valuable building material, for paving streets, and for making bricks and gas-pipes. In fact, it is said to have been so used in America. This discovery is improbably hailed as "one of the most promising results of modern science."

[CHIP:] BRIMSTONE

[W. H. Wills]; 26 May 1855; 11: 398-99; 1/4 cols.

According to the article "Electric Light" (14 April 1855; *HW* 11: 251-54), there are no deposits of sulphur in this country, and Britain derives all its supplies from Sicily. But a correspondent informs *Household Words* that the previous article overlooked the produce of the Irish mines. As he points out, the Wicklow mines have for the last 14 years produced a large quantity of iron pyrites which contains 45% sulphur. This ore has been extensively used in Britain and has greatly reduced the cost of Sicilian brimstone.

DOCTORING BEGINS AT HOME

[George A. Sala]; 18 August 1855; 12: 68-72; 9 cols.

François Vincent Raspail's* annually published and popular book on hygiene, *Manuel Annuaire de la Santé* (18465) has been translated into English by Dr. G. L. Strauss* and entitled *Domestic Medicine; or Plain Instructions in the Art of Preserving*

and Restoring Health by Simple and Efficient Means (1853). Raspail holds that "hygiène" is "the art of preserving the health," while medicine is "the art of recovering or restoring the health when lost or enfeebled." Though people have begun to understand that a science such as chemistry may be "a good thing for a farmer to know," the study of the laws of health and disease is almost entirely neglected. On this point the author agrees, but he does not agree with Raspail when he only attacks the ignorance and presumption of physicians. He says that Raspail could have strengthened his argument if he had referred to the quacks in England--the homeopaths, the practitioners of the "Sangrado system," of the "starving system," or of the "salivating system," and those who experiment on patients with various chemical substances. All these quacks are worse than ignorant physicians. Some notorious "experimentalists" are mentioned. Raspail's major ideas about hygiene are described, along with his many suggestions about healthy living conditions, healthy cooking and diet, and sensible clothes. As the author puts it, Raspail has "nothing to do with doctors," but is nevertheless "the inventor of an entirely new system of medicine."

LONDON STONES

[Blackwell]; 6 October 1855; 12: 228-29; 2 1/2 cols.

"Every tombstone is a study of geologists," and anyone can be a practical geologist in London, because of the many varieties of stone to be found there. The author suggests that instead of travelling to the Alps or to Norway, geologists should stay at home and investigate the "diversities of rock" in the capital. For example, beyond "the kerb of every pavement" in London, the underlying granite often crops out; the granite was formed when the earth was molten and then cooled into a crystalline form. Such stone includes "porphyry, sienite, and basalt." Above the granite, on the roofs of houses, there may be slate from Wicklow or North Wales. Doorsteps and pavements are made from red

sandstone from Devon and limestone from Scotland. Yet the strata or geological order of rock formation of London deposits seems to be in no special sequence because of later surface movements. Therefore it is not easy to discover examples of the transitional rocks of Sir Roderick Murchison's* Silurian system as found in the south-east borders of North Wales. Giving a survey of some of London's most important buildings, the author goes on to describe the many other types of stone used in the city's buildings.

Pilgrim 7: 710, to W. H. Wills, 25 September 1855: "I don't like three such short articles in one No. as London Stones, The Caitiff Postman, and the Erards. Can't you remedy this? It looks so patchy." Wills did not "remedy" it and all three articles appeared.

DECIMAL MONEY

[Edmund Saul Dixon]; 10 November 1855; 12: 349-56; 13 1/2 cols.

To be clear and simple, British coinage should be changed to a decimal system. Several reasons are adduced. For example, we count in tens probably because primitive counting is performed with the help of fingers and toes. Compared to the unit 10, 8 is scanty and limited and 12 burdensome. Roman numerals are more complicated than Arabic decimal notation which has almost become a universal language. How the French plan their "new" decimal coinage is explained: the new French unit is a franc equal to 10 pennies, a franc equals 10 décimes or 100 centimes, and a décime equals 2 sous. Public establishments such as Kew Gardens, the British Museum, Hampton Court and the National Gallery, should charge a small sum to visitors. "No reasonable person would object to pay a centime for admission to the instructive sights which he now inspects gratuitously," and it is less trouble for the door-keeper to take a small coin from each visitor than to record the number of visitors. The pamphlet, *Decimalism* (1855), by a "Commercial Traveller" [perhaps J. W. Paulson who writes the "Introductory Remarks"]; Part I of the pamphlet is "Remarks on the

Proposed Decimalization of the Weights, Measures, and Moneys of Great Britain, with Explanatory Hints and Suggestions"] is mentioned. The article goes into details of how this could be carried out. It suggests that the best way is to remodel the old system (to keep the gold sovereign and to add intermediary coins and sub-divisions), as it may avoid confusion and loss of national identity.

DECIMAL MEASURES

[Edmund Saul Dixon]; 17 November 1855; 12: 365-70; 9 3/4 cols.

The article follows on from Dixon's "Decimal Money" (10 November 1855; *HW* 12: 349-56) which proposes that Britain decimalise its coinage. In the present article, he discusses the mathematics of decimalisation. He explains how the French have decided on their standard measurement of length, the mètre, a ten millionth part of a quadrant, which is a quarter of the earth's meridian, or the length of the meridian of the globe where it passes through the north and south poles. He suggests that England should adapt this measure, because it is "a simple and natural means of measuring length," and an invariable standard measure which has a real or natural basis. In various multiples it gives the kilomètre, the décimètre or a hundred centimètres, the centimètre, etc. The units of liquid measure are given in detail, including gallon, pint, bushel, quarter, and chaldron. He explains how decimalisation might be put into effect, predicting great advantages for international trade if all European countries were to adopt decimal weights, measures and coinage.

[CHIP:] WANTED, SOME GENERAL INFORMATION

[James Payn]; 24 November 1855; 12: 394-96; 2 1/2 cols.

This humorous article complains about the widespread use, in print and conversation, of scientific terms (such as "Vaccination and Inoculation, the Binomial Theorem and the Differential Calculus") when their meaning is never explained. All that people really want is "a little general information" and "the courage to ask for it." As the author says, "I don't like asking questions of scientific people, because they are so unwittingly insulting" and their explanations are often "unintelligible"; a man of science can "define well," but we need someone else "to explain his definitions." The author also includes in his complaint the widespread use of foreign words and names.

COLOURS AND EYES

[Henry Morley]; 29 December 1855; 12: 521-24; 5 1/2 cols. [should read 6 3/4]

The article refers to "Colour-Blindness" (12 November 1853; *HW* 8: 255-57), and like that article relies on the same writer, George Wilson,* whose recently published book, *Researches on Colour-Blindness* (Edinburgh, 1855) is said to give "a great deal of fresh information." It explains how common colour blindness is and the forms it usually takes; for example, which colours are most often confused; which colours cannot be seen at all. Many anecdotes are given of people who suffer colour-blindness, and famous sufferers include John Dalton,* Jean Sismondi,* and Professor Dugald Stewart.* The author corrects an error at the end of the previous article, which had said that colour-blindness affects men and women equally. In fact, the percentage of males with colour-blindness is higher than that of females. Finally, suggestions are given on how to adapt the signalling on railways and ships to help people with colour-blindness.

[Wilson's book is a reprint of his papers in the *Edinburgh Monthly Journal of Medical Science* (November 1853) and *Transactions* of the Scottish Society of Arts, including an

appendix by J. C. Maxwell. Wilson examined 1154 cases of colour-blindness and was the first in England to point out the extreme importance of testing railway-employees and sailors for the defect. The Great Northern Railway at once adopted his recommendations.]

THE FRIEND OF THE LIONS

[Charles Dickens]; 2 February 1856; 13: 61-63; 3 1/4 cols.

The narrator and his friends are in the studio of an animal painter, who, knowing much about beasts and birds and being especially concerned with the lions in the Zoo, wants to give advice to the Zoological Society. The artist, "the particular friend of lions," suggests to the society's secretary, David Mitchell,* that the Zoo's pair of lions should be treated better. While the birds, monkeys (which the poet, Samuel Rogers [1763-1833], calls "our poor relations"), and Hippopotamus, have all been taken care of properly, the lions have been living in poor conditions, confined space, "uniform, unyielding, unnatural, unrealistic, inappropriate" lodgings, and are not fed enough.

The article was initiated by a supposed visit to the artist and sculptor, Edwin Landseer, famous for his animal paintings and the sculptures of the large bronze lions in Trafalgar Square. Landseer had already complained about the Zoo's care of the lions. Although not about science, the article is evidence of Dickens' interest in the Zoo and animal subjects [Dickens's "The 'Good' Hippopotamus" (12 October 1850; *HW* 2: 49-51) is also related to the Zoo, but not about science].

Pilgrim 8: 18, to Sir Edwin Landseer, 10 January 1856: "The Royal Couple shall have my best attention. I will try to express you in the plainest manner, and to allow none of the interest of your argument--a most excellent one--to escape."

[CHIP:] A SMALL MONKISH RELIC

[Francis Trevelyan Buckland]; 9 February 1856; 13: 90-91; 2 1/2 cols.

In the Cathedral where the Greek scholar and the late Dean of Christchurch, Oxford, Thomas Gaisford [1779-1855] was buried, the narrator and others found a little bone said to be a spine from the back of a very large fish, identified as a thornback. The author wondered how the fish got into the cathedral. He knew from an ancient book on fishes and serpents published in 1763 that there was once a one-hundred-pound skate sold by a fishmonger to monks in St. John's College which fed 120 people, and that fish like this were often supplied to the monks. Records in the book suggest that the cook may have thrown fish bones into the kitchen rubbish-hole and that earth from this area happened to be brought into the cathedral during building alterations, as he discovered from *Collectanea Curiosa* (Oxford, 1781).

METEORS

[Warr]; 16 February 1856; 13: 103-5; 5 cols. [should read 4]

On 7 December 1855, a meteor was seen to fall like a fire ball. Superstitious and historical anecdotes about meteors are related, and the question is asked: "What are they before we see them, and where do they come from?" The author explains that meteors, or shooting stars, shine because of friction with the air as they fall to the earth. There are times when many of them fall like a shower: for example, on 14 November 1833, 184 meteors were seen in America and other places; these were said to have been observed when they were 2,238 miles above the earth. It is suggested that circling the sun is a band of meteors which can be seen at certain times in the year when the band's orbit crosses the earth's. After discussing more astronomical theories, the author concludes that meteors are

made of the same material as the Earth, but no one has yet given a decided explanation able to "satisfy the judgment of mankind," of what they are.

ONE CURE MORE

[Henry Morley]; 8 March 1856; 13: 191-92; 4 cols.

On medical and "scientific" grounds, the author condemns a recent quack "Movement-cure" in London, run by a Swede named Ling, [Per Henric Ling (1776-1839), or Peter Ling] and illustrated by a German doctor in his book [Dr Mathias Roth's *Handbook of the Movement-Cure* (1856)]. According to the doctor, patients go through a series of exercises over a definite time and in a definite course. The gymnastic remedy "must be applied scientifically" with the help of the professor or his assistant. The doctor claims that it can cure all kinds of illness. Further details are given emphasising its absurdity.

[According to Donald Baynes, *Auxiliary Methods of Cure: The Weir Mitchell System. Massage. Ling's Swedish Movements. The Hot Water Cure. Electricity* (1888), the method of treatment was introduced by Peter Ling, about the beginning of the nineteenth century. His idea is to treat chronic disease by exercises which he eventually systematised and introduced as a scientific method of treatment. He met with much opposition but the government granted him money to fit up a gymnasium, where he lectured on hygienic gymnastics. His system was eventually recognised as a part of military drill.]

Pilgrim 8: 64, to W. H. Wills, 2 March 1856: "I am sorry to see the Cold Water cure classed in Morley's article among the humbugs of the time. Firstly, because I believe that in reason there is good deal in it. Secondly, because you were at one of the great Malvern Doctors and my wife was at another's. Perhaps this may have occurred to you and you may

have taken it out." As a result of this letter, no explicit mention of the water-cure remains in the articles.

POISON

[Henry Morley]; 22 March 1856; 13: 220-24; 9 cols.

Because people know "too little" about poisons and are "ready to believe too much," physicians and philosophers used to put forward superstitious explanations. But superstition and terror disappeared with the advance of "the natural sciences." As further truths are discovered, the botanist, zoologist, mineralogist, chemist, anatomist, microscopist and "physiologist" have taught us about food, medicine and poison. Science, "the true defender and adviser," can help us a great deal, even "at the cost" of our giving up "Plato, Aristotle and Pliny." For example, in the museum of Kew Gardens, Sir William Hooker* has exhibited horseradish and poisonous aconite to show the public the difference between them. Scientists, especially chemists, can help the public. We need public professional officials, such as medical officers of health, who should be set up in law, physic and divinity to apply pure science in everyday matters. To prevent accidents caused by "death-dealing herbs," or by the adulteration of food, herbalists should not be allowed to trade without a licence, and their shops should be registered. As Alfred Swaine Taylor* has suggested to a committee of the House of Commons, the state should have a permanent committee of people with a knowledge of chemistry, botany and natural history, capable of overseeing organisation and inspection. Trade and science should be brought under their control. There should be legislation, for example, to control the sale of drugs and poisons, for legislation could help prevent accidental poisoning, and prevent suicide or murder for insurance money.

Pilgrim 8: 22, to W. H. Wills, 10 January 1856: "Can't Morley do something about the Sale of Poisons--I suppose Miss Martineau's doctrine of never never never interfering with trade, is not a Gospel from Heaven in this case."

[CHIP:] HORNET ARCHITECTURE

[Miss Catherine Hill]; 19 April 1856; 13: 325-26; 1 col.

A correspondent in Adelaide, Australia, sends a letter describing the structure of a hornet's nest built in her bedroom. She also mentions that Australia has several varieties of insects like wasps and hornets, and that they tend to build their nests in places inconvenient to people.

ALL UP WITH EVERYTHING

[George A. Sala]; 26 April 1856; 13: 337-39; 5 3/4 cols.

Eugène Huzar in his *La Fin du monde par la science* (Paris, 1855) has predicted the end of the world which is to result from the progress of Science. His argument is treated as an absurdity, since Huzar argues that the history of mankind moves in cycles of 5,000 years; and, at the end of each cycle, comes a catastrophe because of "the pride of science" itself: "M. Huzar . . . has come to the conclusion that the end of the world will be disastrous, and that it will naturally result from the aforesaid exaggeration of science and power." Yet this is "incomprehensible to the vast majority of his readers," and Huzar no more than a "generaliser." Huzar had recently written about all kinds of mishaps from science such as death caused by chloroform, and accidents to various scientists such as ballooning accidents. The author says,

This then is the end of our . . . civilisation, our arts and sciences and manufactures, our steam-engines, steam-guns, thrashing and sawing-machines. This is what we have come to with our electric telegraph, our electro-biology, our Royal Institution in Albemarle Street, and our Museum of Economic Geology. Exaggeration of Science! Cataclysm! Collapse! It is all up with everything!

Unlike Huzar, the author is firmly confident in the good ends of science and full of optimism about the future.

Pilgrim 8: 88, to W. H. Wills, 13 April 1856: "All up with everything is loose, scrambling, and careless, for a first article. But I suppose you have nothing better?"

Pilgrim 8: 98, to W. H. Wills, 24 April 1856: "I am very much disheartened by the last published No. of H. W. which is--not to mince the matter--frightfully bad. No idea in it, no purpose, no appropriateness to or about anything, a mere hash-up of most indifferent magazine papers at chance-medley."

EPIDEMICS

[Eliza Lynn]; 10 May 1856; 13: 397-400; 6 cols.

This is a review of "the fixed physical laws" of epidemics described in Southwood Smith's,* *Epidemics Considered with Relation to Their Common Nature and to Climate and Civilization. In Two Lectures Delivered at the Philosophical Institution, Edinburgh, 1855* (Edinburgh, 1856). Epidemics such as typhus, scarlet fever, measles and small pox have several characteristics in common: they are all fevers; they spread rapidly and over vast distance; they are periodical; they sometimes begin with influenza; they are rapid in their effects; and they are alike in their predisposing causes. Smith believed that the chief cause was foul air, and other causes included unusual changes in atmosphere and all the problems that afflict poor people living in overcrowded conditions. Because microscopic

analysis can show the difference between pure and foul air, and clean and foul food and water, the authorities have it in their power to prevent the conditions which result in epidemics.

STRYCHNINE

[Harvey]; 17 May 1856; 13: 420-24; 9 1/2 cols. [should read 8 1/2]

Strychnine comes from the bark and seeds of the tree, *Strychnos nux vomica*, found in Ceylon and India. Taken in powdered form in small doses, strychnine is used as a medicinal tonic, and taken in larger doses, as a stimulant to the nervous system. However, poisonous quantities can initiate terrible symptoms which quickly result in death. Pure strychnine was first extracted from "nux-vomica" in 1818 by Pierre-Joseph Pelletier* and Joseph B. Caventou.* Its properties and misuse, the attempts to find antidotes, such as tannin and lard, and a new one, are reported in the *American Journal of Science and Arts* (November, 1854; 14: 422-23). How to detect strychnine poisoning is discussed, anecdotes of poisoning cases are given, and recent experiments and cases investigated by Dr. Marshall Hall* are described.

MINERALS THAT WE EAT: CHAPTER I

[Ernest Abraham Hart]; 24 May 1856; 13: 437-42; 12 cols. [should read 11 1/4]

Food has begun to be studied scientifically, for man "must eat scientifically and with intelligence, if he would live well." Progress was made with the researches of Gerhardus Mulder,* and those of von Liebig.* into the nature of protein. Scientists see man in terms of chemistry, as being made up of almost three-quarters water, the rest being composed of various minerals. These he obtains from his food, either from plants which draw them

from the air and minerals in the sand, or from the flesh of animals which feed on plants. The nourishment of plants themselves has been studied by Liebig, and Dr. Henry Bence Jones* who has remarked on the extent to which humans absorb minerals. The article then gives a detailed account of salt and its universal use. It discusses Dr. Charles Leith's* medical observations about diseases caused by lack of salt in the diet, salt being "the emblem of eternity; of repentance; of reconciliation, and of wisdom" in the Bible, and it describes Robert Boyle's* use of salt as an antidote to plague in *An Ancient Physician*.

MINERALS THAT WE EAT: CHAPTER II.

[Ernest Abraham Hart]; 7 June 1856; 13: 486-90; 7 cols.

Man is at the centre of creation, and "the series of created beings" radiate "from the type of structure" he presents. A chemical analysis of his physical structure and composition confirms that mankind was "given power over the beast of the field, as well as over the herb on which it grazes" and "dominion over land and sea," as shown (so we are told) by the way in which he is partly composed of both salt and potassium. The sources and importance of several essential minerals in the diet is explained: potash, which is especially useful in preventing scurvy, iron, magnesia, and phosphate of lime. Of course, the usefulness of all these is finally dissolved by death: "In the end a Higher Will interposes, the bond of union is unloosed, the immortal soul wings its way upwards to the Giver of all Being." The author chose to ornament his chemical analysis of the human body with imagery from Genesis.

A LEAF FROM THE OLDEST OF BOOKS

[Richard Owen]; 7 June 1856; 13: 500-2; 5 cols.

The article is about an expedition to the Isle of Sheppey, at the mouth of Thames, and is written for those who "may have been bitten by Buckland* or Lyell* with their favourite science" of geology. A year ago, the author and two colleagues visited Sheppey to collect fossils that appeared to be the remains of tropical plants and animals. They could see fossils of palm-fruits like those that can be found in Moluccas and the Philippines. Some characteristic fossils were bought from a local resident; others were acquired. The fossils found included a large chelonite which is to "be the subject of two beautiful plates in the forthcoming number of Owen's *History of British Fossil Reptiles*," 4 vols. (1849-55). In this article, Owen presents his work in a light tone, emphasising procedure and personal experience. At one point, the narrator even describes the forgetfulness of some geologists. His own name and book are referred to directly. The article is one of the rare occasions when a famous scientist talks about his first-hand scientific studies. It is full of the immediacy and wonder of science.

[CHIP:] THE SALT IN THE SEA

[W. H. Wills]; 14 June 1856; 13: 507; 1/4 col.

The chip corrects a typographical error in "Minerals That We Eat" (24 May 1856; *HW* 13: 437-42). It was stated that the amount of salt in the sea averages "forty" percent, whereas "forty" should be "four"; but the note adds that "according to the best authorities," the proportion of salt in the sea was really no more than "from two-and-a-half to three per cent" in some places. It looks as though Wills, annoyed at having to make what he thinks an unnecessary correction, belittles his own contributor.

THE WORLD OF INSECTS

[Edmund Saul Dixon]; 14 June 1856; 13: 511-16; 10 1/2 cols.

In his *The World of Insects* (1856), John W. Douglas* discusses such "vermin" as moths and cockroaches. The author refers to a report on cockroaches, and even various "carnivorous vegetables" given to the Entomological Society by Edward Newman.* He relates details about Douglas' study, such as the growth of the apple-moth from egg to larvae to mature insect. Other naturalists' names mentioned in passing include Sir Thomas Brown* and Doubleday.*

He mentions the difficulties faced by entomologists. They may be misunderstood or regarded as lunatics as were "Galileo, Tycho Brahe, Priestley and even Davy," who were "pitied in their time," as "foolish enthusiasts" "in the early part of their career." "But great good, and profit, and safety, and lofty wisdom have been derived from studying the structure of the heavens--that is, of the universe--and from investigating the essential nature of the crude materials which compose our globe." "It is not during its infancy that a science displays its wealth and lavishes its benefits." The author argues that the study of entomology is rewarding and that, according to Douglas, the study of the anatomy and reproduction of insects sometimes throws light on the study of the structure and physiology of man. Therefore naturalists must persevere. They may take as long as a year to examine and investigate insects they have captured over a few weeks. The account ends by looking at places in Britain and elsewhere that are "rich in curious and rare insects."

GOLD IN GREAT BRITAIN

[Robert Hunt]; 21 June 1856; 13: 541-43; 4 1/4 cols.

The article gives a survey of the history of the search for gold in Britain up to 1854, when Professor Andrew Ramsay* read a paper to the Geological Society ["Geology of Gold-bearing of District of Merioneth," *The Quarterly Journal of the Geological Society* 10 (1854): 242-47] saying that there was no gold to be found in North Wales except at Cwn Eisen and Dol-y-frwynog. In fact, the existence of gold in North Wales is undoubted, though its extraction cannot pay for itself. There are only a few isolated places in the world where the search for gold can be made to pay.

A WAY TO REMEMBER

[John Abraham Heraud]; 12 July 1856; 13: 616-18; 4 cols.

What can help us to understand and remember scientific ideas is to associate them with familiar everyday experience. The examples given are from astronomy. For instance, the motion of trees seen from a moving train can be associated with the revolution of the solar system (as Herschel* had found) and the effects of speed and light on the aberration of a planet can be explained by the example of firing a ball from a rifle in a moving boat.

BIRD HISTORY

[Dudley Costello]; 19 July 1856; 14: 7-12, 11 3/4 cols. [should read 10 1/2]

This is a review of *L'Histoire de la nature des Oyseaux*, 7 vols. (Paris, 1555), or *History of the Nature of Birds* by Pierre Belon.* The work, a major contribution to sixteenth-century science and natural history, was based on Belon's own observations and excludes mythical animals. But the article is mainly on gastronomy and the eating habits of birds rather than on any serious study.

Pilgrim 8: 701, to Wilkie Collins, 9 November 1858: "You have furnished Costello's wing with a feather, for an eagle flight into the Pension List."

A DISH OF FROGS

[Dudley Costello]; 26 July 1856; 14: 25-30, 11 1/2 cols.

The article begins by quoting the eminent French naturalist, Comte de Lacepède,* who continued Buffon's *Histoire naturelle* 10 vols. (Paris, 1749-67) with volumes on snakes, reptiles, and fish, *Histoire naturelle des quadrupèdes ovipares et des serpens*, 2 vols. (Paris, 1788-89). It gives a very general survey of frogs and tadpoles, their physical formation, focussing on particular species such as tree-frogs (*Hyla*), their diet, and vocal organs. It refers to authorities such as Cuvier.* In a light-hearted fashion, the author refers to Lamarck's ideas which he jokingly says could have led to an astonishing "development of a tadpole into a man." The author alludes to Lamarck's* development theory, later "adopted and enlarged by the more modern and mysterious author" of the *Vestiges of the Natural History of Creation* (1844): "On this principle he presumed that a frog transported to the sandy plains of tropical Africa might, by dint of gasping and elongating the cervical process, become a giraffe." The rest of the article, on gastronomy and frog-fishing, can hardly be called scientific.

THE SCATTERING OF SEED

[Warr]; 2 August 1856; 14: 56-59; 6 3/4 cols.

While many plants multiply by extending roots under the soil, or throwing shoots on top of the soil, or layering, or (with the help of man) by cuttings, the majority of plants

multiply through seeds. The article discusses how and when seeds develop, how they are distributed by nature and by man, and where they germinate. The experiences of Dr. John Lindley* and foreign naturalists working with seeds abroad are mentioned. The rest of the article is about the distribution of seeds of different kinds of plants. Finally the German naturalist Friedrich Traugott Kützing's* research into how "the lowest forms of animal life are likewise convertible into those of the vegetable" is mentioned.

PLURALITY OF MITES

[William Brough]; 9 August 1856; 14: 95-96, 3 1/4 cols.

The narrator dreams that he can microscopically see mites in a piece of cheese. He hears them discussing various contemporary theories about their piece of cheese (the earth): one argues that their cheese was created by a great convulsion; another argues that their cheese is unique; and another that there is a plurality of cheeses. They conclude that there is no other inhabited cheese like theirs. When he wakes up, he reflects:

Yet cheese--and mitey cheese--is sold by tons! Yet suns and systems roll around us; the planet we inhabit, but one atom in a mighty group; that, in its turn, an atom in another mightier one. Where shall we stop! Clusters of satellites revolving around a world: clusters of worlds revolving around a sun: clusters of suns revolving around--
-what?

The narrator's story is clearly inspired by William Whewell's* *The Plurality of Worlds: An Essay* (1853) [in D's library].

SEASIDE EGGS

[prob. John Robertson]; 23 August 1856; 14: 126-30, 6 cols.

The study of embryology only began when William Harvey* studied nutrition and reproduction, the function of the valves in the circulation of the blood, and the evolution of animals from eggs. The author writes of his own discoveries about the eggs of sea-snails, shell-fish, whelks, oysters, mussels, and other sea creatures, referring to their specific Latin or Greek names, how they come into being, and what other naturalists (such as Cuvier* and Lamarck*) have to say about them.

OUR POISONOUS WILD FLOWERS

[Henry Morley]; 20 September 1856; 14: 234-36, 4 cols.

The article, based on Charles Johnson's* *British Poisonous Plants* (1856), gives information about numerous common wild plants and flowers which have poisonous properties. It describes their appearance, which parts are poisonous, the degree of their toxicity, and instances of their having caused death. It also tells stories about berries and fruits.

[A comparison of the original book to the article can be made to show how Morley closely summarises the author's account, following Johnson's examples one by one.]

SEA-GARDENS

[prob. John Robertson]; 27 September 1856; 14: 241-45, 8 cols.

An enthusiastic description of coastal seaweeds and plants, including the author's own picturesque observations, is reported as if from a sailing boat on a fine summer day. The author admits that his article is largely indebted to the French naturalist Jean Lamouroux.*

For the first time, Lamouroux has divided "sea-gardens" into zones of green, olive and red, according to the depth of water. Because sea-gardens are both botanical and zoological, the author can rove about from zone to zone, from subjects such as "cryptogames," ("the plants who marry clandestinely"), to various shell-fish called "balani" that he once closely observed, and finally to limpets.

THE WORLD UNSEEN

[Edmund Saul Dixon]; 11 October 1856; 14: 291-96, 9 3/4 cols.

Several "adepts" in natural philosophy, including Sir Humphry Davy,* have imagined the existence of living creatures in other planets of our solar system. These may well not exist, but there are unseen creatures more accessible to us with a microscope. The instrument can show us such things as a spider's web, a butterfly's scales, dust, and certain "diatoms," examples of which are described. The author then explains the mechanics of the microscope, referring to Dr. William Carpenter's* *Microscope and its Revelations* (1856) and also to a "Professor Smith." Finally he mentions how the microscope has enabled one skilled operator, Paul-Gustave Froment,* to engrave extremely minute manuscripts and drawings upon glass.

THE SHINGLE MOVEMENT

[prob. Robert Baxter Postans]; 18 October 1856; 14: 322-24; 4 1/2 cols.

Different theories about the causes of shingle shifting on beaches are discussed. Some scientific observers say that shingle is moved primarily by the surf working with the winds, and others that it is moved by the tidal current. Others have noted that shingle does not

travel below one-fathom at the low water mark, but this does not explain what happens to so many miles of pebbles on beaches in southern England when they dwindle away at various places, leaving only sand. Researchers have measured the angles of inclination of the beaches and graded their pebbles by size. The conditions on different beaches in Britain and elsewhere are so variable that it is impossible to formulate a single rule that defines what makes shingle accumulate and diminish.

UNDER-WATER EXISTENCE

[prob. John Robertson]; 25 October 1856; 14: 342-47, 10 1/2 cols.

This detailed account, based on close observation, gives information about seaffies, periwinkles, plaice or flounders, and pholas: what they live on, how they leap or move, why they are called by Latin or Linnaean names, how many species there are, and their structure and nature. Many authorities and their specific studies are referred to, such as those by Henri Milne-Edwards,* Gideon Mantell,* Professor Pierre Jean Flourens,* Karl Ernst von Baer* and Antoine Dugès.*

MICROSCOPICS

[Edmund Saul Dixon]; 1 November 1856; 14: 377-81, 9 3/4 cols. [should read 9]

A clear and practical article especially written for people intending to take up microscopy as a hobby. The author gives the history of the microscope and its development from a single lens to the compound microscope. Advice is given on where to buy them, what to use them for, the advantages and disadvantages of seeking a high magnification, and what books to buy or consult. For the novice, he describes how to

prepare a flour and water paste which will produce "eels" observable under the microscope. "The nearer we approach to infinite minuteness, the more we appreciate the infinite beauty . . . which marks every production of the one great creative hand."

THE PURPLE SHORE

[prob. John Robertson]; 8 November 1856; 14: 391-95, 9 cols.

The author's focus on the "zones" of the sea makes it clear that this article supplements "Sea-Gardens" (27 September 1856; *HW* 14: 241-45) and, like that one, is based on the work of Lamouroux.* Here, he focuses on the plants and animals that inhabit the "purple zone," the area offshore beyond the low water mark. He begins by describing sea creatures such as the wrack-spangles or *Serpulae* (a kind of mollusc), *Sabella* (a common sand worm), and *Cyprea* (the cowry). He then discusses edible plants such as dulse and Irish moss. Animals in the purple zone include star fish and sea-urchins, which he describes in detail, quoting the French zoologist Henri Milne-Edwards.* He then mentions different ways to distinguish the zones by their hydrographical, botanical, and zoological characteristics and ends by reporting that the four-zone theory of the French naturalists has been adapted by the British Association and has already been introduced in Germany.

MINIMS

[Edmund Saul Dixon]; 22 November 1856; 14: 440-45, 10 3/4 cols.

The author suggests that the discoveries made by naturalists since the advent of the microscope are like those of musicologists, who have learned that the minim--once thought

to be the smallest unit of musical sound--can be divided into even smaller units. The author is excited by what he can see under a microscope. He gives a dramatic account of animalcules in a drop of water, mixing learned terms and vivid description. Because his aim is to show the wonders a microscope can reveal, he describes a variety of tiny objects: for example, the hairs of insects and vegetables, and particles of pollen, snow and dust. Finally, he suggests that microscopists should adopt as their unit of measurement the millimetre that appears on the scales of French instruments.

ALUMINIUM

[Edmund Saul Dixon and W. H. Wills]; 13 December 1856; 14: 507-10, 6 cols.

Lavoisier first predicted that metals existed in earths and alkalis, and Sir Humphry Davy* later isolated some radical metals using a weak voltaic battery. Building on their work, the German chemist, Friedrich Wöhler,* succeeded in extracting aluminium from clay, and a year later, in 1854, the French chemists, Jean Baptiste André Dumas* and Henri Étienne Sainte-Claire Deville,* discovered the many characteristics of the metal. It remains stable in all atmospheres and is resistant to acids. It is light, strong, easy to work and melts at low temperatures. These qualities will make it useful in industry and technology. The author predicts that, once it becomes cheap to produce, aluminium will be used in everyday products, such as surgical instruments and household implements, and in some ways take the place of gold, silver, copper, and tin. Wöhler and Deville were awarded the Legion of Honour by France, who wished to recognise their contribution to science. Thanks to them, "Science had already fulfilled her part, and it was the turn of manufacturing Art to begin."

THE LAMBETH-MARSH MULCIBERS

[W. H. Wills]; 10 January 1857; 15: 25-27; 5 3/4 cols.

The factory of Maudslay and Field in Lambeth, southeast London, manufactures screw-propellers for marine steam-engines. There is a sense of exultation in the power that has been released to "fulfil the destiny that makes Britain the master manufacturer of the world, the British navy mistress of the seas, and the British subject the most arrogant traveller and the most patient tax-payer under the sun." But the article ends with an anecdote of human interest: a description of how the kind chairman and factory workers had given a donkey as a gift to an old man to replace the one he had lost.

HAMMERING IT IN

[Henry Morley]; 17 January 1857; 15: 59-60; 3 3/4 cols.

The author creates a comic story about an enthusiastic amateur geologist in order to review David Page's* *Advanced Text-Book of Geology, Descriptive and Industrial* (Edinburgh, 1856). The popular "delight caused by the study of geology" is represented by Mr. Boulder, who instructs his friend on subjects such as the theory and formation of igneous and metamorphic rocks, the different types of fracture, the sources of sparkle in rocks, the formation of mud banks, and the components of the earth's crust. Sir Roderick Murchison* and his discovery of the Silurian rocks are mentioned in passing.

A WHALE IN WHITECHAPEL

[Francis Trevelyan Buckland]; 21 March 1857; 15: 272-75; 6 3/4 cols.

A forty-eight-foot long Rorguel, or razor-back whale, "reserved, stretched on a frame-work, the skin entire . . . all complete, so that it was a stuffed whale" was exhibited in London. The author gives a good eye-witness account: the liver "filled a one-horse cart," the heart "a good-sized wash-tub," the fin has "four fingers, like human fingers," and a man could stand in its open mouth. He gives other anecdotes about exhibited whales, and describes what can be learned about them at the College of Surgeons. Despite his vast amount of facts from natural history, the author sees the creation of the whale as directed by a divine purpose which correctly foresaw that nothing so large could have sustained itself on land. Fortunately, because of "the wise economy" of a "benevolent Creator," whale oil is valuable to mankind.

OLD SCRAPS OF SCIENCE

[William Jerdan]; 11 April 1857; 15: 355-57; 4 1/4 cols.

The author was inspired to write the article after attending an address on the recent achievements in science given by Professor Charles Daubeny,* to the British Association for the Advancement of Science [probably one of Daubeny's three reports, "On an Indirect Method of Ascertaining the Presence of Phosphoric Acid in Rocks, where the Quantity of that Ingredient was too Minute to be Determinable by Direct Analysis," "On the Action of Light on the Germination of Seeds," and "On the Influence of Light on the Germination of Plants" given to the 25th BAAS meeting held at Glasgow, 1855]. The author first identifies some eminent figures who were the early members of the Royal Society, "giants in their time--oracles in the sciences." He then relates scores of myths and fabulous tales about natural history which were believed by the contemporaries of these men: "We mean no disparagement; but a cursory retrospective glance over . . . the natural history of that age may . . . teach us to modify the ultra high valuations of our noble selves." His point is that

the achievements of contemporary scientists, "the Daubenys, Sedgwicks, Sabines, Owens (Forbes, Johnstons, Playfairs) Whewells, Murchisons, Playfairs, Ansteds, Henslows, Faradays, Herschels, Brewsters, Airys, Whitworths, Wheatstones, Groveses, HARRISES, and British Association of our day,"* may well be considered absurd two hundred years from now, in "Anno Domini two thousand and fifty-six."

Pilgrim 8: 382, to William Jerdan, 21 July 1857: "both the brief contributions have been published."

[CHIP:] COPROLITE

[Correspondent]; 18 April 1857; 15: 380-81; 2 cols.

Coprolites, the petrified dung of dinosaurs and extinct mammals, were believed in the past to be "bezoar stones" which were used as antidotes to many illnesses. Ancient stories about coprolite are told, and then a brief history of the discovery of coprolite in various parts of Britain, including the "petrified excretions of past animals such as have been found for example in a large quantity in Kirkdale caverns" and "the fossil dung of the Plesiosaurus, Ichthyosaurus, and other inhabitants of the world before the flood" at Lyme Regis and Whiteby. The correspondent from Suffolk, where areas of coprolite were found as recently as 1846, gives a detailed account of the flourishing new business which has resulted: the coprolite is dug up, sifted, weighed and transported to factories which make it into agricultural manure. Nothing is wasted, for the refuse from this process is then used in the manufacture of china and paint.

CRYSTALS

[Robert Brudenell Carter]; 2 May 1857; 15: 414-19; 9 cols.

A close and careful explanation of crystals and crystallisation, what crystals are, how they are formed, and the process of crystallisation. The article deals with familiar forms of crystals, in sugar making, diamonds and rock crystal, and refers to the article on aluminium and cryolite ("Aluminium," 13 December 1856; *HW* 14: 507-10). The writer tells about the superstitious belief in the powers of a crystal ball shown by an exhibitor at the time of the Great Exhibition. The conclusion looks back to the opening on the suggestive power of crystals and observes that the nature of crystallisation seems to show "the direct and visible working of that Mighty Hand" which sustains the universe. In action or in its results of action "countless ages ago, when the world was convulsed by forces of whose power we can form some faint conjecture, from the visible faces of their effects . . . the student is brought, as it were, face to face with Him who is the same yesterday, and today, and for ever." The majority of the article is instructional, thoughtful and clear, but the religious language towards the end makes the conclusion, at least, read like a lecture or sermon.

TWO MILLIONS OF TONS OF SILVER

[Harvey]; 9 May 1857; 15: 443-45; 3 cols.

By analysing gallons of seawater, French chemists have (with great effort) managed to extract silver, and have even calculated that a cubic mile of ocean contains almost three pounds of silver. The French experiments have been taken up by Frederick Field,* a chemist working in South America; [see "On the Existence of Silver in Seawater" by Field, communicated by Michael Faraday to the Royal Society, received Oct. 23 1856]. Silver is evidently to be found in all kinds of substances, animal, vegetable and mineral, because they have all absorbed sulphide of silver, which is widespread in nature. The usefulness or commercial potential of these perceptive discoveries has not been identified as yet.

COMETS, AND THEIR TAILS OF PROPHETS

[Edmund Ollier]; 23 May 1857; 15: 481-84; 6 1/2 cols.

The article is mainly about the old belief that comets portend disorders, but the author shows that such superstitions survive into the present. He mentions the alarm caused by a comet in 1832, and describes as the "last absurdity of the kind" the destruction of the world predicted for 13 June 1858 when a comet is supposed to "swoop down upon us." Ollier reports that there has been talk of the "extinction of the world, with a hypothesis . . . that the sun himself is absolutely going out, like a lamp that has burnt its appointed time." A recent correspondent in the *Times*, using the pseudonym "Helioscopus," stated that sun spots were growing larger and more numerous: "From this, we suppose we are to infer that the robe of fire and luminosity which encompasses the opaque body of the sun, and which is the source of all the vitality of our system, is wearing out--dropping to pieces with celestial rottenness." The tone is light hearted as the account includes general discussions about science, fable, and myth; the comet of June 13 is to be delivered "by Time, like a grim bowler at an awful game of cricket, to terminate our innings, and stump us out for ever." The article concludes that "the world changes, but gradually; and we have therefore no reason to fear a sudden extinction by any collision with comet or rival star."

THE NERVES

[Christopher Wharton Mann]; 30 May 1857; 15: 522-25; 6 1/2 cols.

The author discusses the nervous system and the role of the spinal cord and brain. The nerves of the hand and arm are used to explain reflex movement and how nerves convey sensations to the spinal cord and then to the brain. The functions of the sympathetic

nerves, the sensory nerves and the respiratory nerves are also described. Finally phrenology is dismissed as something "to which anatomy gives no countenance."

TREMENDOUS BORES

[Roberts]; 6 June 1857; 15: 534-36; 3 cols.

The boring worm, or *Teredo*, is a destructive creature which can severely damage the posts of piers, the piles of wooden bridges, and all woodwork in most situations. The *Teredo* is encased in a calcareous body about the size of a finger and from 12-30 inches long. A smaller type, the *Limnoria terebrans*, or gribble worm, is even more destructive because it can bore into the smallest of spaces. Often, the gribble worm bores in and destroys the surrounding wood and is then followed by the *Teredo*, which causes further destruction.

THE CIRCULATION

[Edmund Saul Dixon]; 13 June 1857; 15: 561-65; 8 cols.

The article is based on Pierre Flourens'* *Histoire de la découverte de la circulation du sang* (Paris, 1854). The ancient Greek believed that the arteries contain only air, but Galen [Claudius Galenus (c. 130-c. 201 AD), Greek physician] proved that they, like the veins, contain blood. Galen's discovery was "an advance in science, and such an advance that the whole force of physiology could not get a step further without the aid of modern chemistry." But one of Galen's errors, that a passage existed between the ventricles of the heart, was disproved by Andreas Vesalius [1514-1564], the father of modern anatomy. Many scientists' remarks are mentioned including William Harvey's,* whose book on the

circulation of the blood is "the finest literary effort physiology has produced." Harvey's discoveries are described in detail, and some of his successors whose discoveries were founded on his work.

[CHIP:] WHY IS THE NEGRO BLACK?

[Eliza Lynn]; 20 June 1857; 15: 587-88; 2 cols.

Until recently, it is said that it would have been thought unorthodox and presumptuous to ask for physiological reasons why negroes are black. An explanation is given on the authority of John W. Draper,* *Human Physiology* (New York, 1856). He held that the human liver helps to remove old blood cells and "haematin"; but that in hot climates the "haematin" accumulates and colours the skin. The proposition is carried further and said to account for the less well developed brain of those living in hot climates, because of the liver being "torpid," and that it also accounts for the shape of the skull, diverging from "the ideal" of Caucasian man. It appears that severe cold even has a similar effect on the Esquimaux. The author is sceptical about the theory because it is based on a "disorder": she feels that the theory appears to question the "divine design" and "divine wisdom" in "the distribution of races."

DISINFECTANT

[Eliza Lynn]; 4 July 1857; 16: 9-12; 6 cols.

Dr. Angus Smith's* "On Disinfectants," in the *Journal of the Society of Arts* (24 April 1857) is a study of ventilation and disinfecting. Some methods of sanitation used by the Greeks, Romans and ancient Egyptians are praised, and modern chemical agents for

purification and antiseptis described. An eighteenth-century French chemist discovered the use of Chlorine as a fumigating agent, and Smith describes how it works: chlorine acts by uniting with the compounds of hydrogen--water and ammonia. Chlorine decomposes the sulphur and phosphorous compounds of hydrogen. Oxygen is both a cause of putrefaction and a disinfectant; this can be seen in preserving food. Disinfecting agents such as air, soil, charcoal, and various salts are also mentioned. Finally the author strongly recommends Dr. Smith's own discovery, "McDougall's Disinfecting Powder," a combination of magnesia, sulphurous acid and "phenic acid" (carbolic acid). It is much used in stables, and successfully prevented the recurrence of a fever epidemic when used in the sewers of a small town.

STICKYTOES

[Edmund Saul Dixon and W. H. Wills]; 11 July 1857; 16: 31-34; 5 cols. [should read 5 3/4]

People have begun to keep peculiar creatures as pets, and "Mr. Verdant Stickytoes" is considered to be the current one in fashion. In a joking way, the article introduces the hyla or tree-frog, and gives detailed information about it, such as how to keep it in captivity, its diet, its use in scientific experiments, where various species of tree-frogs are to be found, its normal life expectancy, what sound it makes, and how it catches the flies it lives on. Professor Edward Forbes* claims that the creature can found in southern England.

AN IMMEASURABLE WONDER

[prob. John Robertson]; 1 August 1857; 16: 118-20; 5 cols.

William Borlase's* *Topographical History of Cornwall* [*The Natural History of Cornwall* (Oxford, 1758)] describes a kind of "sea long-worm" which Cuvier* named *Borlasia*. A keen observer, Colonel George Montagu,* has questioned the accuracy of Borlase's description of its length (their measurements differed wildly, by as much as 100 feet). It is suggested that the exaggeration of length may have been because of a visual illusion, as well as incomplete and inaccurate observation. André-Marie-Constant Duméril* named it "un lacet" meaning a lasso, because of its appearance, while British naturalists call it a "ribbon-worm," because of its varying size and colour. Charles Kingsley's description in his *Glaucus, or Wonders of the Shore* (1855) is praised as "direct observation of a very observant man and an excellent writer." Mention is made of "a learned Professor," Quatrefages de Bréau,* whose monograph on the *Nemertes* mistakenly says that the ribbon-worm has no digestive organ; this has been corrected by Colonel Montagu, who discovered its digestive sac [*The Rambles of a Naturalist on the Coasts of France, Spain, and Sicily* 2 vols. (1857)]. Some points remain mysterious and still to be discovered, such as how it breathes, its blood circulation, reproductive capability, and the nature of its nervous system.

MISCROSCOPIC PREPARATIONS

[Edmund Saul Dixon]; 8 August 1857; 16: 132-38; 11 1/2 cols.

The microscope has become "an indispensable aid to science" as well as a commercial product: collections of microscopic preparations are sold to amateurs, men of science, and students; volumes of pictures of microscopic objects are read for enjoyment. The article presents its information as if from "an expert practitioner," and is addressed to "the student, and even to those who are more advanced," and goes into detail about how to

prepare specimens, mount animals in balsam, and make injections into the capillaries of organs to make them easier to see. It mentions a "well-known natural-history agent," Mr. Samuel Stevens of Bloomsbury Street, and an Amadio of Throgmorton Street who sell preparations for the microscope. The objects they supply are said to be difficult to make, but "wonderfully cheap." It turns to the art of making microscopic photographs, and then to Joseph Bourgogne of the Rue Notre-Dame in Paris, who was apparently famous for his discovery that what are called "itch-insects" are bisexual. In the end it suggests founding a museum for microscopic studies.

FALLING LEAVES

[Dr. Brown]; 10 October 1857; 16: 354-55; 4 cols.

The author calls his article a "gossip about leaves," but though short, it is a detailed account using precise botanical terms. Two reasons are given why leaves fall. Three paragraphs follow on the functions of the upper and the lower surfaces of a leaf that enable it to breath and gain nutrition. Leaves are nourished by the sap and obtain energy from "breathing in" the atmosphere, absorbing carbonic acid gas (carbon dioxide), and breathing out oxygen. He goes on to describe how leaves are developed to form fruit as well as flowers, using terminology such as "ventral suture" which is specialised and is not explained to the reader. His excessive scientific terminology and Latin words are combined with awkward sentence structures and obsolete flowery expression (for example, "Paterfamilias of the Vegetable World, shalt thou lie inglorious, rotting, will no friendly, speculative hand grind thee into snuff, or twist thee into the exhilarating Pickwick?"). The last paragraph is about the difference between "simple" and "compound" fruits.

THE LIGHTNING DOCTOR

[Otto von Corvin]; 7 November 1857; 16: 450-53; 4 3/4 cols. [should read 5 1/2]

Thunder and lightning are no longer considered to be "the most awful and sacred manifestations of God" because people now have more knowledge of electricity, such as "magnetism" "galvanism" and the new "Faradism." Faraday has discovered the electricity by induction and a new apparatus, which is made by applying Faraday's theory by a Dr. Duchenne to treat neuralgia and paralysis, was exhibited at the recent annual meeting of the Royal College of Physicians. Details about how it is devised and how it works are given. There are other possible applications of "Faradism," for example, to use the electricity to treat the skin. How the electricity acts on the muscles and the nerves is also explained.

POLARISATION

[Edmund Saul Dixon]; 14 November 1857; 16: 463-68; 10 3/4 cols.

The author first discusses the nature of light and the history of different theories about it. He then describes how modern microscopy has been improved by the polariser, "a newly-arrived instrument" from France which can be attached to microscopes. Polarisation was first observed in 1808 by Professor Étienne Malus,* while viewing the setting sun through a doubly-refracted prism: "The ray so reflected is found to have acquired the property of possessing different sides." The author is excited by the discovery, describing as "magical" the effects of polarised light on various natural objects and chemicals: "it is light endowed with extra delicacy, subtlety, and versatility. It renders visible minute details of structure in the most glaring colours . . . as a detector, polarised light is invaluable."

NATURE'S GREATNESS IN SMALL THINGS

[Ernest Abraham Hart]; 28 November 1857; 16: 511-13; 4 1/4 cols.

The article is about the formulation of the laws of organic cells. With the aid of microscopes, very small living organisms such as animalcules can be observed and "nature's greatness" is said to be exposed by the fact that every organism is developed from an organic cell. It was Robert Brown* who first made such observations; then in 1837 Matthias Jakob Schleiden* generalised the common laws of the formation and reproduction of plants from cells; and soon afterwards, Theodor Schwann* applied the same laws of development to the animal world. Meanwhile, Richard Owen* was studying the same laws of form in anatomy. Some details of their studies are given. The author ends his article by praising the microscope as "the instrument of a new revelation in science."

THE VITAL POINT

[prob. John Robertson]; 23 January 1858; 17: 125-26; 4 cols. [should read 3]

The so-called "vital point" of the "pneumogastric nerves" described by the French physiologist Ann-Charles Lorry,* is a junction of the nerves between the cerebral marrow and the spinal marrow, the rupture of which can cause sudden death. Lorry's account about its location in various animals is quoted; Julien Jean César Legallois* and Marie Jean Pierre Flourens's* investigations into its exact place and decisive function in animals' respiration are also mentioned. Their discoveries cast light on the reason for sudden death on breaking the neck because the fatal nerves are then torn. The account turns to explain the phenomenon of turtle soup being served in London restaurants while the head of the turtle is still shown alive. Similarly, the bodies of frogs and other reptiles will live on if their heads are cut off above the "vital point." The author also refers to incredible (or doubtful)

cases when men "have lived many years, well, sane, and healthy, after their skulls have been cleft to a considerable depth on one side." There are said to be many records of survival after terrible wounds, because of the progress of medical science: "the spread of science diminishes fear and increases courage among mankind".

UNSUSPECTED NEIGHBOURS

[Edmund Saul Dixon]; 6 February 1858; 17: 172-76; 8 cols.

Through a microscope, a myriad of organisms found in street gutters can be seen. These include, for example, the side-swimming lentil or *Phacus pleuronectes*, various kinds of spirilla, and the walking stick worm (*Vorticella*). The author speculates on the difference between these animalcules and plants, and notes that he has described the most common examples, recognisable and easily distinguishable under microscopes with an ordinary magnifying power. They are our unseen neighbours whose purpose is to act as purifiers and scavengers. The article ends in praise of God: "O Lord, how manifold are thy works."

THE SHELL-MOTH

[prob. John Robertson]; 13 February 1858; 17: 205-6; 2 cols.

The author discusses the controversy among naturalists about the habits of the shell-moth, which remain mysterious. He has studied specimens in the Museum of Natural History in Paris. The female moth has no wings and never leaves her shell. She moves by dragging a little bundle of dry twigs glued to her shell. The author describes many species of shell-moth, named "Psychidae," what their shells or crusts are made of, their different appearance, and how they are nocturnal. Duponchal's* descriptions of the moth's

characteristics in his catalogue of the Lepidoptera of Europe are summarised. It ends marvelling at the variety of forms in animated nature and adding that the "laws or principles of nutrition and reproduction are sublime."

OVER, UNDER, OR THROUGH?

[Edmund Saul Dixon]; 20 February 1858; 17: 228-32; 8 1/2 cols.

In 1802 Mathieu [spelled as Matthieu, p. 229a], a French mining-engineer, proposed to build a road tunnel under the straits of Dover. A series of chimneys in the open sea would give ventilation, and he proposed hollow columns of heavy iron rings would both ventilate and serve as foundations for excavation. It was naturally seen as impossible to construct a tunnel like this in the sea because of strong tides and storms.

Recently Aimé Thomé de Gamond* has proposed a tunnel between France and England, and the French government has ordered engineers to examine its possibility. They have suggested that the British government participate in the project. The tunnel would run from somewhere between Boulogne and Calais to between Folkstone and Dover; its proposed length is forty-seven kilometres, including thirty-four kilometres under the sea. Monsieur de Gamond has undertaken a geological study of the ground, and proposes building rocky islands along the route of the tunnel from which vertical shafts can be excavated. A means of flooding the tunnel is to be provided in case of war. The author sees such a project as an example of man coming to the aid of "Mother Earth" with "the mighty weapons of intelligence, science, and industry." Nevertheless the author prefers a different scheme to link the British Isles and the Continent: "a solid embankment capable of bearing a triple or quadruple road on its summit, THROUGH the waves of the Straits of Dover."

BORDER-LAND

[Edmund Saul Dixon]; 6 March 1858; 17: 273-76; 7 1/2 cols.

Looking at a small patch of green scum through the microscope, the author sees oscillatorias, first described by Henry Baker* and his friend, William Arderon* of Norwich as a multitude of "hair-like insects." They seem to march with great regularity and order and can purify the water. Baker remarks that this shows that "however mean or contemptible these creatures may appear to us, the Power that created them has not left them destitute of sagacity, to associate together and act unanimously for the benefit of the community." The author hopes to "render a service to science by clearing up their history": according to modern scientists, oscillatorias are not animalcules but plants of the most primitive form.

Other microscopic organisms that were once thought to be animals, (such as the species of Volvoxes discovered by Antony Van Leeuwenhoek* and Lazzaro Spallanzani,* and described as animalcules by Christian Gottfried Ehrenberg*) have recently been identified as plants. Of course, "it is not easy, especially at first sight, to perceive the boundary line which separates plants from animals." Even the best authorities consider it impossible to draw a definite line "in the present state of science." The reason is because some organisms with animal and vegetable characteristics keep changing at different stages; many are sometimes mobile and sometimes fixed. Whether they are plants is decided by the way they obtain nutrition. If they absorb inorganic nourishment, they may be classified as vegetables; but if they absorb oxygen and give out carbonic acid gas, they are animals.

WINE, NO MYSTERY

[Eliza Lynn]; 20 March 1858; 17: 321-25; 7 1/2 cols.

The article is based on Professor G. J. Mulder's* *The Chemistry of Wine* (1857). "This is the age of revelations" and "every mystery, whether of science or of manufacture . . . is now thrown open to the world." Mulder's explanations are given of why light, heat, and soil greatly affect the quality of the grapes on many kinds of vine grown in France; how wine is made; the chemical reason why it is better not to mix different kinds of grapes to make one wine; which colour of grape is more suitable for which wine, how chemical components (such as tannic acid, albumen, isinglass and lime) act on the colours; and how other chemical agents can be added; the relation between sugar and the production of alcohol; and experiments on fermentation. Finally the article explains how various underhand practices and chemical agents are used by unscrupulous merchants and manufacturing chemists.

GERMINATION

[prob. John Robertson]; 27 March 1858; 17: 340-43; 6 cols.

The author describes the structure of a seed--its skin, albumen, Cotyledons (the lobes), and embryo. Seeds of different plants have various sizes and different embryos contain different substances. He goes on explaining the roles of the three important elements (humidity, heat and oxygen) in the process of germination. The general law of how a seed germinates is given, and exceptions are also mentioned. Light of different colours also affect the growth of plants. A Mr. Payer was employed by the French Academy of Sciences to test the influence of the solar spectrum upon plants. He discovered that the stalks of plants always lean most towards the violet ray, then to the blue, the green, the yellow, the orange and least to the red.

INFUSORIA

[Edmund Saul Dixon]; 3 April 1858; 17: 375-79; 8 cols.

"Nature . . . is, in one sense, infinite, that is there appear to be no limits to the power, the wisdom, and the goodness which the Great Creator of Nature displays in regard to his creatures Nature is a standing proof . . . of the One Great Power." The author sermonises on what can be learned through the study of minute creatures with a microscope. The microscopic infusoria exist in a liquid medium which renders complex organisation unnecessary. In such tiny animals, the laws of physics allow fluids to penetrate simply by absorption: for example, they do not need a heart or circulation. This group includes protozoa, parameciums and lacrymarias. The author describes their physiology, anatomy, and natural history. He reviews what has been supposed in the past, and gives a well-informed account of what he has observed himself, ending with a confident supposition again about the intentions of "the Great Being who has poured out on the human race such a transcendent flood of bliss and light."

A MICROSCOPIC DREAM

[Edmund Saul Dixon]; 10 April 1858; 17: 396-400; 8 cols.

The author dreams he has become one of the conscious infusoria described in his last article, "Infusoria" (3 April 1858; *HW* 17: 375-79). He describes moving in liquid by the use of pseudopods and how he absorbs and ingests food. He is then transformed into the worm, *Anguilla triici*, describing his life-cycle in a kernel of wheat. His final transformation is into a Tardigrade, which some scientists classify as a link between the rotifers and the worms, while other scientists class them with spiders and scorpions.

MY ANNULAR ECLIPSE

[W. H. Wills]; 24 April 1858; 17: 433-36; 7 1/4 cols.

The author makes a story out of the great eclipse on 15 March, telling about his trip to Swindon to see it in company with the astronomer Professor Sidery and his lively family. They have come well equipped. The eclipse itself is overshadowed by clouds, but the narrator's part is enlivened by a flirtation with Miss "Bright-Eyes" Sidery. The piece includes a good deal of popular science.

THE BLUE DYE PLANT

[prob. John Robertson]; 24 April 1858; 17: 436-38; 4 cols.

The author gives a brief but detailed botanical description of the indigo plant. The majority of his article is on the cultivation of the indigo plant in India, the production of indigo dye and the life of indigo planters. What "chemists say" about the plant's nature is noted. He mentions the anecdote that Linnaeus discovered the nature of butterfly plants (including the indigo plant) to form his theory of the "sleep of plants." Butterfly plants "have the habit of spreading out their wings in the day and folding them up at night." The rest of the article is non-scientific: exporting the plant to Europe, the factory in India, and some early records.

EVERYTHING AFTER ITS KIND

[Christopher Wharton Mann]; 24 April 1858; 17: 451-53; 4 1/2 cols.

It is a scientific law that everything in inorganic and organic life is true to its kind. The attempts of "learned men" to show that man has developed from the monkey are "utterly unsupported by facts." What is called "the germ-power" always strives to develop after its kind and to make each new individual repeat the form of its parents and pass through the same transitions. The author gives many examples of this principle in natural history: a lobster can grow another claw if it loses one; a worm can live even when cut in half; the "Hydra viridis" (presumably a freshwater polyp) continues to multiply when cut up. In human beings the principle is illustrated in the way blood vessels re-grow during the healing process in a large open wound.

THE FIRST IDEA OF EVERYTHING

[Eliza Lynn Linton]; 8 May 1858; 17: 481-84; 6 3/4 cols.

Prototypes exist in nature for virtually everything man claims to have discovered. Geometrical and numerical patterns are to be found: crystals always have the same form, the seasons and even colour combinations existed as patterns in nature long before man discovered "laws" about the subjects. Many examples are given. The author mentions the *Vestiges of the Natural History of Creation* (1844) and its theory that "the lower contains the germs of the higher; and, from the multiples of the simplest form of addition, spring both the highest forms of vegetable life and the widest scientific combinations." "Was any such scientific secret lying hidden beneath the roots of the old Brahminical lotus bearing the triune God--Creator, Preserver, and the Destroyer--as belongs emphatically to the supreme and archetypal Hand?" asks the author. Two previous articles, "Crystals" (2 May 1857; *HW* 15: 414-19), on the geometric laws of crystals, and "A Spider in Disguise" (5 April 1851; *HW* 3: 46-48), on the way insects match their environment, and also Michel Eugène Chevreul's* *Theory of Colour* (1854) [trans. from *De la loi du contraste*

simultané des couleurs' (1839)], on chromatic laws in nature, are referred to. Nature is "our great schoolmistress": "In nothing have we originated ideas, in nothing have we created." So the conclusion is reached: "Turn where we will for science, for art, for poetic imagery, for human characteristics, we still find prototypes and models in Nature . . . the more we truly know of Nature, the greater must be the admiration and wonder, and the more profound the humility, with which we pass from her to her Creator."

NEW WHEELS WITHIN WHEELS

[Edmund Saul Dixon]; 15 May 1858; 17: 505-09; 9 cols.

The article refers to "The First Idea of Everything" (8 May 1858; *HW* 17: 481-84) in the last number which argues that there is nothing new under the sun. Yet many new facts, principles, and laws are coming to light, such as a new idea in physics about the spheroidal state, supposedly just discovered and described in Pierre H. Boutigny's* book, *Études sur les corps à l'état sphéroridal* (Paris, 1857). Before Boutigny, many French scientists had performed similar experiments. Through his experiments on starches, Boutigny observed that "a body is in the spheroidal state when its temperature remains fixed or unchanged upon a surface with which it has no contact, and the temperature of which surface may be raised indefinitely." The discovery is said to be sure to bring about important modifications in physical and chemical theory and can thus be considered as beginning a scientific revolution. It is said to be "an immense circle of discovery, comprising natural philosophy, chemistry, geology, astronomy, perhaps even universal nature." For example, no more steam boilers will ever explode, and we will discover new theories about lightning and the formation of coal. The author of the article seems only half convinced, but does not take up the questions raised. Caught up in his own eloquence, the writer ends by leaving us in

suspense because we shall wait "two or three generations" before "a more precise degree of knowledge shall have been attained."

A SWEEP THROUGH THE STARS

[Edmund Saul Dixon]; 22 May 1858; 17: 531-35; 8 3/4 cols.

The author describes the planets which revolve around the sun and the sun spots first discovered by the Jesuit, Scheiner.* Observation of the spots revealed that the sun completed its revolution every twenty-five and a half days. Other information is given: the force of gravity is twenty-eight times as powerful on the sun's surface as on the surface of the earth; the constituents of the sun; the nature of its luminous portion; and its movement. The author quotes the opinions of many authorities such as Herschell,* Arago,* Thomas Woods,* Laplace,* Buffon* (and his cosmological theory), and Boutigny.* Following his French authorities, the author suggests that the planets and meteors within the solar system were once part of the sun. But where, then, did the sun come from? "To what first commencement can we trace the life, the laws, and the movement, which the Eternal Almighty Ruler has ordained to exist"? All we know is that before the world was made "there was One who ruled from everlasting, and who will rule world without end."

THE ETHER

[Edmund Saul Dixon]; 29 May 1858; 17: 558-60; 5 3/4 cols.

Descartes' theory that every planet has a smaller ethereal vortex like a whirlpool which causes its moon to revolve round it was updated by Newton, who suggested that the sun's attractive force makes the planets revolve around it. Yet Newton could not explain the

source of the force. Monsieur Encke* of Berlin observed that the comet named after him decreased its orbit each time it circled the sun. Using Encke's observations, Arago* argued that there is a kind of gaseous substance in space called ether that affects the resistance of orbiting objects. The precise nature of ether has become a controversial object. Sir William Robert Grove* in his *On the Correlation of Physical Forces* (1846) had already remarked that the presence of ether is evidence that space is not a vacuum, as Newton had believed. According to William Prout,* ether was an unweighable fluid which could be liquefied under great compression and extreme cold. Other hypotheses suggest that ether may be a source of electricity, magnetism, and light. The controversy about it is not yet settled. At the Institute of Paris in August 1856, a prize was given to Armand Hippolyte Louis Fizeau* for his study of ether, and the measurement of the speed of light.

JOURNEY TO THE MOON

[Edmund Saul Dixon]; 5 June 1858; 17: 583-88; 10 cols.

All travel and discovery are exciting, and Charles Henri Lecouturier,* the head curator of the Musée des Sciences in Paris, now offers us a chance to have a half-hour visit to the moon through reading his book, *Panorama des Mondes, Astronomie Planétaire* (Paris, 1858). The French scientists are undoubted catastrophists: they believe the moon was formed by an "explosive eruption of inconceivable extent," which shot from the Earth and blew away large fragments into space, some of which became the moon. On earth, the action would have destroyed all existing life forms and cleared the way for a "new creation." If we could stand on the moon, we would find it desolate, monotonous and lacking an atmosphere. We would be able to see the earth, looking beautiful, glowing, and rotating in its orbit. Lecouturier considers the possibility of a future "fearful catastrophe" and the possible consequence of the total extinction of all life, but the author believes that

only "the Great Ruler of the universe" can tell. Scientists who have predicted the future of the earth and the extinction of existing animals include Antoine-François Passy* in his *Geological Description of the Department of the Seine Inférieur* [trans. from *Description géologique du département de la Seine-Inférieure* (Rouen, 1832)], and Monsieur Élie de Beaumont.* The author concludes: "thus, the boldest deductions of modern science accord with the declarations of Holy Writ, that the earth shall one day melt with fervent heat, and that there shall be new heavens and a new earth."

[CHIP:] THE GOLIATH AMONG BRIDGES

[Henry Morley]; 12 June 1858; 17: 607-08; 1 col.

An enormous railway bridge called the Victoria is now under construction in Canada. It crosses the Saint Lawrence River and is being built by the engineers, Robert Stephenson* and A. M. Ross (engineer in chief of the Grand Trunk Railway). The article gives information on the method of construction, the materials used and the cost. The bridge is expected to be finished probably by the end of next year. A model of it can be seen in the Canadian department of the Crystal Palace.

VITAL HEAT

[Edmund Saul Dixon]; 19 June, 1858; 18: 13-18; 10 3/4 cols.

Jules Gavarret,* professor at the Faculty of Medicine of Paris, has written a book [*Physique médicale de la chaleur produite par les êtres vivants* (Paris, 1855)] about how living creatures maintain their temperatures more or less independent of the life around them. The author says he is indebted to Gavarret's work "for the substance of this article,"

which is about the fact that all living creatures normally exist at a higher temperature than the environment. The formerly held belief that the so-called cold-blooded animals, such as whales and dolphins, have the same temperature as the water around them has been disproved. The article gives exact details of the results of investigations into the temperature of various creatures, including man. The author writes at great length, and is clear and precise in giving scientists' names (including Priestley,* Lavoisier,* Swammerdam,* Réaumur,* Newport,* Nobili,* Melloni,* Lagrange,* etc.) and in describing the way in which body heat is physiologically provided and maintained in different species.

STRAWBERRIES

[Edmund Saul Dixon]; 3 July 1858; 18: 60-64; 8 cols.

Botanists tells us that a strawberry is not a berry. According to Rembert Dodoens,* the physician of Malines, the strawberry's medical properties were valued by the ancients more highly than its Epicurean merits. The history of how various original species came to Britain from foreign countries is described, especially the latest importation of the new California species propagated by Van Houtte. Elisa L. Vilmorin [wife of Pierre Vilmorin*] is about to publish a monograph on strawberries which is considered to be valuable to the botanist and fruit-grower. The author describes in detail the best conditions for cultivating strawberries, the methods of propagation, improvements in English cultivation of strawberries since 1818, the many varieties and the prices they fetch in the market. As observed by Dr. John Lindley,* modern English strawberries are the results of many years of experiments started in 1818 by Thomas Andrew Knight,* a great physiologist and horticulturist. Finally the author advocates a project for cultivating perpetual strawberries, as has been done with the cultivation of roses.

OZONE

[Edmund Saul Dixon]; 7 August 1858; 18: 169-73; 9 3/4 cols.

Dr. Letheby's* report on the sanitary state of London mentioned two reasons why people escaped from serious epidemic disease earlier in the year when the Thames became so polluted by sewage: the clay in the river bed had a cleansing effect, and the unusual amount of ozone in the air helped to oxidize the organic poison. The article goes on to summarise published work on ozone. The inventor of the term, Monsieur Schoenbein, Professor of Chemistry at Bâle, described ozone as a compound of oxygen and hydrogen, but various French scientists (Marignac,* De la Rive,* Frémy* and E. Becquerel*) proved it to be electrified oxygen. It was then mainly studied from a chemical point of view, though later by meteorologists and medical men, such as Henri Scoutteten,* head physician of the Military Hospital at Metz from whose book, *L'Ozone* (1856), this article is taken. According to Scoutteten, ozone is the cause of atmospheric electricity, aqueous meteors, and barometer changes, and it can oxidize the air. In meteorology, a study which William Herschell* compared to "a romance," ozone helps to explain the cause of tempests. Its active power and changeable nature make it useful in medicine and agriculture, in the bleaching of cloth and as a disinfectant. More scientists and their studies are referred to. Details are given of how to produce it in the laboratory. Monsieur Wolf* claimed that it seemed able to defeat cholera. Examples are given showing that the relationship between ozone and epidemic illness is not always certain, and though it can be a defence against illness, too much of it turns out to be harmful.

THUNDER AND LIGHTNING

[Eliza Lynn Linton]; 4 September 1858; 18: 270-74; 8 1/2 cols.

Without indicating its sources, the article cites the work of Professor Domenique Arago,* the French physicist, and near the end refers to the "archives of the Académie des Sciences," no doubt taken at second hand. It gives detailed explanations of how lightning is caused, the role of clouds and geography in storms, the chemical, mechanical and physical effects that can follow lightning and thunder, and other facts about the frequency of storms throughout the world. Following Arago, the article discusses forked, sheet, and spherical lightning, then summer lightning, thunder without lightning, thunderbolts, and the effect of lightning.

THE HARVEST MOON

[Edmund Samuel Dixon]; 11 September 1858; 18: 293-96; 6 cols.

The article is a mixture of scientific facts and Dixon's personal observations of the moon. He begins with some remarks comparing scientists' limited knowledge of the moon with the much greater knowledge of the sun, as described by Hippolyte Fizeau* and Jean Bernard Léon Foucault,* Professor William Thomson* of Glasgow, Sir John Herschel,* Professor George Stokes* and Sir Henry Englefield.* He then turns to the moon, and quotes the words of James Glaisher of Greenwich who dismisses some scientists' suggestion that the weather is affected by the moon. Herschel's* *Outline of Astronomy* (fifth edition, "just published") is referred to in support of the idea that moonlight dispels cloud, and quotes Herschel's statement that the surface of the moon "must necessarily be very much heated," possibly above 100° centigrade. Dixon adds his personal observations of what he believed to be moonlight dispelling clouds, an effect he describes as "one of the great mysteries of nature." He speculates that there is a scientific reason for the "unseen influences" of the moon on men and women, a "direct action" which will one day be explained: "Professor Faraday suspends a man in the air, and the man swings into a given

line, obedient to the unseen forces of the earth. We have to learn what are the unseen influences of the moon."

CALLING BAD NAME

[William Lowes Rushton]; 18 September 1858; 18: 332-34; 3 1/2 cols.

The article is about scientific nomenclature. Scientific names with long syllables are "the scientific bully" and the author urges people to use simple language. Men of science hold that a special scientific language is required because ordinary words are not exact enough. Yet to the ordinary people, short and simple words are better than long ones and jargons because they can "be known familiarly and pleasantly in any home." Though scientists may have Latin nomenclature for everything, people can use English nomenclature to call everything in nature. There is not need for scientists to create unnecessary difficulties. "That the language of science must be universal, and that a dead language is neutral ground on which students of all nations may meet, we know and acknowledge." Even Latin or Greek words need not be so used. Scientific naming should be "for some regard to human teeth and human ears" and the author asks for a second names fitted for popular use. The way the German writers write (to use "plain and homely speech" and to give the Latin and Greek terms in brackets) is taken as a good example.

SAFE HARBOUR

[Henry Morley]; 2 October 1858; 18: 372-77; 8 1/2 cols.

The article is based on Edward K. Calver's *On the Construction and Principle of a Wave Screen, Designed for the Formation of Harbours of Refuge* (1858). It explains the

physics and geometry of ocean waves as measured by a number of scientists, engineers and astronomers in recent decades. For example, waves are caused by wind rubbing the water and are the movements on its surface only; tides are "friction deep-water waves." They can cause serious damage to the shoreline and ships. In contrast to deep sea waves are the breakers formed in shoal waters. To measure the strength of a breaker, the force is represented by its weight multiplied by its speed. Such calculations have enabled engineering scientists to conclude that the most effective type of breakwater is the upright wall because it does not convert the deep sea undulations into breakers. Calver's invention is of this type: its object is to "produce sufficient circulation of currents . . . and at the same time to have sufficient solidity to break the sea--a most ingenious and scientific principle."

FIVE COMETS

[Edmund Saul Dixon]; 16 October 1858; 18: 409-12; 7 1/2 cols.

The author seems to have based this article and the two following, "Farewell to the Comet" (30 October 1858; *HW* 18: 463-66) and "Chips from the Comet" (20 November 1858; *HW* 18: 541-44) on the same French sources, including the *Journal Astronomique*. He quotes the same scientists throughout the articles, and repeats some information and observation. Here, he remarks that five comets were observed in the previous year, two of which were referred to in one of his earlier articles: "The Ether" (29 May 1858; *HW* 17: 558-60). Encke's comet, and Faye's* comet, were observed by Monsieur Bruhns at the Berlin Observatory and mentioned by Le Verrier* in *The Journal Astronomique* (14 September). Only Donati's* comet is visible to the naked eye. The author discusses the nature of comets and the rarefied comet-tails, which seem to be attenuated, and through which even faint stars can be seen. There is less certainty about how much substance is contained in the nuclei of comets. It is clear that comets are frequent, and were there

sufficient observatories it is likely that there would never be a moment when some comet or other was not visible from the earth. Comets have popularly been believed to foretell disaster, but contemporary astronomers have proved that they are not the cause of storms, earthquakes or other natural disasters. The account comes up-to-date by concluding that though many questions about comets cannot be answered, their existence allows astronomers, for example, to weigh the planet Mercury and calculate the weight of the Earth.

FAREWELL TO THE COMET

[Edmund Saul Dixon]; 30 October 1858; 18: 463-66; 5 cols.

Donati's comet has remained visible for the last eight months, but is going to leave just as another comet is coming into view. The author notes how the public had begun to be disappointed with comets (since the arrival of one in 1811), until Donati's sighting on 2 June of a beautiful new one named after him. He reports on observations about the luminosity and shape of the comet and hopes the numerous observations of Donati's comet made by professional and amateur astronomers will help to answer the questions: What are comets made of? What role do they play in the universe? Theories which attempt to answer these questions are discussed. Commenting on Laplace's* anxiety that a comet might crash into earth, Dixon says that this is "scarcely possible": not only are comets made of nebulous, not solid matter, but also cannot enter the earth's atmosphere.

CHIPS FROM THE COMET

[Edmund Saul Dixon]; 20 November 1858; 18: 541-44; 5 cols.

The author continues his reports on the recent observations of Donati's comet. He begins with a description of how it threw off rings of light, or "luminous envelopes," as it approached the sun. Further details about its tail, nucleus, orbit and polarised light are reported. There are speculations about the ether in space, especially its density and extent. After considering different hypotheses, Dixon concludes that the most probable theory is that ether extends indefinitely and that within it is an infinite universe which preserves its "vital force" unchanged and indestructible. He finds these ideas "manifestations of the creative power."

IRRITABLE PLANTS

[prob. John Robertson]; 4 December 1858; 19: 16-18; 3 3/4 cols.

The fact that some plants display "irritability"--the botanical term--when touched cannot be explained by chemical or mechanical laws alone. Many examples of irritable plants in Britain and abroad are described, including those which trap flies and other insects. In general, such plants are influenced by light, temperature, chemicals and atmosphere. The article compares the phenomenon of irritability to Linnaeus's* discovery that plants "sleep," that is, some plants open their leaves or petals by day and close them at night. This also is influenced by light, temperature and moisture. Some examples of the "sleep of plants" are given [already mentioned in Robertson's earlier article, "The Blue Dye Plant (24 April 1858; *HW* 17: 436-38)].

MOSSES

[prob. John Robertson]; 11 December 1858; 19: 33-35; 4 cols.

The article elaborately describes mosses, their varieties, botanical structure, distribution, and the many uses they serve in nature. It mentions that the botanist Crantz* found many species in Greenland. In regard to the beautiful form of mosses, the author quotes John Gerard's* *Herbal* (1597) which expresses admiration for "the invisible wisdom and admirable workmanship of the Almighty God." Other information is taken from books including Sir William J. Hooker's* *British Flora* (1830), Nicholas Culpepper's* *British Herbal* (1653), and William Wilson's* *British Mosses* (1855). The author gives precise descriptions (such as the structure of the flower), using Latin terminology, but ends abruptly, saying that in classifying mosses "the structure of the fringe of the teeth is of the first importance."

A NEW ODDITY

[Edmund Saul Dixon]; 1 January 1859; 19: 102-05; 6 cols.

"In science nothing is absolutely new; because everything which is the subject of science has had a previous existence ever since the world began But humanly speaking, everything undiscovered is new at the time of its discovery." Baron Karl von Reichenbach,* "the inventor of creosote," has devoted his time to "perfectly legitimate and orthodox investigations . . . which are allowed to be pursued without the charge of charlatanism." The author explains Reichenbach's discovery of the so-called "od" or "odic force." He demonstrated the force to a group of German naturalists in Vienna, and his book on the subject has been translated by Dr. William Gregory.* In short, Reichenbach's theory is that every living object gives off light; for this reason, German naturalists were able to see the experiments with crystals and chemicals that Reichenbach performed in total darkness. His demonstrations are described in detail, for example, the botanist Endlicher* could recognise the colour and name of a flower in a completely dark room. All this is told

on Von Reichenbach's own authority only. To deny the reality of all this would be to accuse the German scientist of "deliberate falsehood," but the author simply concludes, "It is either a fact, or a cheat and conspiracy."

MICHELET'S BIRD

[Edmund Saul Dixon]; 8 January 1859; 19: 140-44; 8 cols.

The article is based on Michelet's *L'Oiseau* (Paris, 1856). Information such as the forms of the eggs and the wings, how birds see and fly are given in detail.

CHLOROFORM

[William Overend Priestley]; 12 February 1859; 19: 249-52; 7 cols.

The discovery of chloroform in 1831 has been of benefit to both patients and surgeons. Many examples are given of the use of chloroform to save lives and relieve pain in various types of surgery and emergency. Then the history of anaesthesia is surveyed, from the methods used by ancient Greeks, Romans, the Chinese and the Indian up to the use of ether by the Boston dentist, William Morton* in 1846. Ether caused vomiting and irritated the lungs, so the preferred anaesthetic became chloroform, as used by Professor James Young Simpson* of Edinburgh. Some people objected to anaesthesia on religious grounds, or because they thought it risky. Some theologians consider "this new child of science" an attempt to "seek immunity from the pain which God in His good Providence had seen fit to inflict upon" mankind and thus "in the highest degree sinful." However, the author thinks chloroform should continue to be used, despite the occasional fatal case:

"The science of anaesthetics is yet young" so further experience will "diminish the slight risk."

MICHELET AND INSECTS

[Edmund Saul Dixon]; 19 February 1859; 19: 280-86; 13 cols.

This is a review of *L'Insecte* (1858) by Jules Michelet* and his wife. Their other work on birds has already been mentioned in "Michelet's Bird" (8 January 1859; *HW* 19: 140-44). The present article discusses the life cycle of insects from eggs, grubs, larvae, to winged creatures. These stages seem to evoke the hope of immortality: "hope founded on justice, on the impartial love of the Creator of all things living." Studies into the caterpillar made by Lyonnet,* Jan Swammerdame* and René Réaumur* are mentioned. The author then goes on to explain Nature's plan, as designed by God: insects "were sent " to check excessive vegetation, and birds to check the insects. To illustrate this point, he sketches an imaginative picture of the primeval world where species are created and evolve in order to achieve a balance in nature and fulfill a divine plan. For example, the earliest steaming vegetable chaos supported "big-bellied reptiles." With no particular logic, he then passes on to a discussion of spiders and their habits, relating it all in a personal rather than a scientific style. "Modern science, partially and apparently, broke the spell of this ancient poetic mystery," concludes the author, but he still sees creation as a divine plan.

PHYSICAL FORCE

[Edmund Saul Dixon]; 12 March 1859; 19: 354-59; 9 1/2 cols.

The article discusses the physical forces studied in experimental physics: "light, heat, electricity, magnetism, chemical affinity, and motion." The study of these forces "constitutes the main distinction which separates ancient from modern knowledge," and it is because of them that so much material progress has been made in the nineteenth century. The author bases his article closely on William Robert Grove's* *On the Correlation of Physical Forces: Being the Substance of a Course of Lectures* (1846), and on a lecture at the Royal Institution by Alfred Smee* ["The Monogenesis of Physical Force," delivered on 18 February 1857, and later published as a pamphlet], and he expresses his indebtedness to them. The main argument is that all such physical forces are "really and ultimately one," and can be converted into each other. While changing its form, matter or force cannot be made or destroyed; it is neither increased nor diminished. The author discusses the nature of electricity, the relation of heat to mechanical force, and the convertibility of physical forces. He gives examples of friction generating heat, as in experiments by Élie de Beaumont,* Mayer* and Foucault.* He also discusses the possibility of transforming heat into electricity, as demonstrated by Babinet;* this discovery may open a new era by providing cheap electricity. Other experiments with heat and motion have the practical result of showing that present-day steam-engines are highly wasteful in fuel consumption. He concludes with a discussion of time, "a mere repetition of events, each having a beginning and an end," whereas "Eternity is not made up of events; and has, therefore, no beginning and no end."

MINERAL SPRINGS

[William Sidney Gibson]; 19 March 1859; 19: 367-73; 12 1/2 cols.

The mineral waters contain nitrogen, oxygen, carbonic acid, and sulphuretted hydrogen. There are minerals in the rains, the springs and the spas. The author generally introduces some famous springs and spas, and the minerals they contain.

WHITE ANTS

[prob. John Robertson]; 9 April 1859; 19: 449-54; 8 cols. [should read 9 1/4]

The article is based on Henry Smeathman's [d. 1786, German writer] *The Termites . . . in Africa and Other Hot Climates* (1781). There are different kinds of termites. The largest and best known species is "Termes bellicosus." The author describes their nest, the structure of their community, the three classes of them and their characteristics.

ALL THE YEAR ROUND

LIFE IN ROUND NUMBERS

[Unknown author]; 7 May 1859; 1: 31-35; 8 3/4 cols.

"As a science, human longevity . . . has been the degraded bonds slave of quacks and empirics." Remarkably, Pierre J. M. Flourens,* the Perpetual Secretary of the Institute of France, has published *De la Longévité Humaine et de la Quantité de Vie sur le Globe*, Troisième édition, revue et augmentée (Paris, 1854), in which he puts forward new ideas about life and deals with questions "completely new to the scientific world," such as "the quality of life," "the first appearance of life on the globe," "the fixity or the variability of species," and "destroyed and lost species." Instead of inquiring into the mystery of the origin of life, Flourens has thrown it "as far back as possible." He concentrates on its continuity and explains the fact that every living creature has an expected and determinate life span, and that life commences only once. Flourens's model of longevity is the ancient centenarian and Venetian architect, Luigi Cornaro [1475-1566] who wrote four discourses containing advice on how to live a long and sober life. The rest of the article summarises Flourens' medical advice about how to live a long and healthy life.

OUR NEAREST RELATION

[Unknown author]; 28 May 1859; 1: 112-15; 4 1/2 cols.

The article is on the recently-discovered gorilla, its physical appearance, habits, intelligence and similarity to man. It refers to Sir Richard Owen's* paper "Memoir on the Gorilla" read to the Royal Institution in February 1859 [published together with other papers in a collection with the same title in 1865; a presentation copy was in D's library]. It

also mentions a study of tailless apes by Cuvier,* and his misunderstandings. The account seems to be seen through an anatomist's eye, and is possibly by Owen himself.

PHOTOGRAPHIC PRINT

[Unknown author]; 11 June 1859; 1: 162-64; 3 3/4 cols.

"Photography has become a science, with a literature of her own." New chemical substances and methods for making photographs have been discovered. Many recent developments for stabilizing photographs and perfecting the process of photography are mentioned as, for example, Sir John Herschel's* announcement at the most recent meeting of the British Association of his discovery of a group of metals, one of which he named Junonium, a salt that can be acted on by light ["Address to the Chemical Section," "Notices and Abstracts" of *Report of the Twenty-Eighth Meeting of the British Association for the Advancement of Science; Held at Leeds in September 1858* (1859), 41-45]. "A Mr. Pouncy" has discovered a new "method of printing in carbon" and may win a prize. Quintino Sella* of Biella in Piedmont has pointed out a way of using salts of iron and chromium in printing instead of those of silver and gold, and so on. Techniques are improving as further discoveries make the processes simpler and cheaper; details about them and their differences are given. The writer mentions Charles Nègre's [(b. 1820; *ABF*), French painter] process demonstrated at an Exhibition of Photographs at South Kensington in 1858, and the recent application of an electrotpe process which makes it possible to coat a copper-plate with steel in order to produce several impression of a single photograph.

THE ENGLISH PEOPLE'S UNIVERSITY

[Unknown author]; 16 July 1859; 1: 279-83; 8 3/4 cols.

Although about the new University of London in general, the article also deals with how the university has been affected by the importance of science. The university is to institute a new degree of D. Sc.

GAMEKEEPER'S NATURAL HISTORY

[Unknown author]; 10 September 1859; 1: 473-76; 7 1/2 cols.

The author argues in a lively way that gamekeepers who have spent their lives "observing living things, and studying their ways" rather than "reading other men's thoughts" know more about the habits and customs of wild animals than a professor who never goes into a field. He criticises students who may have read a French writer's work on natural history without having elementary information about the food or habits of common animals. He urges English natural history to be written now because some animals are vanishing. It should not be written "from stuffed animals," but be "open air natural history" such as that written by John James Audubon,* Gilbert White* and John Gould,* and "more of it and deeper of it." He then mocks a "Professor Mole" who cannot describe foxes in plain English or study proof and evidence, but only writes incomprehensible arithmetical cyphers and rambles about trivia. The article ends with a visit to a gamekeeper, relating some of his stories.

CLOCKS MADE OF FLOWERS

[Unknown author]; 22 October 1859; 1: 606-8; 5 cols.

Botanists know that plants usually bloom at a definite period in their existence; this is called "periodicity." Gilbert White* used the vernal and autumnal crocus to illustrate the law of periodicity, which is influenced by climate, temperature, light, and moisture. Some botanists, including Linnaeus,* have made dials or clocks according to the periodicity of plants. Examples of the periodicity of different flowers and naturalists' experiments are described.

SMALL SHOT: COOKS AT COLLEGE

[prob. Wilkie Collins]; 29 October 1859; 2: 6-7; 2 1/4 cols.

A personal experience with an incompetent cook is used to satirize the privileged classes and to advocate "scientific" education for all, paupers and cooks included. The author writes:

I look on her [the cook] as a perverter of the gifts of Providence, and, therefore, as an ally of Apollyon himself. The effect of fire on solids or fluids, the law of boiling, the nature of imprisoned juice, the science of condiment, are as unknown to my plain cook as the pleasures of dancing are to a hippopotamus, or the joys of pedestrianism to the great sea serpent. She never thinks; she did not take my wages to think.

Yet the author provides the remedy for this ignorance--"to build an Oxford for cooks," and to give them "lectures on the elements of the chemistry of cooking." What he is really arguing for here is colleges or schools of "domestic science."

SINCE THIS OLD CAP WAS NEW

[George Augustus Sala]; 19 November 1859; 2: 76-80; 8 1/2 cols.

The article advocates progress and reform. A "conservative friend" condemned the tendencies of the present age and wider education. But the author approves of progress, seen "since this old cap was new," and argues that people have rightly become accustomed to new things such as "gas, stem braces, coach-springs, Lucifer matches," in everyday life. He goes on to say: "How the world slid into railway life is a marvel of marvels." But since then railway companies do not seem to have improved. Moreover, advertising in railway stations has "grown into an elaborate science--and a very offensive, impertinent science too--tending chiefly to the glorification of impudence and the success of lies." He points out some more disadvantages of the railways and advocates further improvements. Then he turns to photography, ballooning, cotton-spinning machinery, and the use of new materials such as gutta-percha. Among recent changes in everyday life is the oddity that even the animals in the fields which trains pass through are no longer frightened by the trains. The author concludes that "every year and every day" we see "new Things, that are built up on the ruins of the effete and useless past."

HOUSE-TOP TELEGRAPHS

[John Hollingshead]; 26 November 1859; 2: 106-9; 6 cols.

About twelve years ago, a "pot-house proprietor" offered a glass of ale and an electric shock for fourpence. Though such a "combination of science and drink" was "more than doubtful," it was topical. The time may come when people will fly to the moon as described in the seventeenth century book on aerial navigation by Bishop John Wilkins* [*Discovery of a World in the Moon* (1628)]. The article describes the work of the new

London District Telegraph Co., which has set up one hundred and sixty miles of wire on London housetops. The householders' misgivings are mentioned, but these are outweighed by the benefits the telegraph will bring. Finally, Professor Charles Wheatstone's* new and much more efficient portable telegraph machine is described. It is easy to operate, and will make telegraph cheaper, more effective and more popular.

THE ELEPHANT AT HOME

[Unknown author]; 3 December 1859; 2: 129-32; 7 1/2 cols.

The article introduces Sir James Emerson Tennent's work on *Ceylon* (1859) [in CD's Library] from which it takes new information, and raises such questions as why in Ceylon only one elephant in a hundred (always a male) has tusks. The article discusses elephants' habits and characteristics, correcting old mistaken ideas. It gives "arguments from evidence in favour of the fact which Professor Owen* has suspected," but which no naturalist has asserted, that the elephant's "long narrow stomach divided into cells by many folds at the end" has the same function as the camel's and the llama's. Finally the article recommends readers to read Tennent's book because it discusses other topics "equally original, and equally sound."

INVENTORS AND INVENTIONS

[prob. Henry Morley] 4 February 1860; 2: 353-56; 6 1/4 cols.

John Timbs* new book, *Stories of Inventors and Discoveries in Science and the Useful Arts* (1860) mentions many examples, including Archimedes, Columbus, Guttenberg (fifteenth-century inventor of "small napkin-press-like printing machine"),

Evangelista Torricelli,* Blaise Pascal,* René-Antoine Ferchault de Réaumur* and Daniel Gabriel Fahrenheit* (the inventor of the barometer and thermometer), the unnamed American inventor of a diving-bell, several inventors of early automata and Professor Faber [perhaps Adolf Friedrich von Faber du Faur*], who was said to have invented an automaton in 1846, inventors of steam-engines and telescopes, and so on. Names of contemporary scientists such as Herschel,* Brewster,* and Davy* are mentioned in passing. The main point is that many inventors have suffered poverty and distress, have been wronged or unrecognised by their contemporaries, and have had great difficulty in presenting their ideas and work. The author considers controversies about gas street-lighting in 1825, and the attempts of scientists to find other means such as electric light and "the lime ball," to provide it. He optimistically foresees future progress, predicting the invention of better and cheaper street lighting.

Pilgrim 9: 208, to Lord Brougham, 5 February 1860: "I am most heartily sorry that you have been misrepresented (however innocently) in pages under my control. The paper in question is not of my writing, but had been confided, by myself, to a very responsible and trustworthy hand. In going over the proof, I, of course, observed a reference to you--but thought it curious and interesting--and never in the least doubted it. It is in these words, and no more:--'Brougham bitterly ridiculed Accum the chemist, and one of the upholders of and believers in, the idea [of street-lighting by gas].'" Dickens also wrote a "Note" (25 February 1860; *AYR* 2: 416) to amend the statement, saying that though Lord Brougham was the counsel in an action brought against the gas company, he never set himself against the idea.

RESUSCITATING ANIMALS

[Unknown author]; 18 February 1860; 2: 387-92; 10 cols.

Is it possible to resuscitate animals? There are many kinds of animalcules including rotifers, tardigrades and anguillules. Some of them can be seen under an inexpensive microscope or are even visible to the naked eye. They are certainly gifted with an extreme tenacity of life. It has even been believed by some recent writers, such as Dr. William Benjamin Carpenter* in his *Microscope and its Revisions* (1856) and the *Micrographical Dictionary*, that rotifers can be brought to life again after death. The writer of this article has often tested this theory and proved it wrong. He then blames Carpenter for not relying on microscopical observation but on old authorities like Lazzaro Spallanzani.* Others such as Philip Henry Gosse,* who has made a thorough study of the Wheel-bearers, and Félix-Archimède Pouchet* (the director of the Museum of Natural History and Professor at the School of Medicine and at the Superior School of Science at Rouen), have cast doubt on the idea of animal resurrection. Yet there are still people who believe it. There is further lengthy discussion and illustration, based on Pouchet's work. The article ends abruptly with details of how he has shown that animals cannot bear the temperature of boiling point (100°).

INFALLIBLE PHYSIC

[Unknown author]; 3 March 1860; 2: 448-52; 8 1/2 cols.

Quacks are classified as of two kinds: "one offering to the world an universal panacea for all diseases and all cases of disease; the other professing a speciality, or confining themselves to the treatment of special diseases." Quackery is seen in many advertisements for drugs and remedies. Many examples are given, including Kinesipathy, whose practitioners "rub and pinch the body after a peculiar fashion" in order to cure all sorts of medical and surgical problems. The author quotes a report in the *Quarterly Review* ["Review of John Francis's *Annals, Anecdotes, and Legends: A Chronicle of Life*

Assurance (1853)," by Abraham Hayward, July-October 1859] about the treatment of cancers by shampooing. Several other so-called "cancer curers" are described. The author blames newspapers for printing many astonishing advertisements, and suggests the need for a board of censors to examine medical advertisements and help the public distinguish between legitimate announcement and quack cures.

HOW LONG WILL OUR COAL LAST?

[Unknown author]; 17 March 1860; 2: 488-90; 5 cols.

Coal is limited. People are alarmed that without other sources of fuel, life will be difficult when coal is exhausted. The author carefully calculates the amount of coal in known fields in Britain, and estimates it will last six hundred years at the present rate of consumption. Yet the calculation is based on many assumptions. About large stores of coal in other countries, he says, "there is no fear that coal will perish out of the lands" which "nature has been storing up for man." Yet he predicts that the time will come when coal will be more expensive and the gradual exhaustion of coal will lead to the discovery of a substitute.

NATURE'S PLANTING

[Unknown author]; 24 March 1860; 2: 508-11; 5 1/2 cols.

Plant seeds are scattered by many methods such as the wind, the rain, seas and rivers, by their being ejected by the plants' own seed-vessels, or carried by animals. In introducing the different ways plants distribute their seeds, the author refers to Spencer Thomson's* *Wanders among the Wild Flowers; How to See and How to Gather Them* (1854), William

Derham's* *Physico-Theology* (1713), an article on the rose in *Household Words* ["Roses" (15 September 1855; *HW* 12: 158-64)], and Dr. Hans Sloane's* *Voyage to Jamaica* [*A Voyage to the Islands Madera, Barbados, Nieves, S. Christophers and Jamaica with the Natural History of the Herbs and Trees, Four-footed Beasts, Fishes, Birds, Insects, Reptiles, &c.* (1707-25)]. Charles Martin, the Professor of Botany at the Montpellier Faculty of Medicine, in a letter to Marie Jean Pierre Flourens,* later communicated to the Academy of Sciences, said that about two-thirds of all seeds float on the sea and explained why plants or trees that Humboldt* said were in Jamaica and Cuba are found on the shores of the Hebrides. Other authorities are cited, including Dr. Tancred Robinson,* who wrote about how sea-weed produces its seeds and scatters them, and Gilbert White.* The quality of seed produced, and plants' propagation by shoots are also noted.

ODD FISH

[Unknown author]; 24 March 1860; 2: 516-17; 3 cols.

This is about fish out of water. The kind of fish that has the power to leave a river and "walk" on the land generally has "the pharyngeal bones" at the back of the mouth about the gullet. When taken out of water and placed on the ground, such fish instinctively direct themselves to the nearest water. Many authorities are mentioned including William Yarrell,* books on angling [e. g. *Angler's Assistant; Being An Epitomy of the Whole Art of Angling . . .* (1751)], William Kirby's* seventh *Bridgewater Treatise* [*On the History, Habits, and Instincts of Animals*, 2 vols. (1833), 1852 ed. in CD's Library], and Jean-Baptiste Pallegoix.* The article draws on a full account of such "walking fish" given in Sir Emerson Tennent's *Ceylon* (1859). "Singing fish" which Tennent saw in Batticaloa are also described.

DELUGES

[Unknown Author]; 21 April 1860; 3: 40-47; 12 1/2 cols.

This is a curious farrago, taken from the work of French scientists, especially Alphonse Joseph Adhémar* and Victor Meunier,* arguing that there are periodic great deluges of the Earth. Adhémar has predicted that a Flood as great as Noah's will inundate the earth 6,300 years from the time of writing. The article summarises his theory as recently presented by Victor Meunier. As the author comments, "The warning Noah received through supernatural means, is now given by science to the whole human race." Nevertheless, the author compares this theory, which he admits cannot be proven, with some established facts about geological history, such as the formation of continents, oceans and mountain ranges that took place hundreds of thousands of year ago.

SPECIES

[Unknown Author]; 2 June 1860; 3: 174-78; 7 3/4 cols.

The account is carefully argued. The author attempts to deal fairly with different points of view, and takes note of the fact that because the various "species" appear to show "a series of forms," it does not necessarily follow that we can argue that there has been a development of successive sets of creatures. Yet it appears a plausible hypothesis that life has developed from "a very few primordial forms into which life was first breathed by the Creator Every living creature is the lineal descendant of some creature that has lived before it It has survived during the process of natural selection."

The author argues further against successive creations, and asserts that there is a "Supreme Overruling Power," which sustains creation once in existence," a creation "so

complicated and perfect, that it can only be sustained by an All-wise, Almighty Divinity." Even so, we may wish to believe that the adaptations of created beings to the world have not come about through supernatural power but by a natural agency. "Natural Selection. . . according to Mr. Darwin--not independent creations--is the method through which the Author of Nature has elaborated the providential fitness of His works to themselves and to all surrounding circumstances." It urges that "we ought not to feel greatly surprised, nor need our self-esteem be deeply wounded."

He goes on to quote from Darwin's *Origin* on the way in which plants and animals are "bound together by a web of curious relations," on the distribution of species, and the great passage of time needed for their development. The multiplication of humans may lead to the extinction of other species, but urbanisation and war are checks on mankind.

EARTHQUAKES

[Unknown author]; 9 June 1860; 3: 197-201; 7 cols.

After learning how often there have been earthquakes that have affected London in the past few hundred years, we are told two observers--Robert Mallet,* a mathematician, scientist, and civil engineer, who had proposed to the British Association to do research into it ten years ago [Mallet's "Reports on the Facts of Earthquake "Phaenomena" are published in 1850, 1851, 1854], and a French scientist M. Perrey [perhaps Stephen Joseph Perry*] have independently been collecting information and ranging widely in their inquiries. The account is hardly rigorous. It concludes that statistics seems to show that there is a periodicity in earthquakes, which may relate to the seasons, the relation of the earth to sun and moon, to magnetic conditions, to the planets and even sun spots. It ends by quoting Newton's famous words: "I seem to have been only like a boy playing on the

sea-shore, and diverting myself in now and then finding a smoother pebble, or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me," and says that although "no second Newton has yet arisen," investigations about earthquakes also "represent pebbles on the shore of the ocean of truth." It hopes "it will not be long before they are placed in the proper niche in the cabinet of science."

THE MATCH QUESTION

[Unknown author]; 9 June 1860; 3: 209-12; 5 cols.

French scientists have been considering the pros and cons of Lucifer Matches: though extremely cheap and convenient they are poisonous. White phosphorus is poisonous and too easily accidentally ignited. But it can be "regenerated" or reproduced, while red amorphous phosphorus is not easy to obtain pure. Perhaps we shall return to using the tinder box with flint and steel. The author says that, looking at a tinder box, a poet "cannot strike a light without touching on some of the most thorny questions of physical science; he is fairly launched on the full stream of the Correlation of Physical Forces." The contents of a tinder box are described, and the chemical change in the process of generating fire.

Yet the author does not agree with the French on banning Lucifer matches totally for they "offer more advantages than dangers." A heavy tax might help to avoid their abuse. There are altogether five kinds of safety match: common Lucifers (or "allumettes chimiques"), red phosphorus matches, androgynous matches, matches with rubbing plates and non-poisonous matches. Each is suitable under different circumstances. For example, the first is the cheapest and easy to use but causes "necrosis" or bone-decay (or cancer). Red phosphorus is not yet available to the public, because of its French patent. The article ends appreciating the tinder box again.

AN IMPORTANT MATTER

[Unknown author]; 30 June 1860; 3: 270-74; 7 1/4 cols.

The account given is based on the pamphlet, *Small-pox and Vaccination Historically and Medically Considered: an Inquiry into the Causes of the Recent Increase of Smallpox and the Means for its Prevention* (1860) by Dr. Alfred Collinson. John Simon,* medical officer to the Privy Council, has made an inquiry and three reports about vaccination. The article traces historical records of small-pox, how it spread all over the world, how many people have been blinded or killed, some ways to avoid the infection, and how Dr. Edward Jenner* introduced vaccination. Other medical doctors' experiments are mentioned. It goes on to deal with the practical side of vaccination, and the present need for the "renewal of the vaccine matter," the operation of the National Vaccine Establishment, and compulsory vaccination.

NATURAL SELECTION

[Unknown author]; 7 July 1860; 3: 293-99; 11 3/4 cols.

Darwin's* theories about evolution are much more acceptable than they might have been, because "one heresy prepares the way and weakens the shock," and because we have already become accustomed to new ideas and discoveries in geology and astronomy. Yet as the author says, "the world in general is quite unprepared to hear his unaccustomed views propounded. The propositions are so unfamiliar that, be they false or be they true, they are almost sure to meet with a flat denial." It is necessary to examine and debate Darwin's propositions in order to understand them and see their probability. They have already partly been outlined in the earlier article on "Species" (2 June 1860; *AYR*, 3: 174-78).

The distribution of species is referred to again; also the way in which allied species, when placed under different circumstances, still appear to follow nearly the same instincts. The argument does not follow Darwin correctly at all times, as for example when it supposes that natural selection is somehow to blame (apparently not perfect, but liable to mistakes) because the cuckoo ejects its "foster-brethren" from the nest. It is equally hostile in complaining that Darwin sometimes assumes the need for "hundreds of millions of generations" to work out slight yet profitable changes. The author tenaciously argues that Darwin's arguments often depend on his mere assertion that something is probable because it fits his general theory.

Counter experts are referred to such as Pierre-Hippolyte Boutigny,* "a savant of high rank in his own country," who has argued that because the moon was once ejected from the earth, something similar may happen again; or "Messieurs Joseph Alphonse Adhémar* and Henri Le Hon*" "distinguished men of science," who have argued that the Earth is periodically the subject of a giant deluge [see "Deluges" (21 April 1860; *AYR* 3: 40-47)]. Yet the account then returns to the simpler mechanisms of natural selection, though it is concerned with specifying, elaborating and questioning many of the details on which Darwin bases his arguments.

The author whole-heartily appreciates Darwin, his close observation, intellectual ability and boldness of speculation and describes the opposition to him and his disciples. He himself is a willing theorist, and is imaginatively stimulated to remark that, "We are no longer to look at an organic being as a savage looks at a ship--as at something wholly beyond his comprehension; we are to regard every production of nature as one which has had a history." Yet he concludes that "Natural Selection can only act through and for the good of each being," and Darwin's theory will itself be subject to the process of natural selection.

THE COMING TIDE

[Unknown author]; 18 August 1860; 3: 447-51; 8 1/4 cols.

The article mentions the coming equinoctial high tide due on 16-17 September, and goes on to deal thoroughly and scientifically with tides in general, their cause (gravitation), and the attraction of the moon and sun. It deals with the measurement of high and low water, and "the equilibrium of the ocean." There are unsolved problems, including the nature of the moon's effect on the atmosphere. It ends by describing an experiment with a friction-charged "electrophore."

THE GREAT SOWER

[Unknown author]; 13 October 1860; 4: 9-11; 4 1/4 cols.

Linnaeus* said that "the first cause," for the dissemination of seeds" is "the force or power of the air," and that we should therefore admire "the providence of the creator who sends his winds" to disperse the seeds. Others are distributed by animals, by water, or because of their own design.

SANITARY SCIENCE

[Unknown Author]; 20 October 1860; 4: 29-31; 3 1/2 cols.

The article is on poor sanitation in Britain. Architects lacking any knowledge of sanitary laws and efficient scientific knowledge have designed buildings made with easily rotting or poisonous materials unsuitable for people to live in. This is a very general account of public health, sanitary laws, drains and sewerage, without being directly scientific.

STONE FOR BUILDING

[Unknown author]; 24 November 1860; 4: 149-52; 6 1/4 cols.

After the fire of 1834 had destroyed the old Houses of Parliament, they had been rebuilt (starting in 1840), and there had been a commission to examine the results. More recently there has been an outcry about the rapid deterioration of the stone used in the rebuilding; yet though the article is in general terms about the choice of building stone, which could reduce decay, and its selection with reference to the style of any building, it does look scientifically at the materials chosen. The men who had reported in 1839 are called "scientific commissioners," in spite of some of their mistaken conclusions. Yet the author criticises them for relying more on artistic feeling than on scientific knowledge, saying of certain decisions: "These are curious remarks for eminent scientific commissioners to make; they savour more of artistic feeling, of an eye for colour, than of sound, rigid, scientific induction" [A new report was made in 1867].

WATER EVERYWHERE

[Unknown author]; 8 December 1860; 4: 202-5; 5 1/2 cols.

The account is based on Professor David Thomas Ansted's* *Geological Gossip* (1860) to explain the part water plays in "the transformation continually going on in our earth." "Magnetism, central heat--if there be such a power--the earthquake, and the volcano play their parts," but none greater than water, through its action in rivers, seas, ice, or chemical change. Archeological investigation in the Nile delta has proved that men lived there at least 11,400 years ago; and men have begun to plumb the depths of the sea. Robert Mallet* and Professor Perry of Dijon [perhaps Stephen Joseph Perry*] are mentioned as having catalogued about six or seven thousand earthquakes; Sir David Milne's [(1763-1845;

DNB), admiral; navy lieutenant and commander] ideas about the subject are also referred to. Some account is given of changes made by water and some geological information. The author ends: "Only Mr. Ansted's book itself, can show how pleasantly and usefully its writer gossips about the newest discoveries in the fascinating branches of science" [Ansted's book include chapters on river and water-floods, the ocean and its inhabitants, the Interior of Africa and Australia, earthquakes and volcanoes and many new geological discoveries. Chapter 9 of the book, entitled "The Battle of Life," is devoted to Darwin's evolutionary ideas including quotations from *Origin of Species*, such as: "In looking at nature it is most necessary...never to forget that every single organic being around us may be said to be striving to the utmost to increase in numbers . . . that each lives by a struggle at some period of its life, that heavy destruction inevitably falls either on the young or old . . ." [In the next volume of *All the Year Round*, Ansted himself contributed the article "Recent Discoveries Concerning Light" (15 June 1861; *AYR* 5: 270-72).]

WONDERS OF THE SEA

[Unknown author]; 5 January 1861; 4: 294-99; 11 cols.

An extensive if general article on oceanography, giving a well-informed account of all kinds of sea creatures, including those found at great depth.

MORE ABOUT SILKWORMS

[Unknown Author]; 9 February 1861; 4: 423-29; 12 cols.

Referring back to "Silk for the Multitude" (15 December 1860; *AYR* 4: 233-37) the article explains what can be learned from a newly established "Acclimatising Garden," in

the Bois de Boulogne, in Paris. This was set up to try to establish flora and fauna from other countries, and to "acclimatise" them to new conditions in France. It carried out practical research that went beyond mere botany as in the British Botanical Gardens. It was helped by David William Mitchell* of the London Zoo, and Etienne Geoffroy Saint-Hilaire,* the French scientist and naturalist. Silkworms, which have been acclimatized there and have a great commercial value, dominate the account, along with much miscellaneous information.

UNDER THE SEA

[Unknown Author]; 2 March 1861; 4: 493-500; 13 1/2 cols.

The article begins by referring to the work of Captain Matthew Maury* of the U. S. navy, and his pioneering work in meteorology, oceanography and charting the winds and currents of the oceans [see "Air Map" (8 October 1853; *HW* 8: 128-33) and "What the Wind Blows" (24 March 1855; *HW* 11: 188-91)]. These researches had an enormous practical effect in shortening voyages all over the globe. The account gives information about the amount of water on the earth's surface, and the average depth of the ocean; it explains how water is distributed; how this affects climate; and what can be learned from deep-sea sounding, as by Lieutenant John Mercer Brooke's* "sounding apparatus." The floor of the sea is uneven, and most of it is undistributed by currents and waves above it, according to the microscopic investigations of sands and mites of shells conducted by Professor Bailey of West Point [perhaps John Baily*]. It explains about the Gulf Stream, its cause and effect. Maury had also prepared a map showing the distribution of "sperm whales" (of warm water) and "right whales" (of cold water). It deals with the superior edibility of cold water fish to warm water fish; it mentions the Sargasso Sea; and the prevalence of jelly-fish or sea-nettles. Whoever studies the sea will begin to perceive "the

developments of order and the evidence of design," and "the expression of One Thought--a unity with harmonies which One Intelligence, and One Intelligence alone could utter."

TRANSMUTATION OF SPECIES

[Unknown Author]; 9 March 1861; 4: 519-21; 5 3/4 cols.

It begins by referring to *Telliamed* (Amsterdam, 1748), translated into English as *Telliamed: or Discourses between an Indian Philosopher and a French Missionary* (1750) by the French naturalist, Benoît de Maillet.* De Maillet suggested that "the earth was originally covered with water," and that as land gradually increased creatures must have been modified to adapt themselves to new circumstances. A passage from the book is quoted, which shows picturesque ingenuity, but the idea that changes might develop in species was not in itself an absurd one, and is accepted by "all naturalists who are not inclined to admit that new species have been abruptly introduced from time to time upon the earth, to fill up acknowledged gaps in creation."

The author attempts to explain what a species is, and goes on to refer to Lamarck's theory, the author of *Vestiges of the Natural History of Creation* (1844), and Charles Darwin, "our most ingenious and most sound geologist," who has advanced a modification of earlier ideas. Darwin is commended for basing his belief in natural selection and its operation on a sound knowledge of natural history and the fossil record. The theory is explained clearly and with conviction. One of the most notable paragraphs is also quoted from Darwin's *Origin of Species*.

Professor Owen's views, in opposition to Darwin's, are "hardly more natural and involve quite as many difficulties." The author says that he finds it difficult to give Owen's

views "in simple language." He concludes, "the mystery of creation has yet to be solved." We may not be nearer a solution than De Maillet, but the way to discover it is by close observation, and a readiness to accept what is discovered.

OYSTERS

[Unknown author]; 16 March 1861; 4: 541-47; 12 cols.

The author rambles on about oysters: their appearance, foreign names, French fables and stories about them, the remarks of famous people like Shakespeare and Burns, their distribution in this country and so on. He refers to Pliny's *Natural History*, [by C. Plinius Secundus, AD77, trans. by Dr. Philemon Holland, 1601] Dr. William Carpenter's* *Zoology*, 2 vols. (1845) and mentions other naturalists such as Buffon,* Cuvier,* De Blainville* and other "great names in science" who conducted research into the mollusc.

MAGIC AND SCIENCE

[Unknown author]; 23 March 1861; 4: 561-66; 9 cols.

"Ancient magic was ancient science." The article is based on Louis Ferdinand Alfred Maury's *La Magie et l'astrologie dans l'antiquité et au moyen âge* [or *Magic and Astrology*] (Paris, 1860) and gives many details and quotations from the book. It tells how magic emerged from credulity and science from patience in observing the phenomena of nature. "Magic, no less than Science, rests on the *explanation* of phenomena." Men learned from experience, gradually detecting the laws or order of nature, and adapted to nature. "Science is magic grown modest"; it does not depend on imagination and guesswork. "No one believes in Astrology now," the author says optimistically. Yet

superstitious explanations for epidemic diseases or the Irish Famine have been given and people have "sought refuge in phenomena" they did not understand. Previous generations went on believing in astrology and sorcery. The article discusses dreams and insanity, and surveys superstitions in many countries and cultures from the time of ancient Greece up to the modern belief in table-rapping.

BOYLE'S POINT OF VIEW

[Unknown author]; 20 April 1861; 5: 87-90; 7 3/4 cols.

It is "a very good fashion" of the time to appreciate the benefits of science, and readers are urged to anticipate what improvements science can make in the future by comparing the past to the present. The chemist Robert Boyle* is taken as an example. He is seen as "a pioneer in experimental science He suggested and adopted original modes of ascertaining truth." He studied chemistry, physics, astronomy, geology, and biology; he constructed the modern form of the air pump; and made many important discoveries, such as the way sound is carried by air, the force of steam, the weight of air, and the attraction of electrified and non-electrified bodies. The author also mentions his interest in crystalisation, sun spots, magnetism and looks at the progress of discovery since his time. The advance of science relies greatly on some "master minds" in every century who "alone originate new landmarks in science." Readers are reminded of how much we owe to science, and the "intelligent use of natural things." The ability to "bring into relation a multitude of observations and determined facts is extremely rare, and Boyle belongs with the very few who have had the ability.

MARINE METEOROLOGY

[Unknown author]; 27 April 1861; 5: 110-17; 12 3/4 cols.

The article is based on Captain Matthew Maury's* book, *The Physical Geography of the Sea and Its Meteorology* (1860 revised ed.) [originally 1855], which deals with winds, storms in the Gulf Stream, and meteorological phenomena in the Antarctic regions. Dr. August Jilek's* *Lehrbuch der Oceanographie zum Gebrauche der K. K. Marine* (Wien, 1857), about the condition of the south pole, is referred to. The article explains at length that Captain Maury's evidence supports the hypothesis of the existence of an open sea in the Arctic Ocean. Some other accounts of exploration in the Antarctic are mentioned, and some old accounts are corrected. There is an explanation of how wind direction over the ocean can be traced by the way dust clouds are carried; and an explanation of monsoons, and land and sea breezes. Finally the author observes that "among Captain Maury's most brilliant passages are those which explain the importance of the salt of the sea," and a summary is given of Maury's findings on this topic.

ON TAILS

[Unknown author]; 4 May 1861; 5: 136-40; 7 3/4 cols.

The author writes generally about the tails of different animals. The reason why the form of some animals' tails has remained constant through all the ages is because they have practical capacities, for example, the tails of some fish and reptiles are adapted to the forms of their bodies and suit the animals' movement. Some animals' tails have special functions, for example, some alligators converted their tails into offensive weapons.

THE TREASURES OF THE EARTH: CHAPTER I

[Prof. T. D. Ansted]; 18 May 1861; 5: 174-78; 8 1/4 cols.

The article is a general survey of gems, including diamond, ruby, sapphire, emerald and so on, their different kinds and appearance, where they are found, how they are formed and their chemical characteristics.

COSTLY FOOD FOR FISHES

[Unknown Author]; 18 May 1861; 5: 186-89; 6 cols.

Although there have been nine thousand miles of submarine telegraph laid down, no more than three thousand miles are in working order, and a reason for this is that the telegraph cables were not thoroughly tested before they were used. The costly failure of different lines, including the Atlantic Telegraph and the Red Sea Telegraph, is described. Charles Manby's* summary of an important discussion at the Institution of Civil Engineers is reported at some length. Finally, the author mentions some "scientific, mechanical, and natural enemies of telegraphic enterprise," such as the difficulty of manufacturing the materials, sharp rocks, hungry fish, storms and currents, the need for careful submarine survey and much else. An essential point in the work of successful submarine telegraphy is to use responsible and reliable contractors.

THE TREASURES OF THE EARTH: CHAPTER II

[Prof. T. D. Ansted]; 25 May 1861; 5: 198-200; 5 cols.

The article continues the first part. It links each month to a precious stone and ends by supposing that they were not placed in the earth to be neglected, since that would be contrary to the "spirit of creation."

AN UGLY LIKENESS

[Unknown author]; 1 June 1861; 5; 237-40; 6 1/4 cols.

Referring to an earlier piece ["Our Nearest Relation" (28 May 1859; *AYR* 1: 112-15)] which has already dealt with gorilla, the article reveals further information based on Du Chaillu's* new book [*Explorations and Adventures in Equatorial Africa, with Accounts of the Manners and Customs of the People, and of the Chance of Gorilla, Crocodile, Leopard, Elephant, Hippopotamus, and Other Animals* (1861)]. In addition to the three well-known species of large apes (the chimpanzee, the orang-outang, and the pongo), he discovered three more species (of which the gorilla takes the first rank) and another already known, "man-ape." Du Chaillu's discovery of the gorilla, its appearance, habits, and behaviour are described. In regard to the close relationship of the gorilla to man, or the "ugly likeness" of the gorilla to man, the article says "The most essential difference is in the brain-capacity of the skull, for in all other respects the resemblance is so close as to amount to identity." This "near approximation" should not worry us, however, because we should regard it as showing "how entirely we are redeemed from being devils by that breathing into our nostrils the breath of intellectual existence and capacity by which man became a living soul." It is a miracle that the unsightly, fierce and treacherous gorilla was selected as the "foundation" of man, and that "with scarcely a change in the bodily framework," what has been produced is "the noblest and most intelligent being . . . formed 'in the image of God.'" "What the law of development could do, or whatever else the law of production of species may be, seems to have terminated in the gorilla. Intellect, a moral sense, and a soul

being superadded, the gorilla is converted into a man." In conclusion, the author says, if "men of such climates" had not moved to a better climate and "improved" themselves, they "might take rank with the gorilla and the chimpanzee."

FRESH FISH

[Unknown author]; 8 June 1861; 5: 260-64; 8 1/4 cols.

Though the article is mainly an account of fish breeding, it refers to Cuvier,* Darwin's* remarks on "Divergence of Character" in the *Origin*, and the Acclimatisation Society, whose secretary was Frank Buckland.*

RECENT DISCOVERIES CONCERNING LIGHT

[Prof. T. D. Ansted]; 15 June 1861; 5: 270-72; 6 1/4 cols.

In 1666 Newton first made the discovery of the nature of light and colour; he constructed a reflecting telescope in 1669, and published his research in 1671, though Dr. Isaac Barrow* had already made some remarks on white light. As Newton found, white light is made up of a mixture of red, yellow, and blue rays. His experiments with the sun's rays and how they can be bent on passing through a prism are described. After Newton came other scientists such as Dr. William Hyde Wollaston,* and Josef von Fraunhofer* of Munich, who discovered the prismatic spectrum which shows the elements in the source of light. The author expects that it will be possible to determine the composition of the stars as well as the sun from this information in future. He goes on to say more about recent interest in the sun, sun spots, eclipses of the sun, and the solar atmosphere, and concludes:

Some day it may be the lot of a future family of the human race to discover yet more of the mutual relation of all matter, and learn what is the limit, if any exists, of those influences which bind creation together, and make one vast and measureless unit of all that exists in the universe.

DIALS FOR THE SEA

[Unknown author]; 22 June 1861; 5: 304-6; 5 1/4 cols.

"Perry's Dial," known as the "Patent Anti-Collision Dial and Shipwreck Preventor," was invented by Captain Charles James C. Perry, and described in his *A Brief Treatise on Collisions at Sea and Shipwrecks, Being a Research into the Cause of Those Disasters, and An Introduction of A Preventive in the Use of the Patent Anti-collision Dial and Shipwreck Preventor* (Melbourne, 1860). The dial uses the principles of trigonometry and enables sailors to establish their course and bearings and to steer clear of moving and stationary objects within a seven-mile radius. The article gives details of the instrument and of the situations in which it will be useful. Because of its complexity, the writer remarks that how it works and its mathematical principles "should be described rather in a Nautical Magazine than in a popular journal."

NEXT DOOR NEIGHBOURS TO THE GORILLA

[Unknown author]; 27 July 1861; 5: 423-27; 8 3/4 cols.

For the most part, this is an account of travelling in West Africa which focuses on descriptions of the native Africans. But there is a brief discussion of De Chailly's*

discovery of the gorilla. The author's comparison of man and apes in terms of physical strength shows an awareness of contemporary theories of evolution:

All that we can learn teaches us that man is by nature a weak, slow-footed animal . . . An ape of the same size would easily master a lion, but then the muscles even of the wild man are never hard and vitalised like those of the ape: most probably from such a much larger quantity of the vitalising power being required for the more developed brain.

CONFECTIONER'S BOTANY

[Unknown author]; 10 August 1861; 5: 462-64; 4 1/2 cols.

Vanilla plants are grown in Mexico, Mauritius and Surinam. A description of how vanilla is cultivated is given. Professor Charles-François-Antoine Morren,* of Liege, read a paper on the production of vanilla in Europe at the meeting of the British Association at Newcastle in 1838 ["On the Production of Vanilla in Europe," "Notice and Abstracts" of *Report of the Eighth Meeting of British Association for the Advancement of Science held at Newcastle in August 1838*, 116-17]. Attempts have been made to grow it in Europe and England, but it is difficult to pollinate by natural means and is still too expensive to grow in Europe. Many artificial flavourings for food can now be made by chemists from uncommon and disgusting substances; but vanilla cannot be artificially produced. The article continues by mentioning other flowers and plants used by confectioners such as violets, orange blossoms, angelica, caraway seeds, peppermint, ginger, nutmeg and the cardamom seeds seen on the author's visit to Fortnum and Mason's shop.

ELEPHANTS, FOSSIL AND MUSICAL

[Unknown author]; 10 August 1861; 5: 473-75; 3 3/4 cols.

The fossil remains of elephants found in Europe and Siberia have prompted scientists to conjecture how animals now found only in Asia and Africa could have once lived much farther north. The theories of Buffon,* Cuvier,* La Place* and Owen* are summarised. La Place concluded from the wool and long hair of the Siberian elephants that they had gradually adapted to cold or temperate climates, and both Cuvier and Owen confirmed his theory. Owen's observations based on his studies of elephant teeth are quoted at length. The article goes on to give historical anecdotes about the keen response of elephants to music. Modern examinations of the inner structure of elephants' ears have proven the correctness of the historical anecdotes: elephants have very acute hearing and have been shown to respond to different types of music.

ACCLIMATISATION

[Unknown author]; 17 August 1861; 5: 492-96; 8 cols.

In an attempt to increase the European stock of cultivated plants and wildlife, M. Isidore Saint-Hilaire* founded an "acclimation society" in Paris in 1854. The society flourished, and in 1858 the City of Paris granted it a large space in the Bois de Boulogne in order to make a garden for its specimens. The French example has been copied in England, where a Society for the Acclimatisation of animals, birds, fish, insects and vegetables has been founded. Frank Buckland* has recently read a paper to the Society of Arts on the topic of acclimatisation in Britain.

The article is generally based on Saint-Hilaire's writings on the topics of conservation, the history of the domestication of certain species by different cultures, and the propagation of some species for food. His thoughts on evolution are summarised: "He attaches very great importance to the study of domestic animals, and comes to the conclusion that there is no such thing as immutability of species or fixity of zoological type." Cuvier is quoted in regard to cultivating the wombat and kangaroo for meat, and Darwin's account of the capybra (or water-hog) is mentioned.

DR. WILKINS'S PROPHEPIC DREAMS

[Unknown author]; 14 September 1861; 5: 582-85; 5 3/4 cols.

This is an account of the life and work of the seventeenth century figure, Dr. John Wilkins,* Puritan clergyman, mathematician, one of the founders of the Royal Society and Dean of Ripon and Bishop of Chester. He wrote on flight, on whether the moon was habitable, and on the possibility of communicating by something like the electric telegraph. "He loved truth, and pursued science for its own sake."

THE GENII OF THE LAMPS

[John Hollingshead]; 12 October 1861; 6: 55-58; 5 3/4 cols.

Frederick A. Winsor* was the first man to light a London street with gas and to make gas-lighting a branch of commerce, despite opposition based on caution and prejudice. He exhibited his plans at the Lyceum Theatre in 1803 and 1804, and he lit one side of Pall Mall in 1807. A passage is quoted from one of his pamphlets about his thinking on how to produce gas, introduce it into people's rooms and use it in everyday life. Samuel Clegg,*

the pupil of Matthew Boulton* and James Watt,* and the earliest permanent engineer of the Chartered Gas Company, made many improvements in the manufacture and distribution of gas. Sir William Congreve's* report about the London gas-works in 1822 is mentioned; and also a deputation from the Royal Society with Sir Joseph Banks,* who visited the gas-works of the Chartered Gas Co. at Westminster in 1844 and recommended that the government restrict the size of gas holders. The "beautiful scientific processes" in manufacturing gas, and the number of companies and gas-works are described. According to Samuel Hughes,* to whom the author is indebted for much information on this subject [*A Treatise on Gas-Works and the Practice of Manufacturing and Distributing Coal Gas; with Some Account of the Most Improved Methods of Distilling Coal in Iron, Brick, and Clay Retorts, and of the Various Modes Adopted for Purifying Coal Gas. Including also A Chapter on the Hydrocarbon or Water Gas* (1853)], the quality of gas sold in London has improved since 1829 and its price reduced. Nevertheless, the author is concerned about faulty gas mains and the likelihood of leaks.

THE IRON WAR-SHIP

[Unknown author]; 26 October 1861; 6: 104-7; 6 1/2 cols.

After a recent vote in Parliament of £2,500,000 for five new iron frigates, the author went to Greenhithe to see the new "Warrior." He describes its structure, conversations with a sailor, its Master Gunner, and one of its stokers, and what they tell him about the engine and power of the new vessel. He is surprised by the heavy steam-engine saying: "I don't know what the world is coming to." He concludes that the moral of all this is that "ship-building . . . has changed, is changing, and will continue to change . . . we shall want science . . . and woe to those who are the slowest to learn the new lessons."

HISTORY OF A YOUNG OLOGY

[Unknown author]; 16 November 1861; 6: 186-90; 6 3/4 cols.

Meteorology is "a new science." The first valuable study was John Dalton's* book, *Meteorology Observations and Essays* (1793). Scientific men then continued to observe and investigate. Dr. Dalton's ideas about changes in weather and his contributions to the establishment of the atomic theory that brought about new advances in physics are generally sketched. The article turns to explain different ways of predicting changes in the weather. Some simple phenomena are described, such as varying barometric pressure, the amount of humidity in the air, and its temperature. Instruments to measure these are mentioned. A storm in the Black Sea on 14 November 1854 which damaged the French and British fleets in the Crimean War, was not detected in advance. To sum up, meteorology, which needs attention and accuracy, is an "exact science."

COTTON-FIELDS

[Unknown author]; 7 December 1861; 6: 256-52; 8 cols.

The article speaks about using "scientific men to study the botany and zoology of the cotton-plant," but it is a descriptive account and the conclusions are all practical.

SKATING SPIDERS

[Unknown author]; 4 January 1862; 6: 351-56; 10 1/2 cols.

This is a literary account based on "the first part of a folio work on British and Irish spiders by Mr. Blackwell," discussing "more than a hundred species" [John Blackwall,* *A*

History of the Spiders of Great Britain and Ireland, 2 vols. (1861-64)]. The book is published by the Ray Society. Insect hunters have a penny weekly newspaper, the *Entomologist's Weekly Intelligencer* with a circulation of six hundred. It goes into great descriptive detail from various authorities, but is also based on the author's own observations.

TUNNEL SPIDERS

[Unknown author]; 11 January 1862; 6: 369-72; 5 cols.

The article is a general, anecdotal, and descriptive account of spiders found in tunnels, about "Lady spiders being stronger than the gentlemen," and whether "they dine at their clubs or sleep out."

FIRE

[Unknown author]; 18 January 1862; 6: 393-96; 5 3/4 cols.

The ancient Greek philosophers believed in the four elements: Earth, Air, Water, and Fire. Fire was thought to be a substantive and specific entity. George Stahl called fire, in the state of combination with other bodies, "Phlogiston," or "fixed fire." Herman Boerhaave* distinguished two kinds, namely "elementary fire" and "culinary fire" that lead to the dilatation of all solid bodies and rarefaction of fluids. Chemists of the past thought of fire as having four or five degrees of intensity. At the end of the eighteenth century, the concept of caloric heat was defined. People have been led to think of fire as a "force" instead of a "thing," and heat as "a vibratory movement of the molecules or atoms of hot

bodies." The physical forces now acknowledged are "Heat, Light, Electricity, Magnetism, Chemical Affinity, and Motion," and the article ends by saying:

Fire is only an energetic manifestation of one of these forces....All we know or see is the *effect* of force; we do not see force--we see motion or moving matter. We only know certain changes of matter, for which changes Heat is a generic name; the *thing* heat is unknown. And probably man will ever remain ignorant both of the ultimate structure of matter and of the minutiae of *molecular actions*.

Pilgrim 10: 166, to W. H. Wills, 25 November 1862: "'Fire' had best be distributed--paid for, of course. It is a mere dilution--and a very dry one--of a very well known paper in H. W." [probably "Physical Force" (12 March 1859; *HW* 19: 354-59) by Edmund Saul Dixon].

LONG SEA TELEGRAPHS: CHAPTER I.

[Unknown author]; 15 March 1862; 7: 9-12; 7 1/2 cols.

The author writes to persuade the government and the public that they should invest in telegraphic cables to Asia, Africa and America, so that Europe and these distant places can be united. The art of constructing land electric telegraphs "has been almost brought to perfection," but deep sea cable-laying is still "in the stage of experiment." The way to do this is not like the discovery of "the telescope, the safety-lamp, the steam-engine, or the locomotive railway"--to be worked out by any one man of genius, but will depend on many improvements made over a long term. Since Professor Charles Wheatstone* perfected the telegraph around 1840, it has received a setback because of over-confidence. The history of the few successes and persistent failures of submarine telegraphy is then described, leading up to the recent government report on the subject in April 1861.

LONG SEA TELEGRAPHS: CHAPTER II.

[Unknown author]; 22 March 1862; 7: 39-45; 10 3/4 cols.

The article goes into detail about the difficulties of manufacturing submarine cables, especially the need for copper as the conducting wire, gutta-percha as the insulating covering, and other materials for insulation. It then explains how and why there have been so many failures because of haste, ignorance, and the wish for a quick profit. All this information comes from the latest government report. The conclusion is that for success, "nothing is needed but an honest and intelligent use of exacting materials and machinery."

LARKS ON THE WING

[Unknown author]; 5 April 1862; 7: 78-80; 5 1/4 cols.

Recently and on rare occasions a species of horned lark, the same species identified as "*Alauda alpestris*" by Linnaeus,* has been seen on the east coasts of Britain. The author went to see two of the horned larks caught in Sussex. Larks of the ordinary kind are numerous, but they are often shot or trapped, especially around Brighton. The different kinds are described, and their habits in nesting, emigrating and courting. The American ornithologist John James Audubon* first saw a nest of horned larks on the coast of Labrador. His observation is quoted, and another ornithologist, Alexander Wilson,* suggests the species be named "*Alauda cornuta*." William Yarrell,* in the preface to his *History of British Birds*, 3 vols. (1843) mentions the question about the route horned larks took from North America to Britain. The author does not pursue the subject, but says that "surely the balloon and the telegraph will one day enable men or news to do what birds can do."

HOW PROFESSOR GASTER LECTURED A GHOST

[Unknown author]; 12 April 1862; 7: 107-11; 7 3/4 cols.

This humorous little sketch is about a French professor Gaster, a popular lecturer on "Food, Electricity and other hundred subjects." He has just returned from a party in a good mood, and is thinking of such things as his celebrated treatise on the "Merrythought of the Dodo," to be read at the Royal Society. Perhaps he has drunk too much champagne. He enters his well equipped laboratory, where he keeps the skeleton of a former Polish soldier, and begins to study the effect of alcohol on the digestion, describing how different kinds of food are affected by the gastric juices. While he is doing so he looks at his store, where he sees two skeletons talking. He has a spirited discussion on scientific subjects with them, determined to prove that ghosts do not exist, and threatens them with being included in his next lecture. They eventually leave, and he falls asleep.

POISON-PROOF

[Unknown author]; 10 May 1862; 7: 209-10; 3 cols.

We are usually told that strychnine is fatal, but a recent article by John Attfield* in the *Pharmaceutical Journal and Transactions* reports the existence of mites that can actually live on deadly poison ["Poisons not Always Poisons," *The Pharmaceutical Journal, Second Series*, 1 March 1862]. According to Attfield's experiments exhibited to the Chemical Discussion Association of the Pharmaceutical Society, the mites' excrement shows that they have absorbed strychnine and fed on it. It is because though the poison is eaten, it is not assimilated. Poisons are only poisonous to creatures that are not accustomed to them. The conclusion drawn from such a study of lower animals may sometimes be applied to higher animals. A comment by Professor George Busk* is referred to.

IGNORAMUS AT THE INTERNATIONAL EXHIBITION

[Unknown author]; 21 June 1862; 7: 345-48; 5 3/4 cols.

A friend, an engineer, has taken the author to the machinery department of the International Exhibition to teach him about the steam-engine and other machines. They see exhibits of all different kinds which are vividly described: lighthouse models, armoured ships, mortars, "engines pounding away," pumping machines, hammers, manufacturing machinery, carriages and machines to make housework easier.

SUGAR AND MILK

[Unknown author]; 2 August 1862; 7: 497-98; 2 1/2 cols.

The predecessors of modern chemists were the alchemists, the "fast men of science" who "had faith in a creative chemistry." Modern chemists are learning how to produce artificial forms of organic products, such as glycerine, vinegar and alcohol. A detailed description is given of a process for making glycerine. Louis Pasteur's* research into fermentation, which resulted in his producing live yeast, is described. In conclusion, the author marvels at the thought of "so much life in the air . . . It is everywhere, within us and about us, yet we cannot . . . know more of what it is than that it is a precious gift of the All-Wise."

BALLOON MAD

[Henry Morley]; 2 August 1862; 7: 501-4; 7 3/4 cols.

The article is chiefly a personal account of the death of Robert Cocking, a parachutist who died on 24 July 1837 while testing his parachute. It includes Faraday's* evidence at the inquest, and refers to the careful calculation which went into the design of the newly invented parachute.

IGNORAMUS AT THE EXHIBITION

[Unknown author]; 23 August 1862; 7: 559-64; 9 1/4 cols.

After seeing the mechanical marvels in "Ignoramus at the International Exhibition" (21 June 1862; *AYR* 7: 345-48), the author is taken to the "Eastern Annexe" of the International Exhibition to learn about chemistry. First he sees nitrate of uranium and platinum, the properties of which are described. Then he turns to aluminum, or aluminium, which is dealt with in detail, and alum. He writes of aniline and aniline dyes, phosphorus, soda, and nitrate of silver, used by photographers. Without explaining it, he refers to "the new method of breeding wheat," and "the lift which Darwin's theory of selection seems to have got thereby." He is bewildered by the variety of the exhibits and the scientific names: "And, I ask you candidly--of all those tired-looking trailing women, carrying babies, or thumping lagging children--of all those half-washed men, with their mouths open, and their brains not over-phosphorised," can they understand what they have seen? He concludes: "It may be all very clever and scientific; but . . . it is not the least in the world instructive, and that a few good honest English explanations would have been of ten times more benefit to the sightseers."

FLIES

[Unknown author]; 13 September 1862; 8: 6-10; 7 1/2 cols.

There are different kinds of flies in different countries. The author refers to the comments of Charles Darwin,* René Reaumur,* George Busk,* Georges Cuvier* and many other naturalists. He also mentions James Samuelson's* *Humble Creature, the Earthworm and the Common House Fly* (1858). He also discusses the means of destroying flies and keeping them off.

SEA-SIDE EYES

[Unknown author]; 20 September 1862; 8: 41-45; 9 cols.

The article gives a general description of what can be observed at the sea-side: plants, sea gulls, sands, and sea-side creatures such as molluscs, fish, crabs, and lobsters from which different kinds of shells come. Some characteristics of the creatures and the structure of sea-weed are mentioned.

OWEN'S MUSEUM

[Unknown author]; 27 September 1862; 8: 62-67; 10 cols.

The author visits "a national museum" described by Professor Richard Owen* in his *On the Extent and Aims of a National Museum of Natural History* (1862). He goes to the geological room first, and describes the exhibits, including limestone, fossil remains, chalk, ironstone, copper, and gives information about the geological formation of the earth. Then he goes to another room about zoology to see specimens of all kinds. He does not like to think of there being a "link" between apes and mankind; but he is ready to consider that the "polype" should be the "grandfather of all life." But all this will only be seen in the museum

of the future. Finally he says that what he has described is a museum in the future, the one professor Owen proposes. He urges the reader to follow Owen's advice to found a museum of natural history, "making our museum of natural history what it ought to be—the best, the completest, the largest, the most capacious in the world; with every specimen fairly displayed, and all accessories of habitation, locality, and habits, shown and explained as well."

Pilgrim 10: 117, to Professor Richard Owen, 7 August 1862: "I have been reading with unspeakable interest and pleasure, your charming little book on the extent and aims of a National Museum of Natural History. Pray tell me who is the adventurous creature who made that astounding statement referred to in the footnote page 35, regarding what "students and scientific men greatly prefer." A malignant desire is upon me to ticket that specimen of an infernal genus."

BALLOONING SPIDERS

[Unknown author]; 4 October 1862; 8: 80-83; 5 1/4 cols.

Certain species of spiders can be said to fly because they can either sail on gusts of air using a float of filaments, or travel in the air using silk balloons which they make inflate, regulate and direct. The author, an obvious authority on spiders, reports, and sometimes corrects, the observations on spiders made by many authorities, such as Darwin,* on his voyage in the *Beagle* (1839), John Blackwall's* *A History of the Spiders of Great Britain and Ireland* (1861-62), Latreille's* his 1833 English edition of Cuvier's* *Animal Kingdom*, John Murray's* *Experimental Researches* (1826) and Martin Lister.*

BONE-MAKING

[Unknown author]; 8 November 1862; 8: 209-11; 3 cols.

In 1736 a London surgeon happened to find that the dye madder could colour human bones, without affecting muscles, membranes, and cartilage. Three years afterwards the physiologist, Henri-Louis Duhamel Du Monceau,* repeated the experiment and inquired further to find out how bones grow in thickness in successive layers. Then Pierre Jean Flourens* repeated their experiments on bone-growth and saw how the medullary canal grows by the reabsorption of internal layers and as bones grow in thickness, they grow in length. Others found that the growth of bone is the gradual transformation of membrane into cartilage, and cartilage into bone. These discoveries subsequently proved useful in surgery. The practice of Philipp Frédéric Blandin* in using this knowledge to treat a patient was described by Dr. Philipeaux [perhaps Raymond Philipeaux*]. The author praises the series of discoveries as showing "Science holding up a guiding finger to Skill when touching the brain or seat of Intelligence."

Pilgrim 10: 151 to W. H. Wills, 24 October 1862: "I don't much like the scheme for the next No. [8 November]. It looks so excessively patchworky. But I will go carefully over it and the printer's list, in good time for Wednesday."

FALLEN FROM THE CLOUDS

[Unknown author]; 22 November 1862; 8: 250-56; 11 3/4 cols.

Information is given about how the temperature of the strata of the Earth increases at an average of about one degree every fifty or sixty feet. Then volcanoes and their eruptions are described, especially a certain phenomenon of red-rain caused by salt in the rain. The

author then turns to anecdotes about insects such as butterflies, and spiders, frogs and fish that have sometimes been known to fall on the sea or land.

Pilgrim 10: 156, to W. H. Wills, 4 November 1862: "I should like a Natural History sort of article in the middle of the No. Unless I am mistaken, Down from the Clouds has not yet gone in? That would do very well. If you have Morley's Laboratory paper in connexion with the Poisoning question, by all means get *that* in, and don't delay it."

SCALE INSECTS

[Unknown author]; 6 December 1862; 8: 307-9; 1 1/2 cols.

Scale insects, or cocci, which attack hothouse plants and fruit, can be observed under the microscope. The physical appearance of the mites is described, and an account of their history and the growth of scientific knowledge about them is given. The cochineal which they produce is extremely valuable and is used to colour food, to cure whooping-cough, and in dyeing.

THE MODERN ALCHEMIST

[Henry Morley]; 27 December 1862; 8: 380-84; 8 cols.

The author is taken by the ghost of the medieval alchemist, Artephius, to visit a laboratory. The phantom shows him some deadly poisons, such as arsenic, and describes how they work. Finally the author says he drew his account from Dr. Alfred Taylor* of the laboratory of Guy's Hospital.

Pilgrim 10: 146 to W. H. Wills, 15 October 1862: "Is he getting on with the Laboratory one? It would be well-timed soon after this poisoning-case" [25-7 September, the trial of Mrs Catherine Wilson, see *Pilgrim* 10: 138n].

FACTORY SPIDERS

[Unknown author]; 3 January 1863; 8: 391-96; 8 1/4 cols.

In July 1852, the author observed flora and fauna on the south coast of England while looking for tunnelling spiders on a clay bank. He found a kind of six-eyed spider, "*Dysdera erythrina* of Latreille." Pierre-Andrezac Latreille* was wrong to say that their eyes are placed on a tubercle--rather, they are placed in front of the "head-chest, above the jaws and fangs." The reason why the sticky globules on the webs of certain spiders hold flies without impeding the spider is because they have feet with hooks, though there are the spiders called Mygalidae that have feet with brushes or hair-like papillae and which might be held by others' webs like flies. There is a description of how many globules there are in a web, how fast a spider makes its web, the characteristics of the *Dysdera erythrina*, and the labyrinth spiders kept by the author and how they cooperate to make tubes and labyrinths. Other remarks on spiders' sociability, how spiders prey on each other, and how spiders unite to build social webs to entrap their mutual prey are mentioned.

SKIN DEEP

[Unknown author]; 21 February 1863; 8: 562-64; 3 1/2 cols.

The principle of perspiration was investigated in the seventeenth century by the Italian physician Santorio* who devised a weighing-chair to examine the quantity and quality of

perspiration. He published a treatise concluding that skin was a respiratory organ that helps us to breath. He also made an instrument or thermometer for measuring the force of the pulse. Addison wrote an article about Santorio in no. 25 of the *Spectator* which is an ironic letter to him by "one of the sickly tribe who are commonly known by the name of Valetudinarians," ridiculing people who keep to rigid rules about something as subtle as health. The author believes that "Santorio was a man of science, painfully inquiring into scientific laws, and his name deserves to be rescued from the oblivion into which it has long fallen."

Pilgrim 10: 210, to W. H. Wills, 4 February 1863: "To wit, *Skin Deep* (called originally, Santorio and his theories) . . . *Some Curious Lights* (called originally Light-Bearing) For the most part, I think these articles are better than those you mention in your letter received this morning."

SOME CURIOUS LIGHTS

[Unknown author]; 28 February 1863; 9: 16-20; 8 1/4 cols.

Basing his article on Dr. Thomas Lamb Phipson,* *Phosphorescence, or the Emission of Light by Minerals, Plants and Animals* (1862), the author describes the first account of the phosphorescence in fluorspar by a sixteenth century Bolognese cobbler and alchemist, and then gives details of later experiments with phosphorescent minerals by some seventeenth-century scientists. Many substances are phosphorescent: gold, copper, silver, common salt at great heat, chloride of calcium, crystals of nitrate of uranium, feld-spar, water as it changes to ice, some gases, luminous plants, flowers, sea-creatures, earthworms, insects, flesh and the eyes of various creatures even including man. There have been reports of luminous rain, snow, and fog, water-spouts, and lights in the sky. The most phosphoric of substances is phosphorus itself. The subject is said "to be in its infancy yet."

HOW OLD ARE WE?

[Unknown author]; 7 March 1863; 9: 32-37; 9 1/4 cols.

Sir Charles Lyell's* *The Geological Evidences of the Antiquity of Man, with Remarks on the Theories of the Origin of Species by Variation* (1863) is mentioned as having been published "a few days ago" by John Murray. Lyell is known as "the great opponent of sensational geology," and he has now turned to investigate what the traces of early man (not found in fossils) can tell us. The article summarises what Lyell says can be learned from remains in Danish bogs, heaps of oysters, and marine shells in Danish islands and North America. Referring to "Subterranean Switzerland" (5 November 1859; *AYR* 2: 25-31), it then turns to the remains of lake dwellings in Switzerland, perhaps five to seven thousand years old. Shafts sunk in the Nile delta have revealed bricks which seem to be 12,000 years old, and much older remains have been found near New Orleans and in Florida. Further discoveries are mentioned, leaving no doubt that "man and the mammoth once co-existed." These lead on to a mention of the discovery of the bones of Neanderthal man, and the tools made by ancient man. The conclusion to be drawn from the research of several geologists is that though man is "geologically a new comer upon earth, his antiquity is, nevertheless, much greater than chronologists have hitherto supposed."

AN IRON STORM AT SHOEBOURNE

[Unknown author]; 11 April 1863; 9: 157-162; 9 cols.

An account is given of the combats or competitions between the cannons developed by Joseph Whitworth* and William Armstrong* held in Shoeburyness. The article describes the scene when the 68-pounder Whitworth cannon and the 110-pounder Armstrong cannon were charged and aimed at iron targets. The difference between the weight of their

shells and the size or length of the two cannon is given in detail. The author suggests that some other experiments should be carried out, such as firing the cannon from a ship in motion to decide which is the better.

CLOCK FAST, FIVE HUNDRED YEARS

[Unknown author]; 25 April 1863; 9: 213-16; 7 1/2 cols.

This is a fantasy about the shape of things to come five hundred years in the future. It is far from strictly scientific, but it "foresees" fast travel, underground railways, cheap power, new foods and feminism.

AT YOUR FINGERS' ENDS

[Unknown author]; 2 May 1863; 9: 233-37; 9 1/2 cols.

France and other European countries have adopted the decimal system in counting and the metric system for measuring. In Britain, there is still a confusing variety of systems of weights and measures, and several societies and international associations have urged a uniform system and petitioned Parliament. Among them are the Society of Arts, James Yates,* one of the vice-presidents of the British Branch of the "International Association for obtaining an uniform Decimal System of Weight, Measure and Coins," and Frank P. Fellows of the Wolverhampton Chamber of Commerce. The second half of the article gives information from Yates' recently published lecture to the Society of Arts, on how a parliamentary committee on weights and measures, presided over by William Ewart [(1798-1869; *DNB*), politician and reformer], has been formed. The author gives examples of how confusing the variety of weights and measures are in Britain, observes that French

workmen and the public prefer a uniform system, and finally explains how the metric and decimal systems could be adopted in Britain.

OUR OIL FLASKS

[Unknown author]; 9 May 1863; 9: 260-64; 8 1/4 cols.

There are two kinds of oil: the fixed or fatty oil composed of oxygen, hydrogen and carbon that is good for food and light, and the volatile or essential oil with a varied composition that is used in perfumery and medicine. According to Michel Chevreul,* "the father of the fatty acids," the fixed oils have three constituents--olein, margarine and stearine. Chemical experiments to show their nature and the amount of oil in animal bodies and plants are described. The article discusses the different types of oils derived from nuts plants, flowers, olives and seeds, and from animals and fish. The essential oils derived from orange-flowers, the dried clove-bud, elder flowers, lavender-spikes, rose-leaves and so on are mostly used in perfume. Finally, there is an explanation of mineral oils, which are not really oils at all, but fluid hydro-carbons.

STRUCK BY LIGHTNING

[Unknown author]; 16 May 1863; 9: 270-73; 5 1/4 cols.

Before Snow Harris's* invention of the permanent lightning conductors, in use since the mid-1840s, many ships were damaged, shipwrecked or sunk when struck by lightning, and hundreds of sailors killed or disabled. He invented a system of double lines of copper plate that were embedded in the masts and connected by similar conductors to the beams and hull of the ship. The article goes on to give anecdotes of eighteenth-century and nineteenth-

century ships struck by lightning. Harris's conductors cannot protect ships from exceptional electrical phenomena, but "to all intents and purposes vessels armed with conductors are now safe."

BIRD-GAROTTERS

[Unknown author]; 30 May 1863; 9: 320-23; 7 cols.

According to William Yarrell* and William Macgillivray,* there are four main species of the little-known skua, a kind of sea-hawk which was only defined as a distinct group in the 1820s. They can be found on the coasts of Norway, Denmark, Holland, Belgium, France, and in the Faroes, Shetland Islands and Hebrides. A rare species called Buffon's* skua was shot in Sussex in October, 1862, and more common kinds are the Richardson's skua, named after Sir John Richardson,* and the Pomarine skua. They are remarkable for attacking other birds in flight, forcing them to disgorge the fish in their gullet, and then catching the falling fish. Descriptions of their appearance, behaviour and habitat are given.

BEHIND THE SCENES AT VESUVIUS

[Unknown author]; 6 June 1863; 9: 345-48; 6 1/4 cols.

The author lived for more than two years "in full view" of the volcano Vesuvius when it was continuously active. He gives a merely descriptive account of his last experience of observing its eruption.

MARVELLOUS LIGHTNING

[Unknown author]; 6 June 1863; 9: 357-60; 6 3/4 cols.

Thunder-clouds are composed of "different kinds of clouds." Franklin* and Horace Bénédicte de Saussure* are referred to for their opinions about how a thunder cloud is formed. Arago* has discovered old records about storm-clouds which need further examination. A lightning bolt in 1700 that struck seven people is described. Professor Charles Wheatstone* has discovered the way to measure the duration of a flash of lightning. Different kinds of lightning, such as silent lightning and sulphur-like lightning, are described. Then authorities are referred to about its effect on metals. Some incidents show lightning fusing metal, and other examples of its power are given.

THUNDER

[Unknown author]; 13 June 1863; 9: 375-78; 6 1/2 cols.

People in Lima, Peru, never see lightning or hear thunder, and there may be geographical reasons which affect the occurrence of thunder and lightning. Dominique Arago* believed that mountainous areas have more storms. The article describes many of the author's personal experiences. Mary Somerville,* in her *Physical Geography* (1848) explains that "Electricity of each kind is probably elicited by the friction of currents of air." The account turns to literary references, adding that the idea that lightning is an effect of aerial friction can be found in Tennyson and Shakespeare. The effect of lightning on hair is also discussed in an anecdotal way, and the article refers to the "interesting and enchanting region of scientific research, into which I cannot enter the chemistry of lightning," as it continues in the style of a familiar essay. Though some scientists are mentioned and

questions raised, such as the causes of storms, the article concentrates more on personal observations and anecdotes than on serious scientific study.

MADAME DE CORNEILLAN

[Unknown author]; 11 July 1863; 9: 466-68; 5 cols.

In 1810, Napoleon I offered a prize of a million francs for the best machine for spinning flax, and Philippe de Girard* won it for his invention. Though he established a flax-mill in Paris in 1813, he fell into debt and after 1826 became an engineer in Poland. His plans had been stolen and sold in England. Only in 1853 was a commission appointed to pay a national recompense to his niece, Madame de Corneillan. She has devoted herself to the acclimatisation of a new silkworm that feeds on ailanthus-tree leaves. Her work was mentioned in "Silk for the Multitude" (15 December 1860; *AYR* 4: 233-37). The article then turns to two kinds of oak silkworms brought from Japan and China, and concludes that new and different kinds of silk will come to benefit the public.

BEWICK'S BIRDS

[Unknown author]; 1 August 1863; 9: 536-39; 6 cols.

The article is a favourable review of Thomas Bewick's* two-volume *History of British Birds* (1779-1804) illustrated with his own woodcuts. Though "not equal to the writing of White of Selborne,"* his book is full of "pictorial exhibition of a lively fancy" and vivid observations. Some vignettes from the books are described to show his expressive ability as an artist.

THE PITCHER-PLANT

[Unknown author]; 8 August 1863; 9: 563-65; 3 3/4 cols.

In 1860 the pitcher-plant was found to be the remedy for an epidemic of small-pox in Halifax, Nova Scotia. Some specimens were sent to Europe to be studied. As chemical analysis has shown, the plant has the qualities of a febrifuge: it contains potash, soda, and malic acid. The plant's leaf can perform the functions of respiration and transpiration: the lower part of the leaf is clothed with hairs and made of cellular tissue which obtains carbonic gas from water and the smooth upper part from the air. The plant's form is like a pitcher and can take water from the air to prevent it drying up. "The botanists are at their wits' end to explain and classify this plant." The author prefaces his own theory about the plant by saying: "Scientific truth is obtained by bringing guesses to the test of observation and experiment." London doctors disagree about its medical usefulness.

A GREAT THUNDER-STORM

[Unknown author]; 8 August 1863; 9: 565-70; 9 1/2 cols.

On the night of 25 June 1863, a rare tropical storm visited Sussex. The author saw it from the Sussex Downs and Brighton, and took detailed notes. Though he refers to authorities such as Hugh Miller's* description of the geology of the local hills, it is mainly just a description of what he saw. Scientific questions are hardly raised.

SAND GROUSE

[Unknown author]; 19 September 1863; 10: 78-81; 5 cols.

Sand grouse were apparently new to Britain at the time of writing and had been only recently observed, though in 1859 two specimens were killed and are preserved in museums at Lynn and Derby. The author examined one killed in Sussex and gives details of the bird's physical appearance, varieties, habitat, behaviour and so on, including what others have written. Sand grouse apparently come from Africa, and can be found in Asia. The question remains whether they can be caught and kept for further study in this country rather than killed. Sir William Jardine's* account of different species of sand grouse from other countries, and Dr. Andrew Smith's* *Illustrations of the Zoology of South Africa* (1838) are referred to.

HERONS

[Unknown author]; 26 September 1863; 10: 114-17; 7 1/2 cols.

The article is based on Arthur Edward Knox's* *Ornithological Rambles in Sussex; with A Systematic Catalogue of the Birds of that County, and Remarks on their Local Distribution* (1849). It quotes from the book passages about the heron's ability to fight fiercely and how Knox came to observe the birds' nests. It describes a number of heronries. Then it goes on to give an account of the extraordinarily long gullet of a specimen shown to the Zoological Society. Other observers, such as a Dr. Neill of Canon Mills [perhaps Patrick Neill*], Edinburgh, and William Macgillivray,* are drawn on for interesting descriptions.

ROOKS AND HERONS

[Unknown author]; 3 October 1863; 10: 136-41; 9 cols.

A comparison is made of ravens, crows, rooks and herons, and their breeding, nest-building, and general nature. Several observers' accounts are discussed including Arthur Edward Knox's* book, *Ornithological Rambles in Sussex; with A Systematic Catalogue of the Birds of that County, and Remarks on their Local Distribution* (1849). The article records a good deal of observation and anecdote. At one point, the author says, "During the sleepless nights of a long illness, I learned to distinguish the notes of between thirty and forty different species of birds, and their different hours for beginning their chatterings, whistlings, and warblings." He was presumably a specialist himself and the same author of the previous article "Hérons" (26 September 1863; *AYR* 10: 114-17).

VERMICULARITIES

[Unknown author]; 17 October 1863; 10: 177-79; 5 1/4 cols.

In the evolutionary scale of animals, the worm is described as being "the starting-point . . . the rudimental form of all the complex organisations which come after it." The author's thesis that the physiology of the worm is a primitive model of human physiology is founded on his conviction that "the animal creation must be one, since there is only one Creator." A description of the anatomy and habits of different kinds of worms is prefaced by a collection of proverbs, myths and anecdotes about worms, together with many of the author's personal observations of worms. One authority quoted is Sir Everard Home's* thirteenth lecture in his *Lectures on Comparative Anatomy, 6 vols.* (1814-28).

THE FIRE SEA

[Unknown author]; 28 November 1863; 10: 321-25; 8 1/2 cols.

A recent earthquake on the 6th of October has confirmed the hypothesis held by many authorities in geology and geography that there is molten fire at the centre of the earth. Theories about the formation of planets held by La Place* and Buffon* were derived from ideas of earlier philosophers, such as Descartes and Leibnitz. Planets were thought to be cooling stars, on the surface of which a crust was eventually formed. Some remarks made by the French scientist, Jean Louis Armand de Quatrefages de Bréau,* are quoted, arguing that the earth's surface would be destroyed by its inner fires but for its "five hundred and fifty-nine volcanoes" which acted as "safety valves." The article also contains further general discussion about: the surface crust of the earth; mention of experiments by Buffon and Fourier on how long the surface may have taken to consolidate on cooling; the experience of the recent earthquake; opinions of earlier writers on the appearance of marine shells high on mountains; and changing sea-levels. The article is an interesting example of a piece on popular science.

FOR LABRADOR, SIR?

[Unknown author]; 12 December 1863; 10: 379-81; 5 1/2 cols.

The article is about the work of Henry Youle Hind,* professor of Chemistry and Geology in the University of Toronto, who explored the interior of the Labrador peninsula.

TRIFLES FROM CEYLON

[prob. J. E. Tennent]; 19 December 1863; 10: 402-6; 7 3/4 cols.

The article is an account of animals and reptiles in Ceylon. The author refers in the beginning to Sir Emerson Tennent and his book on Ceylon, and then he describes what he himself observed in Ceylon: the river alligators, snakes, vermin, and other creatures.

[According to *Pilgrim* 318n, Oppenlander wrongly puts the author's name as Frank Dickens who was working in the AYR office before going to India in 1864, and had not knowledge of Ceylon.]

Pilgrim 10: 318, to W. H. Wills, [22] November 1863: "The Ceylon paper you will receive from Frank."

LAUGHING GULLS

[Unknown author]; 19 December 1863; 10: 396-98; 3 1/4 cols.

Although Edward Stanley's* *British Birds [A Familiar History of Birds: Their Nature, Habits, and Instincts]* (1835) has one or two pages on the Laughing Gull and St. John's* *Short Sketches of the Wild Sports and Natural History of the Highlands* (1846) gives a graphic account of its haunts in Scotland, ornithologists seem not to have written about the location where the bird can most easily be seen in spring and summer. The article describes an island in a lake in Norfolk which is the residence and breeding-place of the Laughing Gull from March to August, and gives a picturesque sketch of the birds' activities.

METEORIC STONES

[Unknown author]; 16 January 1864; 10: 488-91; 5 3/4 cols.

The statements about meteorites falling to earth that were made by Livy, Herodotus and others were dismissed in the eighteenth century. The publications of Ernst Florence Friedrich Chladni's* pamphlet, Joseph Izarn's* *Des Pierres Tombées du Ciel* (Paris, 1803) and of Luke Howard's* paper in the *Philosophical Transactions*, have recorded a great number of meteorites. Showers of meteors have been specific occasions when many meteorites have been observed by people such as Humboldt,* a Mr. Ellicot [perhaps John Ellicott*] and Jean Baptiste Biot* in France. "The Creator of the Universe" is said to have apparently so arranged it that meteorites explode or are blown up before impact, although this cannot be explained: "the only real conclusion we can arrive at, is, that we know no more of the origin of meteoric stones, than we do of the origin of the globe on which we live."

POPULAR NAMES OF BRITISH PLANTS

[Unknown author]; 30 January 1864; 10: 534-39; 9 cols.

The article is based on Dr. Richard Prior's* *Popular Names of British Plants, Being An Explanation of the Origin and Meaning of the Names of Our Indigenous and Most Commonly Cultivated Species* (1863). Knowing and naming go together, and the study of the names of plants "tells us what men knew and thought of them." The article gives many interesting examples of botanical names corresponding to the plants' specific characteristics.

PLANT SIGNATURES

[Unknown author]; 6 February 1864; 10: 557-61; 7 1/2 cols.

This is a second article based on Dr. Richard Prior's* *Popular Names of British Plants* (1863). It gives more examples of how plants are named. An ancient book, William Cole's *Art of Simpling, An Introduction to the Knowledge and Gathering of Plants* (1656) explains the theory of "Plant Signatures," which is that plants useful to man can be recognised by their appearance. Many plants still bear popular names given them in accordance with this belief, often based on "superstitions and passions" and "pious delusions and migrations." Some plant names are translated from Greek and Latin; and other names derive from the uses the plants can be put to, their growing habits, their appearance, and their resemblance to something else.

THE STORY OF THE GUNS

[Unknown author]; 13 February 1864; 11: 18-24; 12 1/4 cols.

The article is a favourable review of Sir James Emerson Tennent's *The Story of the Guns* (1864), [a presentation copy with Tennent's inscription was in Dickens's library]. Tennent's book, though including minute details and technical information, is full of interest because of the author's imagination, "powers of observation and picturesque description," and his "adapting his scientific knowledge to the development of the most prominent and popular topic of the day." It goes into detail about the history of the development of guns, from the old musket called Brown Bess, to the improved Minié Rifle (1851), the Enfield Rifle (1853), and the Whitworth Rifle (1857). It turns to cannon and the Armstrong gun invented by Sir William Armstrong* and favoured by General Peel. Whether or not the gun invented by Whitworth is better than Armstrong's is not decided: perhaps they are equally good.

VARIETIES OF MEN

[Unknown author]; 19 March 1864; 11: 128-30; 5 cols.

The author discusses the varieties in colour, physiognomy and intelligence of different races and speculates about the possible causes. There are different explanations for why the negro is black: for example, Pierre Foissac's* idea about the predominance of carbon in his vegetable diet [argued in his *De l'influence des Climats sur l'homme* (Paris, 1837)], or Arnold Adolphe Berthold's* idea that heat increases the activity of the lungs and liver so that more carbon is disposed under the skin. But there is also contrary evidence. The influence of climate on people's lives, physique, and intellectual development is also discussed.

ALL MOONSHINE

[Unknown author]; 7 May 1864; 11: 299-301; 4 1/2 cols.

The article disputes the belief promoted by almanacs and some weather prophets that the moon exerts influence on the weather and other phenomena. Though much attention has been given to the subject, there is no definite way of predicting the weather. Some superstitions without scientific foundation are mentioned, for example, the saying that if it rains on St. Swithin's day, it will rain for forty days, or that if timber is felled when the moon is on the increase, it will decay, or that the moon's rays can cause blindness and madness. Exact meteorological records in France and England may help to decide whether fixed rules can be found for predicting the weather over a short period.

THE ENTOMOLOGIST GONE SOUTH

[Unknown author]; 18 June 1864; 11: 440-44; 6 1/2 cols.

This is a light-hearted but informed article on disagreeable insects to be found in the southern United States. In the first paragraph, the author refers to Professor Charles Kingsley's* remarks on the mosquito. The unnamed entomologist, perhaps the author himself, went to America to study Diptera which are derived from Hymenoptera and Neuroptera. According him, there are many flies in the Gulf States of America in May, and in summer all over the southern and northern States on the East Coast. Mosquitoes particularly abound in some parts of Florida. He also describes being tormented by flies, gnats, wasps, ticks, spiders and earwigs. He especially focused on a kind of "yellow fly," studied its nature and observed it under the microscope. There is also general information about how to preserve specimens that have been collected.

OUR LITTLE FRIENDS

[Unknown Author]; 23 July 1864; 11: 562-64; 6 cols.

The article about silkworms is based on T. L. Phipson's* *The Utilisation of Minute Life; Being Practical Studies on Insects, Crustacea, Mollusca, Worms, Polypes, Infusoria, and Sponges* (1864) [Ch. 2, "Silk-Producing Insects"]. Different kinds of silkworms in countries such as India, China and Africa, their characteristics and the nature of their silk, are described in detail.

AN AMAZONIAN NATURALIST

[Unknown author]; 30 July 1864; 11: 592-96; 8 cols.

The article is based on a book by Henry Walter Bates* who lived on the borders of the river Amazon for several years [*The Naturalist on the River Amazons, a Record of Adventures, Habits of Animals, Sketches of Brazilian and Indian Life and Aspects of Nature under the Equator during Eleven Years of Travel*, 2 vols. (1863)]. Bates conducted his research "with a view towards solving the problem of the origin of species." The book gives observations of eight hundred unusual creatures such as parasites, bird-catching spiders, ants, monkeys and many others. A vivid exotic scene is sketched.

FRENCH VIPERS

[Unknown author]; 20 August 1864; 12: 36-40; 8 1/2 cols.

In France, there are three kinds of venomous viper, the Aspic, the Pelias, and the Ammodytes. The author gives a detailed description: how a female's jaws can protect offspring, how to recognise the different kinds of snakes, and where they are usually found. They have grown so common that in most of north-eastern France a bounty is paid for killing them, and other parts of the country have also shown them multiplying. They hibernate in winter and re-appear in spring. Though poisonous, their bite is not usually deadly: it can be cauterised or remedied by other treatments. Wild boars are known to kill snakes, as are certain dogs, birds and domestic fowl. Many medical authorities are referred to. The author himself considers his article as a "too-winding essay."

CAN YOU SWIM?

[Unknown author]; 27 August 1864; 12: 54-58; 7 1/2 cols.

Some animals are gifted with the ability to swim; some are not. The reason why dogs and cats do not need to learn to swim but people do is because of the difference between bipeds and quadrupeds. Examples of the swimming abilities of various animals are given. Though some ducks and geese are web-footed, they rarely swim; and the Darwinites explain the instance of having webbed feet as an hereditary feature surviving modified habits. Then the author analyses the physical condition in the action of swimming, gives instructions on how to swim, and discusses the advantages of swimming and what kind of water is most suitable for swimming.

THE LAND OF MONTEZUMA

[Unknown author]; 17 September 1864; 12: 129-33; 8 3/4 cols.

The article is about "fossil man" in the stone age, based on Michel Chevalier's* *Le Mexique, Ancien et Moderne* (Paris, 1864) [translated as *Mexico, Ancient and Modern*, 2 vols. by Thomas Alpass]. It concerns Mexico in the time of the Aztec empire, and describes an extinct civilisation, its agriculture, animal food, temples, morality and so on. Apparently, we can find the same sort of interest in looking into relatively recent human history, as we find in stories about extinct animals. The naturalist imagines mammoths, and revels "in the beauties of a bygone fauna," creatures "which no longer exist" that give him "endless amusement."

BEES

[Unknown author]; 17 September 1864; 12: 133-35; 4 1/4 cols.

This describes the behaviour of bees: how the three classes of bees in a hive--the queen, the drones or males, and the workers--live together, build the cells, look for food, mate, hatch eggs and feed their young. The article is like a classroom text book which gives straightforward information in simple language.

Pilgrim 10: 431, to W. H. Wills, 1 October 1864: "I don't like Bees as a subject: having had my honey turned into Gall by Bee Masters in the Times. I think I have a better paper."

[The *Times* had carried a correspondence on bees, July-August 1864].

LEATHER GUNS

[Unknown author]; 24 September 1864; 12: 162-63; 2 3/4 cols.

The seventeenth-century Scottish inventor, Robert Scott, developed a cannon made of hardened leather instead of the heavy and cumbersome metal cannon of the time. His guns were successfully used in battle by Gustavus Adolphus in Sweden and later by Charles I. Another unusual substance used in war as an alternative to gunpowder was invented in the 1840s and described in the *Quarterly Journal of Science*: this is "gun-cotton" [a highly explosive compound made by soaking cotton in nitric and sulphuric acids]. Gun-cotton can be used in artillery and also in the same way as dynamite.

THE LIVES AND DEATHS OF THE PEOPLE

[Unknown author]; 8 October 1864; 12: 198-205; 13 1/2 cols.

The article is based on the annual report of the medical officer of the Privy Council, John Simon* as required by the Public Health Act of 1858. Many contemporary

physicians are mentioned in this summary of the health and living conditions of the poor and of low-paid workers.

A SECOND SWARM OF BEES

[Unknown author]; 15 October 1864; 12: 222-26; 8 1/4 cols.

This takes up the same subject as "Bees" (17 September 1864; *AFR* 12: 133-35), and is again mainly about the practical side of bee-keeping. It mentions anecdotes of bee-keeping, including one about Dr. John Templeton,* the Secretary of the Society for the Encouragement of Arts, who used to allow bees to cover his head and face. It mentions other experts at handling bees. The article then describes accidents suffered by people stung by bees, explains bees' impulse to sting and other characteristics of behaviour. Experiments with bees are described; some of them useful, but others cruel.

WORKMEN'S DISEASES

[Unknown author]; 29 October 1864; 12: 272-75; 6 cols.

The article is a medical account about scurvy in merchant ships. The author also mentions other occupational hazards, diseases and disabilities, such as lead poisoning, mercurial poisoning and diseases resulting from lack of ventilation.

WATER

[Unknown author]; 12 November 1864; 12: 326-32; 10 3/4 cols.

Analytical chemistry provides much of the information for this very comprehensive article on water, which includes its density, weight, purity, gravity and what happens to it on freezing and evaporating. Water is incorrectly said to be composed of oxygen (89.9 parts) and hydrogen (11.1 parts). The different types of water--spring, well, river, pond, and ice--are explained, and there is a discussion of the medical use of water and of the efficacy of mineral water. Newton's ideas about the chemical nature of water and Gaspard Monge's* explanations of the formation of hail are mentioned.

FAT PEOPLE

[Unknown author]; 19 November 1864; 12: 352-55; 6 1/4 cols.

The article is based on *Sur l'Homme, et le Développement de ses Facultés ou Essai de physique sociale* (1835) [trans. as *A Treatise on Man and the Development of His Faculties* (1842)] by Adolphe Jacques Quételet* of Brussels. His research on people's weight shows that the weight of a man usually ranges from 108 to 220 pounds, and that of a woman from 88 to 207 pounds. His estimate has to be modified in some cases for different countries. The weights of people of different ages also vary. Further statistics are given by a Mr. Cowell, who weighed children and young people in factories, and Professor J. D. Forbes,* who weighed more than 800 youths in Edinburgh. Some specific abnormal cases are mentioned.

AIR: CHAPTER I

[Unknown author]; 3 December 1864; 12: 399-402; 7 cols.

The pressure of air on every square inch of the surfaces of our bodies is 15 pounds, but we do not feel it because the pressures are from within as well as outside our bodies. Experiments on the weight of air need the use of an air-pump and an exact balance. The elasticity of air is discussed. The characteristics of oxygen, azote [nitrogen] and other constituents of air are also dealt with. The article ends by describing how plants use air.

AIR: CHAPTER II.

[Unknown author]; 10 December 1864; 12: 422-25; 6 1/4 cols.

The article deals further with the purity of air, weather, the power of steam-engines, scent, the motion of the air, and its influence on a flying balloon or floating ship. The observations of de Saussure,* Humbolt [Humboldt],* Smee,* Faraday* and many scientific authorities on air are mentioned.

EARTH: CHAPTER I.

[Unknown author]; 24 December 1864; 12: 469-74; 9 1/4 cols.

The article begins by explaining that planets are cooled stars, and that the continents of the Earth "repose and float upon the internal nucleus of the Earth which is still in a state of fusion, or even fluid elasticity." This is because the centre of the Earth is a hot liquid mass. It goes on to say more about this "central fire" and then discusses the composition of the Earth, the differences between stars and planets, volcanoes, the gradual formation of the Earth, and the different types of soil. Finally, the burial customs of different cultures are discussed, and we are reminded of the usefulness of the earth in such fields as painting, manufacturing, agriculture and building.

EARTH: CHAPTER II.

[Unknown author]; 31 December 1864; 12: 486-89; 5 1/2 cols.

The "scenery, spirit, and science" in Jule Verne's* recently published *Voyage au Centre de la Terre* (Paris, 1864) inspired the author to review it by writing his own imaginary account of an expedition a hundred miles below the surface of the Earth, based on a summary of the novel. The explorers encounter underground volcanic phenomena, seas and mountain ranges. The second half of the article explains the difficulties of constructing the tunnel of Mont Cenis in the Alps, a project being undertaken by English capitalists and engineers. A newly invented tool to bore through rock is described.

TALL PEOPLE

[Unknown author]; 31 December 1864; 12: 489-93; 7 cols.

As well as a study of "Fat People" (19 November 1864; *AYR* 12: 352-55), professor Lambert-Adolphe-Jaques Quételet* has made a statistical study of how tall people are. He has learned, for example, that people in towns are generally taller than those who grow up in the country. Studies have been made of the extent to which men grow in their early adult life, their height in relation to their standard of living, and differences between small and larger men. Though the article begins with an apparently scientific approach, it includes the evidence of religious and classical history. Something is said about more recent "giants."

MAGNESIAN LIGHT

[Unknown author]; 4 February 1865; 13: 33-35; 4 cols.

Scientists such as Sir Humphry Davy* have discovered many new metals which can be made use of, such as aluminum. In 1829 Antoine Bussy* made the further discovery of magnesia which has been used for medical purposes. A French scientist first used magnesium wire "last summer" to produce dazzling brightness at one of the meetings of the Association Scientifique. The author draws on some French sources, such as Marc Antoine Augustine Gaudin's* treatise on the use of magnesium and the cost of using it for lighting. He concludes that magnesium, with its powerful illuminating power, is suitable for photography, surgery, and naval signals, but too expensive for lighting towns, because it costs twice as much as gas.

MARY ANNING, THE FOSSIL FINDER

[Unknown author]; 11 February 1865; 13: 60-63; 5 1/2 cols.

Mary Anning,* a self-taught carpenter's daughter of Lyme Regis, was an important woman geologist. She discovered the skeleton of a Plesiosaurus. Professor Owen* and Dr. Buckland* thought highly of her. She was said to have begun collecting fossils at about the age of ten, and in 1811 found the first Ichthyosaurus (fish-lizard), "a monster some thirty feet long." Many people had different ideas of what it was till it was sent to Cuvier* who identified it. We are told of her other contributions to geology and of her European scientific reputation. Dr. Carus* wrote an account of his visiting her collections in 1844. "Her history" says the author, "shows what humble people may do, if they have just purpose and courage enough, towards promoting the cause of science." The inscription in a local memorial window to her commemorates "her usefulness in furthering the science of geology."

A LADY ON THE PEAK OF TENERIFFE

[Unknown author]; 18 February 1865; 13: 85-88; 6 1/2 cols.

The astronomer Charles Piazzi Smyth* managed to take a big telescope to the Peak in Teneriffe over 10,000 feet high, and carried out a series of observations in 1856 with his wife using £500 granted by the Astronomer Royal. We are told how he got there, what life was like, how to boil water under low barometric pressure, and given much vivid description, all from Smyth's *Account of the Astronomical Experiment of 1856 on the Peak of Teneriffe* (1858).

PHOTOLOGICAL FACTS: CHAPTER I.

[Unknown author] 11 March 1865; 13: 149-53; 8 1/4 cols.

The article discusses the many discoveries about light and substances that can be used in photographing astronomical objects made by scientists including the Herschels* and some astronomers. A Mr. Huggins has presented to the Royal Society results of his examination of the light of the nebulae by an optical apparatus. He discovered that nebulae are masses of gas or luminous vapour, rather than clusters of solid or liquid bodies. Such spectral analysis supports Laplace's* theory of the origin of the solar system.

ARTIFICIAL FERTILITY

[Unknown author]; 11 March 1865; 13: 157-64; 14 cols.

Much of the investigation into artificial fertilisers has been merely practical, but it has also been dependent on the use of chemistry. Sir Humphry Davy* is mentioned as an early

scientific pioneer, then Liebig* who in 1839 showed how to produce super-phosphate of lime. Then geologists who made further contributions to the field are mentioned. The article then goes on to discuss agricultural sewage, and the recommendations of agricultural chemists.

THE LAMP FISH

[Unknown author]; 25 March 1865; 13: 199-201; 4 cols.

The Lamp Fish that lives on the coasts of British Columbia, Russian America, and Queen Charlotte's Island contains an abundance of oil. Its Latin name, *Salmo (Mallotus) Pacificus* was given by Sir John Richardson.* They are caught by the Indians, who then cure and dry them for winter food. The dried fish can also be used as lanterns by having a wick pulled through the bodies. Excess fish are converted into oil.

PHOTOLOGICAL FACTS. CHAPTER II.

[Unknown author]; 25 March 1865; 13: 208-12; 7 1/4 cols.

The article is based on this year's *Annual* published by the Bureau des Longitudes which contains a "Notice on the Speed of Light" by Charles-Eugène Delaunay.* There are descriptions of the theories about light of Aristotle, Descartes, Mallebranche, and Newton. The nature of light is explained and details of scientific research into how light travels are given. The conclusion is that light travels twenty metres in one fifteen-millionth of a second.

THE CHEMISTRY OF WASHING

[Unknown author]; 8 April 1865; 13: 248-53; 9 1/2 cols.

The article is based on the report of a government commission set up in 1850 to enquire into the hygiene of public laundries. The author explains that because they are vegetable matter, linen and cotton can putrefy, and putrefaction is accelerated when the fibres become coated with types of dirt such as sugar, gum, grease and decomposing animal matter. He goes on to give a chemical analysis of stains and how to remove them. As for soap, its main value is its ability to form a solution with which oil and grease will combine. Other cleansing agents, such as soda, potash and hypochloric acid are discussed, and there is a brief survey of the history of washing in different cultures.

RESPECTING THE SUN

[Unknown author]; 22 April 1865; 13: 297-300; 6 1/2 cols.

The distance from the earth to the sun is about 95,000,000 miles and in 1874, when the transit of Venus across the sun takes place, there will be a chance to settle exactly how far from the earth Venus is. General information about the sun is given such as its enormous volume, its density, its weight and speed. The article also mentions the idea held by George Wilson,* Dominique François Jean Arago* and the Herschels* that the sun itself is not entirely fire but a solid ball enclosed in a photosphere or luminous atmosphere. It goes on to describe sun spots, and to recommend the French astronomer, Hervé Faye,* whose "two remarkable *Mémoires*," which include fresh facts, have been summarised by de Parville.* It mentions the discovery of spectral analysis by Robert Bunsen* and Gustav Kirchhoff.* Faye also suggested that the sun is made up of "solid incandescent particles, suspended in a gaseous medium," which "act in the same way as a solid source of light."

Then it discusses the seven phases of the sun, which is a cooling star. A report by William Herschel* in an unnamed journal of the 24th of March 1791 is referred to. The author concludes, "The earth and the moon, we are told, offer examples of this successive evolution. Evidently, the earth was once a veritable sun for the moon. The moon, whose mass is very much smaller, was naturally the first to cool. Then the earth . . . at last acquired a crust and became entirely solid at the surface . . . It is probable that life was developed in the moon when it had scarcely yet appeared on earth. We are informed that the moon represents the earth's future, the sun her past."

ANTLERS

[Unknown author]; 22 April 1865; 13: 302-6; 7 cols.

Deer are cud-chewers that have cutting teeth and upper jaws with pads; their tongues are like hands that catch things. the author quotes Professor Owen* on the huge extinct Irish deer. An account is given of how horns are formed from the periosteum, a membrane which becomes bones. The anatomy and stages of growth of antlers are described, and an explanation of why and how antlers are shed is given. Also mentioned are anecdotes and travellers' reports about deer.

MORE LIGHT

[Unknown author]; 29 April 1865; 13: 318-21; 7 cols.

This is chiefly concerned with the practical business of producing gas, including the "chemical mysteries of a gas retort." "A complete revolution has taken place in the

matters." The author explains how coal yields gas and how the refuse (including gas, coke, tar and ammoniacal liquor) can be used to produce other chemical substances.

CIRCUMLOCUTIONAL VACCINATION

[Unknown author]; 13 May 1865; 13: 376-78; 2 3/4 cols.

The article reviews the history of vaccination, brings it up-to-date, and makes an appeal for a renewed inquiry in England into seeing that the matter used in vaccination is effective.

WINE AGAINST PHYSIC

[Unknown author]; 24 June 1865; 13: 521-23; 4 3/4 cols.

Doctors have come to discover that good wine and food can be more beneficial to people than drugs. The article is based on Dr. Robert Druitt,* *Report on Cheap Wines, Their Quality, Wholesomeness and Price* (1865) and discusses the medical uses of different kinds of cheap wine to treat physical ailments and illnesses.

IS HEAT MOTION?

[Unknown Author]; 1 July 1865; 13: 534-38; 9 cols.

The article is based on John Tyndall's* *Heat Considered as a Mode of Motion* (1863), which is said to be "more entertaining than a novel." Tyndall's thesis is that heat, light, electricity, magnetism, chemical affinity and motion are all connected and interdependent, and also that any of them can be converted into any of the others. These ideas have been

discussed in *On the Correlation of Physical Forces: Being the Substance of A Course of Lectures Delivered in the London Institution, in the Year 1843* (1846) by Sir William Grove* and *The Monogenesis of Physical Forces* (1857) by Alfred Smeec.* Both works were mentioned in "Physical Force" (12 March 1859; *HW* 19: 354-59). Speculations about the nature of heat and fire were described in "Fire" (18 January 1862; *AYR* 6: 393-96). Tyndall's* theory that heat can produce mechanical force, and vice versa, is explained.

Some other authorities on the relation between heat and motion are mentioned, such as Theodor Billroth* and Hermann von Helmholtz,* and Professor Karl Friedrich Wilhelm Ludwig* of Vienna. An account is given of the experiments Tyndall conducted in his lectures, including, for example, showing motion caused by electricity and the generation of heat by friction. The article turns to Dr. Julius Robert von Mayer's* meteoric theory of the sun, his speculations about the sun's heat, and the possibility of calculating its rate of cooling. Von Mayer's conclusion was that, when substances or planets fall into the sun because of the force of gravity, solar light and heat are generated and the sun's emission of heat is maintained, so that we may have an agency able to restore the sun's lost energy. At the Hull meeting of the British Association [September 1853], John James Waterston* sketched a similar theory ["Observations on the Density of Saturated Vapours and their Liquids at the Point of Transition"]. The transactions of the Royal Society of Edinburgh in 1854 included Professor William Thomson's* *Memoir* ["On the Mechanical Energies of the Solar System"] in which he considered "the total heat provided by all the planets falling into the sun would cover its emission for forty-five thousand five hundred and eighty-nine years."

LIGHTNING-STRUCK

[Unknown author]; 29 July 1865; 14: 6-9; 6 cols.

Many people are struck by lightning, which can act in various ways. It has been known to follow bell wires, to strike someone in a railway carriage, and to injure or burn without inflicting a mortal injury. Many stories about the effect of lightning are told, without being examined, questioned, or explained scientifically. Some inventions can prevent such misfortunes, such as lightning-conductors and Sir Snow Harris's conductors applied to ships.

HEAT AND WORK

[Unknown author]; 5 August 1865; 14: 29-33; 9 1/4 cols.

Following "Is Heat Motion?" (1 July 1865; *AYR* 13: 534-38), the article continues to discuss Tyndall's work on heat. In his *Heat Considered as A Mode of Motion: Being A Course of Twelve Lectures Delivered at the Royal Institution of Great Britain in the Season of 1862* (1863), Tyndall showed that heat is expended whenever work is done. He also performed experiments in which heat was consumed in mechanical work. For example, if compressed air is let out of a solid vessel at the same temperature as the room in which the action takes place, heat will be taken from the air within the container. On the other hand, the air forced from a bellows will be warm, since the force expelling it is mechanical; gas expelled from a soda-bottle, on the other hand, lowers the temperature of the remaining contents. A ball of lead dropped from a height generates heat on being suddenly stopped. A foot-pound of heat is the amount required to lift one pound one foot, and 772 foot-pounds are needed to raise the temperature of a pound of water by one

degree Fahrenheit. Gustave Adolphe Hirn's* theory about the rule of the mechanical equivalent of heat is also mentioned.

As the Sun is the source of life and motion, the question arises whether other planets are sufficiently warm to maintain life. It seems that they might be if insulated by an atmosphere admitting solar rays but preventing the escape of heat. Tyndall considers ways in which the energy of the Sun is stored on earth: in rivers and water-power, in chemical inter-action, animal life, and gravitating forces. By human standards the Sun is "an inexhaustible source of physical energy . . . the cause of all terrestrial activity." Human volition alone cannot create force; the energy of animals is material; the organic world depends on the inorganic. But beyond the world of physics and in the region of thought are problems not yet explained: "Thus, though the territory of science is wide, it has its limits," and "the real mystery yet looms beyond us."

BOUNCING BOYS

[Andrew Halliday]; 5 August 1865; 14: 37-40; 5 1/4 cols.

This is a general essay on educational change, recognising that the new generation is at home with practical photography and "the closest secrets of nature." Schools teach chemistry at literature's expense. We find children explaining away a "moving shadow" at night "on scientific principles"; but "give children printing-presses, retorts, and chemicals. . . but don't let them skip the Arabian Nights." The author bets that "my dear Professor Owen has had faith in the Roc."

OCEAN SWELLS

[Unknown author]; 26 August 1865; 14: 101-6; 10 cols.

A Dutch physician, Dr. Pieter Bleeker,* has just published a book showing portraits of fish found in the water of the Indian Archipelago [*Revision des espèces de krastacembelus (Belone Cuo) de l'Inde archipelagique* (Leiden, 1862-66)]. Fish there are wonderfully colourful, as the author shows by describing different kinds, such as one of the "scari." The "pseudoscarus tricolor" is not just amazingly colourful, but is like a parrot. Other kinds, "the labroids" and "the silurians," are also described, before the author turns to eels, their lengths, colours, and habits.

A FEW SATURNINE OBSERVATIONS

[Unknown author]; 2 September 1865; 14: 129-33; 6 3/4 cols.

The article is based on R. A. Proctor's* book, *Saturn and His System* (1865). It gives a fanciful account of heavenly "parties," in which Saturn appears "dull, slow, yellow faced" and crawling "over the floor of heaven like a gouty and bilious nabob." He takes nine times longer to travel round the Sun than the Earth does and at a speed three times slower. A year on Saturn is twenty-seven and half times longer than our years. The article then lapses into a mixture of myth and folk-lore, mentioning authorities from Bishop John Wilkins* to Nermolaus Barbarus. A glance at Proctor's monograph sets the writer off again, though Proctor "is too learned for us," but he nevertheless gives a general historical account of how Saturn's rings were possibly discovered by Galileo, then Christian Huygens,* Giovanni Domenico Cassini,* Herschel* and more recent observers, William Cranch Bond* in America and William Lassell* in England. There is a reference to James Clerk Maxwell,* who obtained the Adams Prize at Cambridge University eight years ago "for an

essay upon Saturn's rings" [*On the Stability of the Motion of Saturn's Rings* (Adams Prize Essay, Cambridge, 1856)]. The article is an interesting mixture of the informed and the fanciful.

BIRD-FANCIES

[Unknown author]; 9 September 1865; 14: 153-57; 8 cols.

The article discusses the many contradictory theories about the migration of birds and particularly swallows, who have been said not to fly away to different parts of the earth as the weather changed, but to hibernate under water. It is thus an account of false beliefs, held in defiance of scientific inquiry, from the time of Aristotle and Pliny. The belief that swallows submerged themselves under water was held by many respected naturalists, including Gilbert White,* Linnaeus,* Cuvier* and Thomas Pennant.* John Hunter,* in contrast, was assured that it was impossible. White's observations are quoted at length.

ALL THE WORLD AKIN

[Unknown author]; 7 October 1865; 14: 250-52; 4 3/4 cols.

The article is based on Victor Borie's* discussion of cholera in the *Siècle*. "We cannot believe it to be the hand of Providence punishing us for our evil deeds." Cholera, the plague, is "the consequence of human stupidity and folly," for man has not yet learned to avoid it properly. We are told where it begins. Because people in the delta of the Ganges do not bury their dead, the corpses are cast ashore at the mouth of the river. Then, when the dry season comes, the marshes exposed under the sun draw up moisture and effluvia which cause cholera, distributed by global atmospheric currents. Dr. Selim Ernest Maurin's

essay, *Prophylaxie du Cholera* has explained the matter [see *Analyse et synthèse de l'épidémicité cigérique; question sociale. Origine, développement, propagation des épidémies de Choléra* (Marseille, 1865)]. Europe should form a coalition against the scourge and prevent it by draining the Ganges delta. Dr. Maurin's advice about prevention and treatment is optimistically mentioned: see your doctor, be temperate, unafraid, clean and avoid "especially-laxative fruits." We are urged to deal with the problem because the centre of infection, "at present an implacable instrument of death," "might be made to become an inexhaustible source of wealth."

BEFORE THE DELUGE

[Unknown author]; 13 January 1866; 15: 7-11; 7 1/4 cols.

The article is about Louis Figuier's* *La terre avant le déluge* (Paris, 1863) translated into English as *The World before the Deluge* (1865). The book is seen as one of many "romances of fact." Though the author is "a little too exclusive and narrow" in thinking that almost the first book the young should read is one on natural history, about such matters as "the structure of a tree, the composition of a flower, the organs of animals, the perfection of the crystalline form in minerals," and "the history of the world," the reviewer thinks he is right in believing that "nothing is more instructive and elevating than an introduction to new unknown, and wonderful facts." He makes the point that the Creator or "Sovereign Master" has willed that some species should become extinct "quite naturally," and they have made way for other more perfect races according to the plan of the "All-powerful." "We see the work of creation perfecting itself unceasingly."

The author appreciates the clear and easy-reading style of the translation from French into English. He thinks that Figuier has well illustrated change "from Chaos to the Deluge,"

using his vivid imagination and the authentic proofs of fossils, bones and elephants' or mammoths' tusks. The same fossils found in different places show that they shared the same climate during ancient times. Some hypotheses about the earth's changing climate are considered, but Figuier "has the courage to admit" that nothing can be conclusive, asking that "in science its professors should never be afraid to say, *I do not know.*" He discusses the cause of the glacial period, and says that Professor Tyndall and other scientists who have studied ancient glaciers have given different explanations for the reduction of temperature during the glacial epoch. He asks whence it came, and answers, "from the will of the Author of the universe." Then he wonders when mankind is doomed to disappear. The answer "is hidden in the knowledge of the Almighty Creator of the world, who formed the universe." [A copy of the book was in CD's library.]

CHESTERFIELD JUNIOR. A SON'S ADVICE TO HIS FATHER

[Unknown author]; 20 January 1866; 15: 45-48; 6 1/2 cols.

The article parodying Lord Chesterfield's *Letters to His Son* (1774), is written as a letter from Mr. Chesterfield's son to his father. He urges his father to forsake what is obsolete because the world has been changing. He says that things have been turned "topsy-turvy": accepted facts have altered, and everyone should remodel his ideas to catch up with the times. The young of the present age have received a better education than their parents. As the son proudly says of their scientific learning: "Try us with anything you like; the distance between the planet Mercury and the moon; the manner of the formation of the old red sandstone." He had been shocked to hear his father contradict Professor Barnacles' assertion that a certain cliff was "composed of the remains of minute creatures," and criticise Darwinian theory: "Why, bless my life and soul, does the man mean to tell me that my grandfather was a monkey?" He ironically advises his father not to try hard to keep up

with the "inevitable march of modern events" and "the irresistible tide of progress," because he is aware that when middle-aged people attempt to deal with the "great changes of modern times," they often suffer "nervous diseases" and "brain affections."

He also touches on the characteristics of those who engage in scientific pursuits, their strain and anxiety, agony and intolerance. One such man "steals away to his dressing-room and blows his brains out" because he is "desperately perplexed" and not able to keep up with the pace of his competitors. The "luxury of the age" is that people can do things more swiftly than they did before, but people have difficulty in keeping up the pace. [This is the first of a series on recent changes, and the most representative. Later letters are under the same title but on different matters, none of which touches on science.]

BOSIO'S STUPENDOUS FLOWER

[Unknown author]; 24 February 1866; 15: 152-54; 3 1/2 cols.

John Gibson Lockhart wrote about a mysterious passion-flower in *Valerius, A Roman Story*, 3 vols. (Edinburgh, 1821), but, in fact, the passion-flower was introduced to Europe in the early seventeenth century by the historian Giacomo Bosio [Giacomo Bosio] in his *La Trionfante gloriosa Croce* (1610), which describes it as a flower representing God and His Passion. Bosio had never actually seen it, and his description of its perpetual bell-like shape is wrong. Yet his account drew the attention of botanists and theologians, and the flower was soon introduced to the gardens of Cardinal Odoardo Farnese in Italy. The scientist and "pious Christian," Tobias Aldinus [pseud. of Pietro Castelli (1570-1657; UC)], keeper of the garden, also wrote about it [*Exactissima descriptio rariorum quarundam plantarum que continentur Romae in Horto Farnesiano* (Rome, 1625)]. Details about structure of the flower and its nature are given. It was then introduced to England from Virginia. The

English botanist John Parkinson* published his account of it in 1629 [*Paradisi in Sole Paradisus Terrestris; or, A Choise Garden of All Sorts of Rarest Flowers*] and called it "Clematis Virginiana."

SOMETHING STRONG IN WATER

[Unknown author]; 24 February 1866; 15: 157-58; 2 cols.

The article criticises the superstitious, medieval beliefs expressed by the Abbé Gaume [Jean Joseph Gaume (1802-79; UC)] in his treatise on the virtue of holy water [*Das Weihwasser im neun sehten Jahrhundert . . . aus dem Französischen Übersetzt Von J. K. (Regensburg, 1866)*]. Gaume maintained that holy water could cure all sorts of ills and diseases, such as fractures, blindness, madness and cancer, and he tried to prove that it prevents "plagues and epidemics, destroys noxious insects, and cures vine-disease." In short, "This is the agent that science . . . persistently ignores." The article condemns Gaume's beliefs as "having no origin whatever in any rational, scientific, or natural grounds" and ironically asks how many priests might be needed to bless the ocean to avoid all shipwrecks and loss of life.

ATOMS

[Unknown author]; 17 March 1866; 15: 235-38; 6 1/4 cols.

Matter exists in one of three forms--solid, liquid, and gaseous--and is made of atoms which form molecules. This is true throughout the universe, since we discover from aerolites or bolides that no new substances are apparently to be found elsewhere. The author quotes Professor John Tyndall,* seemingly from his work on *Heat, A Mode of*

Motton (1863), to the effect that atoms probably vibrate or revolve; they are constantly in motion; matter differs only in the grouping of its elements or molecules; any body is like a miniature astronomical system; and that with a microscope of sufficient power we could see these elements and the great spaces between them. They can be "weighed," so that the hydrogen atom is classed as one, and oxygen as sixteen. Heat involves the collision of atoms, and "atoms and their motions are...the physical cause of colour." They are not to be despised: "Their force is gigantic, irresistible--rending iron, riving rocks . . . and if fully set in action, consuming the world with fervent heat" [2 Peter 3: 12].

INHUMAN HUMANITY

[Unknown Author]; 17 March 1866; 15: 238-40; 5 1/2 cols.

The article condemns and mocks the Royal Humane Society ("Royal Inhumane Society") founded by Dr. William Hawes* in the eighteenth century to study how to help restore to life apparently drowned people. At first Dr. Hawes offered awards to those who could save the apparently drowned. But an appendix to a recent report records cruel experiments on animals which are shown to have discovered nothing of practical value.

MIGHT AND MAGNITUDE

[Unknown author]; 24 March 1866; 15: 255-57; 4 3/4 cols.

The article indirectly suggests that heat and power come from the sun in whatever form we find them; and that the power of an animal, relative to its size, comes from its efficiency in making use of its food, which itself has been created by the energy of the sun. The basic argument is that energy is constantly transforming itself and that the ultimate source of

energy is "The Sun--himself created by the Great Maker of all things." Thus the Sun is "God's material instrument." The article goes on to discuss magnitude, evidently drawing on French authorities, and argues that "the muscular force of living creatures" appears to be "in inverse proportion to their mass."

MICROSCOPIC FUNGI

[Unknown author]; 14 April 1866; 15: 318-21; 6 cols.

After a discussion of the systems of classifying the organic and animal worlds, and how the student comes to learn "the solidarity of all the sciences," the article refers to recent useful introductory works on different branches of natural history, such as those by Yarrell,* Forbes,* Berkeley,* Moore,* Harvey,* Hassall,* Sowerby,* and Gould.* These have now been joined by Mordecai Cubitt Cooke's* *Rust, Smut, Mildew, and Mould. An Introduction to the Theory of Microscopic Fungi* (1865). Cooke's "elegant and inexpensive volume" is highly praised, and the article gives an explanation of the six different orders of fungi, how to identify them, and how to study them under a microscope: "Homely, insignificant, and even repulsive objects" when "examined, investigated, and dissected" are found to "consist of exquisite component parts." The contributor must have been a keen reader of scientific books, for he appreciates the publishers Van Voorst, Lovell Reeve, and Hardwick for publishing "works suited to all pockets, and almost to all comprehensions." Examples include the beautiful woodcuts in Jean-Baptiste Payer's *Botanique Cryptogamique* (1850), reproduced in *Micrographic Dictionary* (1856) [by John William Griffith]. The article admires science for "converting ugliness into beauty."

LIFE SOWN BROADCAST

[Unknown author]; 21 April 1866; 15: 355-56; 2 1/4 cols.

James Arndell Youl,* Edward Wilson* and others founded the Acclimatisation Society in Australia to increase the resources of the colony and introduce common English animals. According to the report of its annual meeting, animals have been liberated in many places include English birds, insects, fish, rabbits, hares and so on. The society also exported to Europe some native Australian animals, such as kangaroos.

MR. WHELKS COMBINING INSTRUCTION WITH AMUSEMENT

[Andrew Halliday]; 7 July 1866; 15: 610-13; 5 3/4 cols.

The article describes the visit of a fictional working-class character, Mr. Whelks, to the Royal Polytechnic Institution. He is disappointed by what he sees and leaves early. There is little that is scientific about its current lectures, which make use of a magic lantern, give an inaccurate account of Sir David Brewster's* optical discoveries, demonstrate the old diving bell, and show how to mend broken china. There is a silly lecture on Shakespeare with some tableaux, and another on Scott. Altogether, the author judges the show "not quite worthy of a Royal Institution founded for the diffusion of useful knowledge," and he feels that it presented more elevating performances in its early days.

FORCE AND MATTER

[Unknown author]; 21 July 1866; 16: 35-38; 6 1/2 cols.

The article is based on John Tyndall's* lecture on force and matter. Matter is transformed and vivified by force: "It is Almighty Force, combined with Wisdom and Benevolence, which has moulded the universe into its present state of Beauty and regularity." Yet the author is concerned to explain, if he can, how matter is "vivified" in this way. He returns to what has previously been said about atoms [see "Atoms" (17 March 1866; 15: 235-38)], though he does not refer to the previous article directly. He goes on to discuss the phenomenon of crystallisation, whether of ice and snow, sea salt, or rock crystal, and switches to the lectures on force and matter by a French scientist, M. Hénant. The author believes that Hénant gets out of his depth: "though the territory of science is wide, it has its limits, from which we look with vacant gaze into the region beyond." The article is scientific but rather pious in tone.

NOT QUITE A MAN FOR A STRAIT-JACKET

[Unknown author]; 28 July 1866; 16: 62-65; 7 3/4 cols.

It is argued that Thomas Gray,* the railway pioneer, was the main originator of the railway system, and that this half-pay retired naval lieutenant should be much more honoured for the part he played in shaping the ideas which led to this great development. In fact, he was thought of as insane. An account is given of the way he struggled and fought to impress his idea on "the leaders and teachers of the world, parliament men, scientific men, literary men, and . . . the great journalists." The criticisms of some of the contemporary journals is noted, such as the *Edinburgh Review* which said "Put him in a strait-jacket" and the *Quarterly Review's* which said, "Such persons are not worth our notice." Writers such as Samuel Smiles, in his biography of George Stephenson,* have failed to do justice to Gray and his book, *Observations on a General Iron Railway* (1820).

The author argues that he has been robbed of due recognition. Mention is also made of his wish to end the cruelty to horses caused by the stage-coach system.

FISH OUT OF WATER

[Unknown author]; 11 August 1866; 16: 104-6; 4 cols.

The article begins: "All animals, says the Darwinian theory, spring from an aquatic origin." It is a loosely argued essay on this general theme, not confined to animals, but including insects, gnats, dragon-flies, and water-beetles. Whales and porpoises, seals and walruses are mammals that have reverted to water. Plants may have had an aquatic origin, some fish really take to dry land, and watercress can be grown without water.

OUR LENGTHENING DAY

[Unknown author]; 15 September 1866; 16: 232-36; 6 1/2 cols.

The author recalls for his readers' memories "a few familiar but important scraps of knowledge, which everybody learns at school, and portions of which have to be unlearned afterwards." He compares the earth, which is an oblate spheroid, to an orange, to explain that the length of the day is determined by the earth's travelling round the sun in an ellipse, and that the earth is sometimes a little nearer to the sun when it approaches the focus of the ellipse than at other times. We are told how the moon revolves round the earth, and how the moon and the sun affect the tides. This generates friction which means a slight slowing down in the earth's rotation, and a loss of heat. The result is that "the earth's temperature is expected gradually to drop," but the exact amount of the slackening of rotation is not yet known.

STEAM IN THE STREETS

[Unknown author]; 3 November 1866; 16: 394-97; 6 3/4 cols.

The article introduces a history of steam-powered land transport. Many inventors and their works are described. Sir Isaac Newton had already speculated about "a globular vessel perched upon four little wheels, a jet-pipe protruding from one side," a seat on the other side, and "a triumphant charioteer on the seat," and Nicholas-Joseph Cugnot* made a steam-carriage model which realised Newton's idea. A Dr. Robinson conceived a road vehicle by steam power and communicated this to James Watt,* who then devised a steam-carriage, but did not develop it. After Cugnot, a Cornish engineer, Murdoch* [William Murdock*] invented a steam-carriage, but this was forgotten. Then William Symington* made a mechanism, fixed to the back of a carriage, which was exhibited in Edinburgh. Oliver Evans* of Pennsylvania also suggested a proposal for a steam-carriage which would go fifteen miles an hour. Others including Trevethick [Richard Trevithick*], tried to construct much lighter and more portable ones to make "a scientific steam-carriage." Subsequent inventions and improvements are mentioned. Finally, a committee appointed to investigate locomotives reported the advantages of a steam-carriage, because it was speedier and cheaper than horses, and judged the wide tyres of the carriage's wheels would cause less damage to roads than narrow wheels and horses' hooves. Other inventions and ideas are described. The author predicts that locomotives on the roads could be commercially profitable. He considers some ideas about their management and thinks legal restrictions too tight. Finally, he says optimistically, "We shall see."

GAPS IN THE SOLAR SYSTEM

[Unknown author]; 10 November 1866; 16: 414-15; 2 cols.

This reports on a paper published in a French journal on the subject of Le Verrier's* announcement that there ought to be planets between the sun and Mercury. The hypothesis was based on "Bode's Law," first discovered by the German astronomer Johann Titius*: add 4 to each of the series 0, 3, 6, 12, 24, 48, 96, 192 (each number except the first is double the one before it) giving 4, 7, 10, 16, 28, 52, 100, 196. All except 28 and 196, are equivalent to the distances of the planets from the sun. The "trick of numbers" was named after Johann Elert Bode.* "Bode's law" was later shown to be questionable. Further astronomers pursued other inquiries and speculations, but all we can be sure of is that "we do not yet know all the members of our solar system."

INTERNATIONAL FISHERY -MEETING

[Unknown author]; 1 December 1866; 16: 493-97; 8 cols.

The second International Fisheries Exhibition took place at Boulogne this year. The article is not altogether scientific, but gives a systematic account, based on what was seen at the Exhibition, of what was known about fish, marine flora and fauna in general, and the processing techniques associated with each category. The tools of the earliest known fishermen were on display, and Frank Buckland* contributed to the exhibition in various ways; for example, he exhibited a series of eight specimens showing the development of salmon from the egg to adult fish, and a collection of oyster-shells from many countries.

THE VEGETABLE WORLD

[Unknown author]; 15 December 1866; 16: 533-37; 6 1/2 cols.

When we look at the stars we often wonder which are inhabited, and which "possessed a world of vegetables"; "we may fairly assume that the Benevolent Being who created *them*, would also create higher organisms to profit by the supplies they furnish." It is the human race that "tops the ladder of organic life." The article then turns to tell what is to be found in the populariser, Louis Figuier's* *Histoire des Plantes* (1865), translated as *The Vegetable World* (1867). It reveals extraordinary facts about botany, especially about cryptogamous plants, or seaweeds, mosses, mushrooms, lichens, and ferns. His aim is to inspire young readers with "due admiration of the Divine power and goodness, making it a rational admiration." The work evidently gave fundamental information about plant life; and the reviewer cites earlier botanists, such as Duhamel Du Monceau,* the Swiss naturalist Charles Bonnet,* and experiments by T. A. Knight* and Henri Dutrochet.* He goes on to discuss fruit, and then turns to Linnaeus* as a famous early botanist. Linnaeus's famous system of classification is explained together with the controversies initiated by other botanists, such as William Withering* and John Ray.* Bernard de Jussieu's* system, which has the advantage of being a correct system if "Darwin's* theory of the origin of species be true," is good for teaching botany. Yet the author and translator seem to prefer "the natural system of botany" as explained by Dr. John Lindley* in his *An Introduction to the Natural System of Botany* (1830). Lindley's system is different from the one Figuier originally used, and it "has superseded all others in the British schools."

OLD STORIES RE-TOLD: THE GREAT FROST OF 1814.

[George Walter Thornbury]; 23 March 1867; 17: 299-304; 9 1/2 cols.

The frost of 1814 lasted nearly sixty days; earlier hard frosty winters are mentioned. The author tells how it started, gives newspaper reports, and describes the serious effects it had. Science "has not yet discovered" if it was because of the movement of the polar

icebergs or "the conflicts between aerial currents and irregular cycles of telluric influence." "Science is still short-sighted, and has much to learn," but "Time will show that these phenomena move also in orbits, and obey fixed laws."

[Dickens's letters to Wills show that he took an interest in Thornbury's articles of the "Old Stories Re-told" series, but chiefly when they were about recent social changes, see *Nonesuch* 3: 484, 520-21, 536-37, 540 and 557].

STICK- (NOT TABLE-) TURNING

[Unknown author]; 20 April 1867; 17: 391-94; 5 cols.

Dowsing or divination by means of a rod is a well-known and attested phenomenon, and many examples of its use are mentioned. The author asks how far this divination can be true; whether it is fraudulent or partly fraudulent; and what can be learned by experiment and scientific inquiries, such as those of the French chemist, Michel Eugène Chévreul.* He devised "a small pendulum" with an iron ring to test the alleged power of a Parisian lady. He believed that a "mental process" was involved. He carried his inquiries further, and with others he reported in 1852. The conclusion appears to have been that the rod works when the operator knows what is expected of him, as the condition of mind called "expectant attention" has a peculiar effect upon the nerves and muscles. Yet this still leaves much unexplained. The article is an inquiring study, suggesting the need for what Bacon called the "experimentum crucis," or test in which the operator does not know what he is looking for. The author is rightly sceptical of Karl Aron von Reichenbach's* "Od force," much talked and written about at the time. He is, in fact, asking for a rational investigation and tries to deal rationally with the matter. In its way, the article is an interesting example of the rise of the scientific approach in place of the authority of simple assertion.

STOMACH AND HEART

[Unknown author]; 4 May 1867; 17: 438-40; 4 cols.

"Great discoveries in science in modern times are made almost daily." Many ancient theories are questionable and need to be inquired into. For example, it was once assumed that the heart was "the seat of the affections." The article argues that emotions come not from the heart but the stomach. It explains that when the heart is abnormal or diseased, the affections have not been found to have been changed. Sea-sickness may alter one's disposition, but when the stomach comes back to normal, the person regains his feelings. Though the author claims to appeal to facts, he draws his examples from the Bible or literary sources.

IS IT POSSIBLE?

[Unknown author]; 22 June 1867; 17: 614-20; 12 1/4 cols.

"The key to every scientific mystery is not hung up outside the door" but "is found in unlikely corners," and "has to be scrubbed, fitted, tested" till it is fully understood. Yet a new theory tends to be discussed as "superstitious credulity." Investigation and experiment will assure people. In the case of spiritualistic doctrines, the account argues that though it is perfectly possible to reject the follies and the frauds of spiritualists, attention can be directed to examine the "psychological bases" from which spiritualists claim to derive their power. Ghosts are possible because electricity is a fluid powerful essence which we are also unable to explain. Changes of light can effect chemicals in ways we cannot understand. Therefore it is perhaps possible that there is a subtle state between materiality and immateriality which cannot be accounted for, and that *ghosts* are part of a "marvellous code." The rest of the article outlines the story of the famous "Lyttelton ghost." The whole

code." The rest of the article outlines the story of the famous "Lyttelton ghost." The whole piece is an argument in favour of keeping one's mind open to proposals and suppositions.

SNAKES IN QUEENSLAND

[Unknown author]; 3 August 1867; 18: 126-28; 4 1/4 cols.

There are only a few extremely venomous snakes in Queensland, Australia, including the Brown Snake, the Whip Snake, the Diamond Snake, and the Black Snake. The author vividly describes his friend's encounter with a Whip snake, and gives experiences of his own such as being bitten by a Carpet Snake and killing a Black Snake. He tells of the effect of snake bites, of fights with snakes, and of a way of recognising venomous snakes.

THE SPIRIT OF PROGRESS

[Unknown author]; 24 August 1867; 18: 199-202; 4 1/4 cols.

Mythical tales collected by George W. Dasent [(1817-96; *DNB*), Scandinavian scholar] and John F. Campbell* tell us something of the pre-historic period. They speculate about how man came to use iron tools and weapons, and how the savage became civilised through knowledge, skill and practice. But "The wonders of the old fairy tales are far surpassed by the exploits of modern scientific discoverers, and results once supposed miraculous are now produced by natural means within the comprehension of the humblest inquirer, not at wide intervals of time, but daily." Science brings out "the real miracles" that are "passing in the public life of the world, in the progress of society, in the march of events, and in the improvement of individual character." The experience of the past will guide us to progress and "we have only to allow perfect liberty to the intelligent factors

now at work in every direction to secure for the future that development of the human in each individual." In the author's opinion, man's imagination still plays its part even in the modern age, which is apparently dominated by the "exploits of scientific discoverers." There are still miracles and wonders to be found in natural life, unaffected by so-called "scientific" change.

THE POETRY OF FACT

[Unknown author]; 14 September 1867; 18: 277-79; 5 1/4 cols.

"Science has made a poetry of its own; it flies on the wings of the lightning, and has subdued the elements of fire and water; developing the powers of steam and gas and electricity, making each and all subservient to the advantage of man." The modern "poets" are "Fulton, Arkwright, Watt, Telford and Stephenson."* The author criticises those who considered as a mad dream of Sir Hugh Myddelton's [(1560?-1631; *DNB*), goldsmith, banker and clothmaker] attempt to increase the supply of water to London by constructing a canal, the New River, and the folly of people like Sir Walter Scott who were so over-cautious as "to laugh at the idea of lighting towns with gas." He also criticises the House of Commons, which once ridiculed Stephenson for his confidence in the safety of speedy trains. "These wonders have been accomplished, and with them the poetic has passed into our common life." He admires Sir John Franklin,* Robert Stephenson,* Isambard K. Brunel,* David Livingstone [(1813-73; *DNB*), African missionary and explorer], Hugh Miller* and Humboldt* who are "in the onward march of time, of mind, and of morals." There is the need to dispel ignorance, illusions and false ideas from the popular mind.

THE NORTH POLE QUESTION

[Unknown author]; 21 September 1867; 18: 306-9; 7 1/4 cols.

It used to be thought that the icy surface of the Earth at the North and South Poles was covered by water rather than land; but it is now argued that there is an Antarctic continent which is relatively mild in temperature. This has been maintained in Matthew Maury's* *The Physical Geology of the Sea and Its Meteorology* (1855). The French, under Gustave Lambert,* have been equipping an expedition to approach the North Pole by Behring's Strait. Lambert's theory is based on what he calls the "insolation" of the sun, or the quantity of heat it throws out in different places in different times and seasons, which he combines with other ideas about the evidence for a continuous expanse of deep sea in the Arctic. There has been disagreement about whether the North Pole can be approached or reached by the sea or whether it will need a long overland journey; and Lambert is trying to form a North Pole Partnership Company to settle the matter by exploration, [see *L'expédition au pôle nord, par Gustave Lambert, chef de l'expédition. Assemblée générale du 20 décembre 1867.* (Paris, 1868)].

OLD STORIES RE-TOLD: BALLOON ASCENTS.

[George Walter Thornbury]; 2 November 1867; 18: 447-53; 10 3/4 cols.

As far back as the seventeenth century, many experimenters, such as Bishop John Wilkins,* one of the founders of the Royal Society, believed that the time would come when men would fly. There were several attempts until, in 1782, the brothers Montgolfier* constructed hot air balloons. In October that year, Pilâtre de Rozier ascended in a tethered balloon; next month, he and a companion travelled five miles. Other successful flights soon followed of over 10,000 ft, and of 27 miles. Attempts were made to control and direct the

balloons' flights without much success. Vincent Lunardi* made the first balloon ascent in England in 1784; the first cross Channel flight was in January 1785. An account is given of several remarkable balloon ascents; but ballooning is usually impractical and dangerous because there is no way of steering, though it may be successful for military purposes or meteorological investigation.

OLD STORIES RE-TOLD: EARTHQUAKES

[George Walter Thornbury]; 30 November 1867; 18: 545-49; 7 1/4 cols.

This is almost entirely a description of what happened in the earthquakes in Lima (28 October 1746) and Lisbon (1 November 1755). Great scientific curiosity was aroused at the time about the relationship between weather and earthquakes, but this is all treated in a very general way. "At present science stands dumb before the earthquake."

FLIES

[Unknown author]; 4 January 1868; 19: 88-92; 7 1/4 cols.

According to naturalists, a fly is deaf but has good eyesight. It breeds in hot countries, such as the middle and southern states of North America. In England, there are field-flies that are larger than the domestic fly. Dr. John Haast,* a fellow of the Linnaean Society wrote to Dr. J. D. Hooker* from New Zealand about the spread of the European house-fly that drives away the aboriginal New Zealand fly. The article then turns to the mosquito which "has not yet made its appearance in the British Isles." The author has written about his observations and tells how mosquitoes breed in marshes or swamps, their habit of flying

low, and Sir Samuel White Baker's* remark on the terrible bite of a particular kind of fly called the "Abyssinian seroot."

A LONG LOOK-OUT

[Unknown author]; 1 February 1868; 19: 174-76; 6 1/2 cols.

The article is an astronomical study of the distance between the earth and the sun. The exact distance is hoped to be determined by the transits of Venus across the sun which will take place on 9 December 1874 and 16 December 1882. The dates of the next chances to make the calculation will be 8 June 2004 and 5 June 2012. The article gives a tabular list of the relatively rare transits of Venus between 1639 and 2368. Captain Cook's last observation from Tahiti of a transit of Venus is mentioned. The article then explains how to measure terrestrial distances by a "parallax." The parallax is a relative relation, or angle, "formed by an object with two different observers placed at different stations." The idea of calculating the sun's parallax came from Edmond Halley,* whose method was published in the *Philosophical Transactions* of the Royal Society in 1691, no. 193, and in 1716, no. 348. The author says: "while we are thus looking out for Venus, I wonder what the Venusians think of us." Whewell's idea of the habitability of their globe is mentioned, and the author fancies there can be "little doubt" about the existence of Venusians.

SOUND

[Unknown author]; 22 February 1868; 19: 255-58; 5 3/4 cols.

"Dr. Tyndall's Heat was a great as well as an agreeable surprise." "A book of science could be interesting!" This is a review of Tyndall's book on *Sound* (1867) made up of eight

lectures. It deals with the transmission of sound, which appears to arise from "motion." We are told about the mechanism of sound, how it is transmitted, how the rate at which sound travels in air at freezing point is 1090 feet per second, and its being like waves in the air. A distinctive feature is that Tyndall gives reason for his conclusions and demonstrates them in experiments. Light and radiant heat are also "wave motions." The subject of acoustics is dealt with. Things are "not merely told, but clearly proved."

ON THE WING

[Unknown author]; 29 February 1868; 19: 281-84; 7 3/4 cols.

The article gives a history of flight, and foresees its likely realisation. It discusses, in a scientific spirit, some of the principles of flying as shown in birds. The essence of flight is "two things--buoyancy and waftage."

IN THE AIR

[Unknown author]; 7 March 1868; 19: 300-5; 9 1/4 cols.

This continues "On the Wing" (20 February 1868; *AYR* 19: 281-84). There is a discussion of the methods of flight of such objects as seeds, pollen, eggs and insects. Buoyancy in both air and water is the result of gases. How different kinds of animals, such as birds and bats, are designed for flight is described. The article ends by looking forward to an exhibition of flying machines promised by the Aeronautical Society in the summer of 1869.

FARADAY

[Unknown author]; 4 April 1868; 19: 399-402; 6 cols.

This is a review of Professor Tyndall's* recent short life of Michael Faraday* [*Faraday as A Discoverer* (1868)], the "masterly exponent of scientific discovery," who had died in August 1867. "His was the glory of holding aloft among nations the scientific name of England during a period of forty years." It mentions his achievements.

[*Nonesuch* 3: 627 to W. H. Wills, 28 February 1868, Dickens told Wills to publish this piece after 20 March, as it is taken from the *Atlantic Monthly*].

THE LESSER LIGHT

[Unknown author]; 18 April 1868; 19: 442-44; 4 1/2 cols.

This is a general article on the moon, Newton, and the principle of gravitation. It is claimed that the moon had a role in Newton's discovery of gravitation because it is gravitation that enables the moon to circle the earth.

OUR INNER SELVES

[Unknown author]; 2 May 1868; 19: 486-87; 2 1/4 cols

The article is about the use of new instruments for seeing inside the human body, such as the Ophthalmoscope for inspecting the eye, the Laryngoscope for examining the larynx, and the Splanchnoscope, a tube like a lantern that is inserted via the throat so that the internal organs are illuminated and can thus be examined from outside the body.

CREATURES OF THE SEA

[Unknown author]; 13 June 1868; 20: 8-11; 5 1/2 cols.

The article reviews Figuiet's* *The Ocean World; Being A Descriptive History of the Sea and Its Living Inhabitants* (1868), translated partly from his *La terre et la mer* (Paris, 1864) and largely from his *La vie et les mœurs des animaux* (Paris, 1866). It is said that the first person who ate an oyster did so not from hunger but curiosity. It discusses the discovery of the ocean world including, for example, how molluscs develop pearls. It goes on to deal with stone-boring molluscs, teredos or ship-worms, and other sea-creatures. The book itself is illustrated by 427 engravings.

TOWN AND COUNTRY SPARROWS

[Charles Mackay]; 20 June 1868; 20: 41-44; 6 1/4 cols.

The article tells about sparrows (of whom there are no less than sixty-seven varieties), where they live and breed, and what the author has observed in his garden. It refers to the French naturalist, Buffon* who called the sparrow an "idle glutton," and William Bewick's [(1795-1866; *DNB*), portrait and historical painter] favourable remark that they protect the vegetables by destroying insects and caterpillars, and are not merely troublesome.

THE COMING ECLIPSE

[Unknown author]; 1 August 1868; 20: 185-87; 5 cols.

There is to be an eclipse visible in southeast Asia on the 18th August, though invisible in Europe. Most European governments have organised scientific missions to the region.

The French Minister of Public Instruction and the Académie des Sciences have sent Pierre Jules César Janssen* to examine the sun's spectra and analyse the solar atmosphere. "Photological Facts" (11 March 1865; *AYR* 13: 149-53) and "A Long Look-Out" (1 February 1868; *AYR* 19: 174-76) are referred to. The author says he is indebted for details to Henry de Parville.* Then observations made in the past, and Herschel's* and Arago's* ideas about the sun are discussed. Questions are dealt with such as: What is the source of the sun's heat? What does the sun consist of? Whether it has inhabitants? According to Herschell, the source of the sun's heat is "neither a liquid nor an elastic fluid, but a stratum of phosphoric clouds floating in the Sun's transparent atmosphere." As the article says, after the coming eclipse, "We shall probably have a more approximate answer to the much-vexed question: What is the Sun?"

LIGHTNING

[Unknown author]; 29 August 1868; 20: 274-76; 5 cols.

The article is a history of the discovery of the nature of lightning. It tells how knowledge about it was gained in the eighteenth century through observations and experiments by men such as Franklin* and those before and after him.

PAINLESS OPERATIONS

[Unknown author]; 5 September 1868; 20: 298-300; 4 1/4 cols.

Only twenty years ago, Sir Humphry Davy's suggestion enabled an American doctor, Horace Wells* to discover that nitrous oxide could induce temporary unconsciousness. Other anaesthetics were discovered soon afterwards: sulphuric ether (by Dr. William

Morton*), and chloroform (by Dr. James Simpson,* of Edinburgh). The article reviews the way in which each substance has been introduced and used in practice during the past twenty years in Britain and America.

THE AGE OF STONE

[Unknown author]; 3 October 1868; 20: 394-96; 4 3/4 cols.

A book has recently been published in France entitled *La Chute du Ciel* or *The Fall of the Sky* (Paris, 1865) [by Alfred Baron d'Espiard de Colonge]. It not only claims that meteorites have fallen from the sky, but also fossils, coal, erratic boulders and flint implements. Rather evasively, the reviewer disclaims any responsibility for examining the idea, but says that "science" has to break "gradually on the human understanding" like "the light of the day." He also says, "The theory does not disturb our equanimity," because "when a new science, 'Prehistoric Archaeology' fills leaders in the *Times*, and occupies a prominent place in addresses of Presidents of the British Association, we may without anxiety leave the said things formed in the drift to receive eventually a correct account of their use and origin." He then goes back, in a general way, over the question of the age of the earth and the age of mankind and discusses the discoveries of the prehistoric French archeologist, Jaques Boucher de Perthes of Abbeville [(1788-1868; UC)] who showed that man was on earth thousands of years ago. Sir Charles Lyell* is also referred to.

PARAFFINE

[Unknown author]; 19 December 1868; *N. S.* 1: 58-61; 6 1/2 cols.

About 1847 Professor Lyon Playfair* happened to discover paraffin in a coal mine in Derbyshire and, encouraged by James Young,* he conducted experiments to distill the liquid to obtain a kind of oil. When the supply dried up, he discovered how to make an artificial petroleum from coal. Yet a sufficiently productive means of refining oil from coal was not found till 1850, near Bathgate. Young set up the Bathgate Paraffin Works, but there was a legal dispute between Young and the owner of the estate the coal came from. The author explains the technique and the process of extracting, dissolving and straining the paraffin to make tar, liquid paraffin, naphtha, paraffine wax for candles, and other products.

PRECIOUS STONES

[Unknown author]; 16 January 1869; *N. S.* 1: 153-55; 5 1/2 cols.

The article is based on Charles William King's [(1818-1888; *DNB*), author on engraved gems] *The Natural History, Ancient and Modern, of Precious Stones and Gems, and of the Precious Metals* (1865). It gives ancient accounts of diamonds, and then turns to describe where they are still to be found. It is said that "Modern science has made no further advance towards a solution" of the ancient idea that an octahedral diamond could be a modification of the octahedron crystal of alluvial gold. It also discusses how to value diamonds. A Dr. Wall's method of distinguishing diamonds from other stones published in the *Philosophical Transactions* is mentioned. The rest of the article is mostly historical.

POURING OIL UPON THE WAVES

[Unknown author]; 30 January 1869; *N. S.* 1: 198-200; 4 cols.

A stewardess describes in a letter the experience of the *Hibernia*, shipwrecked in a recent storm (25 November) when the captain poured oil upon the waves to lessen them. The effect of oil calming the sea had long been known, and accounts by Pliny, Edmond Halley* and John Franklin* are referred to. Other instances are given, such as one in the eighteenth century on a Dutch East Indiaman's voyage to the East, when the captain poured out "a few ounces of olive oil" into the sea to prevent shipwreck in a storm. The plan is said to have succeeded. It explains how and why the oil acts, mostly based on Franklin's explanation that oil prevents small waves or wrinkles forming within each large wave: in other words, that the oil cannot prevent large waves but can prevent new waves forming on the back of them.

[The same subject had been treated in "Oil upon the Waves" (18 March 1854; *HW* 9: 98-100) by George Dodd. The difference is that this second piece tries to explain how and why in fuller detail.]

THE ECLIPSE SEEN IN INDIA

[Unknown author]; 13 February 1869; *N. S.* 1: 250-53; 6 cols.

Reference is made to "The Coming Eclipse" (1 August 1868; *AYR* 20: 185-87) which looked forward to the eclipse on 18 August 1868, seeing it from the French scientists' point of view. It has been observed by Henri de Parville* who was sent by the French mission to India to make his discoveries there. His and other people's previous observation of sunspots, and the spectrum of the solar light during the eclipse had set scientists thinking about the nature of the sun, and whether it was solid, liquid or gaseous. Astronomical spectroscopy, as developed by Gustav Kirchoff* and Robert Bunsen,* had brought greater knowledge of the constituent elements of the sun. The French scientists were able to

observe the corona of the sun, when it was totally eclipsed by the moon, and they could see it was unquestionably incandescent gas.

LIGHTING

[Unknown author]; 20 February 1869; *N. S.* 1: 268-71; 7 1/4 cols.

The author writes about the history of the invention of lamps, gas lighting and the attempts of "science" to "dethrone gas" as it has dethroned oil.

WAR BALLOONS

[Unknown author]; 27 February 1869; *N. S.* 1: 297-99; 5 1/4 cols.

The article gives an account of the military application of balloons in France in the 1790s. How a scientific commission was set up to investigate the matter, and how some scientists and engineers tried to find out satisfactory ways of producing enough hydrogen are described.

SEWING MACHINES

[Unknown author]; 27 March 1869; *N. S.* 1: 394-97; 4 1/2 cols.

Though chiefly about the technical invention of sewing machines by the French, the article is linked with "modern scientific discovery." It tells how the first sewing machine was made by a French tailor in 1830, and the following improvement, the invention of an electric motor to drive it.

HOROLOGY

[Unknown author]; 24 April 1869; *N. S.* 1: 487-91; 7 cols.

The author looks back to the earliest clocks: the water clock invented by the Assyrians in 759 B. C. made of a cylindrical brass vessel, the sun-dial invented at Alexandria in 558 B. C. and the clepsydra with a one-handed dial made by an Egyptian. Barbarians used pebbles to mark the time, and monks in the beginning of the sixth century computed time by saying prayers counted by beads on a string. The sand glass and the first hour-glass were invented by a French monk. King Alfred also devised a method of computing time by a rushlight set in a lantern. Finally more advanced clocks, watches and even an electric clock, are mentioned.

PLAYING WITH LIGHTNING

[Unknown author]; 29 May 1869; *N. S.* 1: 617-20; 6 3/4 cols.

The article opens with a detailed description of what the Royal Institution used to be like, and goes on to give an account of an "induction coil," how one is made, and how it works, based on John Henry Pepper's* lecture at the Royal Polytechnic Institution on lightning-making. The method was discovered by Faraday: an electric current passing through a coil may momentarily be induced in another coil concentrically wound round it. It can be used to raise massive sparks. Other apparatus used, such as the "contact breaker" and the "condenser," how coils are made and connected, and how lightning is produced are described.

THE UNIVERSE

[Unknown author]; 5 June 1869; *N. S.* 2: 10-12; 4 3/4 cols.

Scientific discoveries tend to prove that "the universe is one, a unity, made up of like co-ordinate parts, and of similar when not identical materials." Examples to support this belief are given. Space and time are assumed to be infinitely extensible; consequently the earth is a mere planet regularly revolving round the sun rather than the centre of the universe. And the stars are suns of different dimensions, each with a system of planets revolving round it. The distance of these stars from each other is immense. These heavenly bodies are composed of exactly the same substance as the crust of the earth. The article goes on to consider the nature of matter, and quotes Professor Tyndall* "on the effect of hammer blows on a lump of lead": "The motion of the mass, *as a whole*, is transformed into a motion of *the molecules* of the mass." But this is not visible. Matter is thought to be made up of "galaxies of atoms." Thus "the universe is one--a unity" in its mechanical and material constitution.

SEALS

[Unknown author]; 3 July 1869; *N. S.* 2: 105-8; 7 1/2 cols.

There are about thirty species of seal, of which under half are "fur seals." These seals are found only in Northern latitudes. They are not fish, but warm-blooded mammals. After a general description of seals, the second half of the article is on seal fishery.

UNDER THE CHANNEL

[Unknown author]; 24 July 1869; *N. S.* 2: 173-78; 8 3/4 cols.

The article considers the pros and cons of a railway between France and England. An eminent French engineer suggested some years ago a magnificent scheme for making a railway bridge across the Straits of Dover. Although it had advantages, the cost and engineering difficulties were insuperable. Yet William Low* has been examining for years the possibility of building a tunnel through the chalk below the sea, which he has been organising since 1867. In fact, from 1856 the French engineer Aimé Thomé de Gamond* had advocated building a tunnel and published a report for the Paris Exposition of 1867 to exhibit his plans [*Account of the Plans for A New Project of a Submarine Tunnel between England and France*, 2 vols. (1867)]. Yet it progressed slowly because of circumlocutionism in Britain till the President of the Board of Trade and a committee of six chaired by Lord Richard Grosvenor at last brought out a report. It concludes that it is possible. Some problems including ventilation have to be overcome. The cost estimated at two million pounds is to be raised by the two governments. The author optimistically predicts that it will eventually be carried out.

A DRIFT FOR LIFE

[Unknown author]; 8 January 1870; *N. S.* 3: 132-35; 6 3/4 cols.

The article introduces William Abraham Bell's *New Tracks in North America*, 2 vols. (1869). It begins with an appreciation of the recently opened Great Central Pacific Railway. The railway passes through the strange scenery of Colorado and Utah including a series of high table-lands in steps, "seamed with gulfs . . . thousands of feet deep," desert, cactus, and deep clefts. Other accounts from the book about geological formations, rivers, rocks, and canyons are described. Though it is not scientific, the experience and description open new scenes to the traveller.

SERPENTS AT SEA

[Unknown author]; 15 January 1870; *N. S.* 3: 152-55; 7 cols.

Sea serpents were still topical and had apparently been reported in 1869. Various earlier accounts are cited. In the end the author is sceptical and tells how the one which was seen in 1848 by a Captain Smith was discovered to be nothing but seaweed, and how at other times a group of porpoises may have been mistaken for a single monster.

THE PHILOSOPHER AND THE MONKEY

[Unknown author]; 12 February 1870; *N. S.* 3: 251-52; 3/4 col.

It is a poem in ten verses warning the evolutionist philosopher to be careful about applying his theories to the human mind, or "the mechanism by which we think." It says that the philosopher has examined four footed animals and hopes to dissect "the magic of Mind." He wants to know "How to catch the invisible," "How does a lion open his jaws," and "How does a monkey wag his Tail." But the poet has watched a monkey that listened to a musical-box and broke it to see how it worked. The poet asks the philosopher to "Let the works of the mind-watch go! Claws and tail have been cast away! But peep in the looking-glass today, / Remember Monkey-land long ago."

TO BOULOGNE BY DRY LAND

[Unknown author]; 12 February 1870; *N. S.* 3: 256-58; 4 cols.

The article follows up the subject of plans for a Channel-crossing discussed in earlier volumes. It argues that it would possible to build a watertight tunnel and effective bridges.

The French geologist Adhémar* argues that the Channel itself was formed only 14,000 years ago, "at the last grand deluge but one" prior to Noah's deluge. Other proposals have been made for narrowing the division itself, and leaving a channel or ship canal. There are many problems to be resolved. It is not a question of technology but "a question of time, and labour, and material," and consequently "a question of expense." It is optimistically and even absurdly supposed that the work might be carried out in twelve years or less.

WISE DOCTOR LEMME

[Unknown author]; 12 February 1870; *N. S.* 3: 258-61; 6 cols.

Charles Kingsley's* *Madam How and Lady Why; or First Lessons in Earth Lore for Children* (1870) just published for the young readers, introduces a young lady physician. In contrast to this an earlier kind of "Old Madam How and Old Lady Why" by a Dr. Levine Lemne is mentioned [Levinus Lemnius (1505-1568; UC), wrote *De miraculis occultis nature* (Antverplae, 1574), trans. as *A Discourse Touching Generation Fit for the Use of Physitians, Midwives, and All Young Married People* (1667)]. Dr. Lemne was a physician practising in the sixteenth century in a little town of Zealand, near the Dutch coast. His work is said to try to explain various occult matters as, for example, why short men are more passionate, humorous and quick-witted. It is because their bodies are "dryer" and "catch fire more readily and burn faster than moist folks." An account is given of Lemne's extremely unscientific beliefs, superstitions, and absurdities. For example, moonshine can influence people and may drive them to strange behaviour such as cannibalism; some people can speak foreign languages they had never learned, when they are ill; an old-fashioned schoolmaster might shake a child or knock his head to create heat or action in his brain. A man with unusually large lungs can swim an hour and a half under water. A murdered body bleeds when the corpse's friends or relations stand beside it, for

"something of life lasts in the body newly dead." To put a ring on the ring finger is to refresh the heart and prevent gout; and because people of the age of seven and of multiples of seven tend to sickness, it is good to be bled every year in spring and autumn to delay the accumulation of illness. The articles suggests that a daily tubbing and scrubbing is good, but it is no use washing the head or feet.

LIGHT FOR LIGHTHOUSES

[Unknown author]; 19 February 1870; *N. S.* 3: 282-85; 6 1/4 cols.

The article is on improvements in lighthouses. The old coal fires, once used as beacons, could hardly be kept burning in wind and rain. Though unaffected by the weather, candles in lanterns or chandeliers are weak. Spermaceti oil lamps have been used for fifty years and recently rape-seed oil has been used as more economical, reliable, and needing less attention. Besides these, there are other oils which have been used for various purposes. They are not suitable. Oxy-hydrogen light has been experimented with. Now there is the proposal to light buoys and beacons by electricity. The current would be transmitted from shore to the buoys or beacons. A previous article ["The Wolf-Rock Light" (4 September 1869; *AYR N. S.* 2: 328-30)] came to the conclusion that electricity will give the "coming light." It produces no flame but has a vivid brightness. It explains how the current is generated and gives a historical account. Faraday's discovery of how to generate electricity was first used for this purpose by a Professor Holmes who produced an apparatus in 1859 tried at the South Foreland Light House. Then the French elaborated it in their exhibition at Paris in 1867. The discovery of parabolic, concave, and spherical reflectors, and the development of the system of lighting called catoptric are mentioned. The author has no intention of going further because "we might indulge in a heap of technical talk which would plunge most readers into a state of hopeless bewilderment, but such details would

not be generally interesting." Finally it describes a "dioptric" system of lighting produced by four or fewer circular wicks whose arrangements in a band of glass called a "lenticular belt" can prevent waste light. There are still further possibilities in the use of electric light.

METEORS

[Unknown author]; 16 April 1870; *N. S.* 3: 469-73; 9 1/4 cols.

The article refers to a previous article "The Universe" (5 June 1869; *AYR N. S.* 2: 10-12). It is based on C. E. Delaunay's* theory of the unity of the constitution of the universe. Spectral analysis has already shown this before, and Delaunay has apparently gone further to consider shooting stars and meteors, and has shown that these have fallen from the sky. They are often mainly composed of iron; and, for some time, they have been the subject of curiosity and inquiry, as by Ernst Florens Fredrich Chladni,* who wrote about them in 1794. A historical account is also given of other earlier inquiries. The path of meteors, or shooting stars, can be straight or coincide with the arc of a great circle traced on the celestial hemisphere. They seem like luminous balls of fire; and after their appearance, an explosion takes place and they burst into fragments. This is when we observe "a meteor proper" or a "bolide." On the other hand, there may be solid, stony ones, metallic bodies or aërolites (stones of the air). The writer speculates about the relation between shooting stars, bolides and aërolites. He also refers to such sources as John Keppler's [Johann Kepler (1571-1630; *UC*)] *Ephemerides* (1617-30), *Memoirs of the Académie des Sciences for 1700*, and Edmund Halley's* note published in the *Philosophical Transactions* (no. 341) in 1714. Petrus Van Musschenbrock's* *Course of Experimental and Mathematical Physics* [*Course de physique expérimentale et mathématique* (Paris, 1769)] explains that meteors are "principally composed of brimstone and other combustible things from volcanos."

THE INTELLIGENCE OF PLANTS

[Unknown author]; 23 April 1870; *N. S.* 3: 488-91; 6 cols.

Linnaeus* and others who have recently defined plants have suggested that plants do not "feel," but the author argues that they *are* conscious of their own existence. His reason is that some plants are sensitive to the slightest touch. "Whether I am scientifically and philosophically right or wrong, I take a pleasure in believing that," he says. He asserts that every living life, plant or animal, has the faculty of sensation given in a different degree by the Creator: "The idea is not new to poetry, though not accepted by science." He says:

Science may laugh at all such notions, but Science, though a very great and learned lady, does not yet know everything. Her elder sister, Poetry, often sees further and deeper into things than she does. Did not Shakespeare in the *Tempest*, foreshadow the possibility of the electric telegraph more than two hundred years before Wheatstone? Did not Dr. Erasmus Darwin, long in advance of James Watt and Robert Stephenson, predict the steam ship and the locomotive engine? Did not Coleridge, in the *Ancient Mariner*, explain the modus operandi of the then unsuspected atmospheric railway?

As a student of natural history himself, the author says his sympathies "go with the poets rather than with the scientific men." He quotes a description of love-making from Erasmus Darwin's *The Love of Plants* (1789) [Part I of *The Botanic Garden*] full of the plants' emotions. He argues that though flowers have no organs of sight, hearing, taste, or smell, they do have a sense of touch. Climbing plants like marrows can climb, stretch, adjust and adapt to the environment or reach out from a dark room to a light one, penetrate a hole or chink, and stretch beyond the shadows of trees. It is a sign of "God's power and love." Plants themselves may be able to feel joy and sorrow.

SHOOTING STARS

[Unknown author]; 14 May 1870; *N. S.* 3: 571-76; 9 3/4 cols.

Shooting stars and meteors are apparently not the same. The arguments have again been taken from a publication by the French astronomer, Charles-Eugène Delaunay,* and an attempt is made to explain the great frequency and number of shooting stars, with many allusions to allegedly expert observers. Little is clear: "The reasoning by which M. Delaunay works out his proposition is too lengthy and too full of illustrative details to find room for here. The inquiring reader . . . is referred to the original 'Notice'." He appears to imply that the shooting stars are "astronomical" bodies which arise from space, and are not "atmosphere." They are "of the same nature as comets." The intensity of the phenomenon of shooting stars differs in frequency and quantity; they are of annual, diurnal and azimuthal kinds. According to Delaunay there is no uniformity. The three kinds occur in every locality. Periodical shooting stars sometimes come from a definite direction, but sporadic ones wander in space in every direction. The former are given names and their orbits agree with those of comets. Their nature and cause are summarized.

SELECTED BIOGRAPHICAL INDEX

For the convenience of the reader, the following list identifies the asterisked names, mainly scientists of the eighteenth and nineteenth century, mentioned in the summaries. Others to whom Dickens refers in his writings and whose works were once in his library, are also noted.

ADAMS, Andrew Leith (1827-82; *DNB*), zoologist, army surgeon, 1848-73, and professor of zoology at the College of Science, Dublin, 1873-78.

ADHÉMAR, Joseph Alphonse (1797-1862; *IBF*), French mathematician.

AIRY, Sir George Biddell (1801-92; *DNB, DSB*), astronomer; member of Astronomical Society and Geological Society; Lucasian professor of mathematics at Cambridge, 1826; director of the Cambridge Observatory, 1828; designed instruments for the Royal Observatory; FRS.

ANNING, Mary (1799-1847; *DNB*), paleontologist; discovered the fossil skeleton of an ichthyosaurus in a cliff near Lyme in 1811, and subsequently the first specimens of the plesiosaurus and first pterodactyl in 1828.

ANSTED, David Thomas (1814-80; *DNB*), professor of geology at King's College, London, and assistant secretary to Geological Society, 1844-47; wrote books on geology and travel.

ARAGO, Dominique François Jean (1786-1853; *WWW, DSB*), French astronomer, physicist and politician; director of Paris Observatory, 1830; achievements mainly in the fields of astronomy, magnetism and optics.

ARDERON, William (1703-67; *DNB*), naturalist; excise officer; managing clerk at the New Mills, Norwich, FRS; wrote largely on natural history and microscopical science.

ARKWRIGHT, Sir Richard (1732-92; *DNB*), engineer and inventor; devised the first practical way of mechanical spinning by using rollers.

ARMSTRONG, Sir William George, Baron Armstrong of Cragside (1810-1900; DNB), inventor, industrialist; FRS; invented hydraulic pressure accumulator, 1850; designed submarine mines for use in Crimean War, 1854; invented the rifled breech-loading gun, with a cylinder constructed on scientific principles, which was favourably reported upon by General Peel's Committee on Rifled Cannon, 1858; supervised Elswick Ordnance Company to make Armstrong guns for British government.

ARNOTT, Neil (1788-1874; DNB), Scottish physician and scientist; FRS; the secretary of the Royal Society, 1848-53, a founder and original member of senate of the University of London, 1836.

ATKINSON, James (1780-1852; DNB), Persian scholar, surgeon and medical officer.

ATTFIELD, John (1835-1911; WWW), pharmacologist; FRS; demonstrator of chemistry in St. Bartholomew's Hospital, 1854-62; professor of practical chemistry of Pharmaceutical Society, 1862-96; co-founder of British Pharmaceutical Conference, 1863.

AUDUBON, John James (1785-1851; DAB, WWW, DSB), American ornithologist and artist.

BABBAGE, Charles (1792-1871; DNB, DSB), mathematician and scientific mechanician; joined Herschel and others to found the Analytical Society, 1812; FRS; took a part in the foundation of the Astronomical Society, 1820 and was the secretary, 1824 and later, vice president; one of the principal founders of Statistical Society; a pioneer of the computer for his Calculating Machine; was a frequent guest of Dickens's; author of the ninth *Bridgewater Treatise*, also in CD's library.

BABINET, Jacques (1794-1872; WWW, DSB), French physicist, member of French Acad. of Sciences; invented a hygrometer, 1824; researched double retraction, the parhelion, magnetism and the planet Mercury.

BACHHOFFNER, George Henry (1810-79; DNB), one of the founders of London Polytechnic Institution where he lectured on scientific subjects.

BAER, Karl Ernst von (1792-1876; *WWW*), German biologist, discoverer of the mammalian ovum and a pioneer of embryology.

BAILY, John (1811-50; *UC*), published a map of central America.

BAKER, Henry (1698-1774; *DNB, DSB*), naturalist and poet; FRS; did valuable work on the teaching of the deaf and dumb; conducted with Defoe the *Universal Spectator* and *Weekly Journal*, 1728-33; published works on microscopes and natural science; observed crystal morphology under the microscope.

BANKS, Sir Joseph (1743-1820; *DNB, DSB*), botanist; president of the Royal Society, 1778-1820; travelled in Newfoundland, 1766; accompanied Cook's expedition and made valuable collections, 1768-71.

BARROW, Isaac (1630-77; *DNB, DSB*), divine, mathematician, and theologian; professor of geometry at Gresham College, London, and then Lucasian professor of Mathematics, Cambridge; resigned his chair in 1669 in favour of his pupil Newton; remembered chiefly for his mathematical and optical writings.

BARTLETT, John Russell (1805-66; *DAB*), American antiquarian, bibliographer, and member of the Franklin Society.

BATES, Henry Walter (1825-92; *DNB, DSB*), naturalist; explored the Amazon, 1848-59, and discovered over eight thousand new species of insects; assistant secretary of the Royal Geographical Society, 1864-92; president of Entomological Society, 1869 and 1878; FRS.

BEARD, William (1772-1868; *DNB*), collector of bones which he found in excavations in the neighbourhood of Hutton, Bleadon and Sandford; his collection, including many bones of great rarity, is now in the Museum at Taunton Castle.

BECHE, Sir Henry Thomas de la (1796-1855; *DNB*), eminent geologist; at his own expense started making a geological map of England, 1835; President of the Geological Society, 1847-9.

BECHER, Alexander Bridport (1796-1876; *Boase*), captain; assistant in Hydrographic office, 1823-65; secretary to board of visitors of Royal Observatory; edited *Nautical Magazine*, 1832-71.

BECQUEREL, Alexandre Edmond (1820-91; *WWW*), French physicist, researched into solar radiation light.

BECQUEREL, Antoine Henri (1852-1908), French physicist; remembered for his discovery of radioactivity.

BELL, Sir Charles (1774-1842; *DNB, DSB*), Scottish anatomist and surgeon, and medical teacher, FRS; made important discoveries of the functions of nerves; a presentation copy of his Bridgewater Treatise, *The Hand; its Mechanism and Vital Endowments as Evincing Design* (6th ed., 1854) with his wife's inscription, and his *Anatomy And Philosophy of Expression as connected with the Fine Arts* (4th ed., 1847) were in CD's library.

BELL, Thomas (1792-1880; *DNB*), naturalist and dental surgeon; FRS; professor of Zoology at King's College, London; secretary of Royal Society, 1848-53; president of the Linnean Society; edited Gilbert White's *Natural History of Selborne*.

BELON, Pierre (1517-64; *WWW, DSB*), French naturalist and anatomist; chiefly remembered for his descriptions of birds and marine animals.

BENNETT, Edward Turner (1797-1836; *DNB*), zoologist, surgeon in London; promoted establishment of the Entomological Society, 1882 which later became the Zoological Society.

BERKELEY, Miles Joseph (1803-89; *DNB*), botanist; FRS; wrote on fungi.

BERTHOLD, Arnold Adolphe (1803-61; *DSB*), German anatomist and physician; professor of medicine at Göttingen, 1853, curator of the zoological collections; founder of hormone research; his research with Robert Bunsen led to the discovery of hydrated iron oxide as an antidote for arsenic poisoning.

BERTHOUD, Ferdinand (1727-1807; *WWW*), Swiss horological craftsman and inventor, worked in Paris from 1748.

BILLROTH, Christian Albert Theodor (1829-94; *WWW, DSB*), surgeon and pathologist; studied histology and pathology; helped found modern intestinal surgery; devised many operations for gastro-intestinal surgery; introduced Lister's antiseptic methods in Europe.

BIOT, Jean-Baptiste (1774-1862; *WWW, DSB*), French physicist, pioneer of polarimetry; professor of mathematics and of physics at the Collège de France; member of the Académie des Sciences; professor of astronomy in the Faculty of science, University of Paris; invented a polariscope and established the fundamental laws of the rotation of the plane of polarisation of light by optically active substances.

BLACK, Joseph (1728-99; *DNB, DSB*), chemist and physician; pioneer in chemistry of gases; professor of medicine, Glasgow, 1756-66, and of medicine and chemistry, Edinburgh, 1766-97.

BLACKWALL, John (1790-1881; *DNB*), zoologist and science writer.

BLANCHARD, Jean Pierre François (1750-1809; *WWW*), French balloonist, inventor of the parachute; tried to build flying machine in 1770's; invented a hydraulic machine, 1772; the first to cross the English Channel by balloon (from Dover to Calais) with John Jefferies, 1785.

BLANDIN, Philipp Frédéric (1798-1849; *WWW*), French surgeon; described mixed glands near tip of tongue, 1826; advocated ether as anesthetic.

BLEEKER, Pieter (1819-78; *UC*), ichthyologist; wrote many books on fish.

BLOMEFIELD, Leonard, formerly **Leonard Jenyns** (1800-93; *DNB*), naturalist, vicar of Swaffham Bulbeck, Cambridge, 1828-49; member of Linnean Society and of Cambridge Philosophical Society, 1822; original member of Zoological Society and Entomological Society; wrote on natural history.

BODE, Johann Elert (1747-1826; *DSB*), German astronomer; compiled *Astronomisches Jahrbuch für* (1774); director of the astronomical observatory; member of the Berlin Academy; publicised a law about the radii of the planetary orbits suggested by Johann Daniell Titius (1729-96), known as "Bode's law."

BOERHAAVE, Herman (1668-1738; *DSB, WWW*), Dutch chemist and physician; professor of chemistry, botany, medicine and clinical medicine at Leiden University.

BOND, William Cranch (1789-1859; *DAB, DSB*), American astronomer; first director of the American observatory; discovered (with his son) Hyperion, a satellite of Saturn, and Saturn's crêpe ring, but wrongly concluded that all Saturn's rings are liquid; exhibited a daguerreotype photograph of the moon at the Great Exhibition, 1851.

BONNET, Charles (1720-93; *DSB, WWW*), Swiss naturalist, biologist and theoretician of biology; studied insects.

BORIE, Victor (1818-80; *UC*), wrote on agriculture and cholera.

BORLASE, William (1695-1772; *DNB*), antiquary and clergyman; FRS; published essay on Cornish diamonds in *Philosophical Transactions*.

BOULTON, Matthew (1728-1809; *DNB*), engineer; in partnership with James Watt, they manufactured steam engines from 1774; he also made coins for Britain and other countries; FRS.

BOUTIGNY, Pierre-Hippolyte (1798-1884; *WWW*), French chemist and pharmacist, investigated calcification, legal medicine and the adulteration of foodstuffs; worked in industrial chemistry in London; president of the Society of Pharmacy, member of Association of Civil Engineers.

BOWRING, Sir John (1792-1872; *DNB*), British diplomat; editor of *Westminster Review*, 1824; travelled abroad, 1819-20; Counsel and governor in Hong Kong, 1854

BOYLE, Robert (1627-91; *DNB, DSB*), natural philosopher and chemist; took leading part in founding the Royal Society; proved proportional relation between elasticity and

pressure known as "Boyle's law"; his most important experiments were based on the use of the air pump.

BRADLEY, James (1693-1762; *DNB, DSB*), divine and astronomer; Savilian professor of astronomy at Oxford, 1721 and Regius professor of astronomy at Greenwich, 1742; discovered the "aberration of light," 1729, and "nutations of earth's axis," 1748; FRS.

BRANDE, William Thomas (1788-1866; *DNB, DSB*), chemist; one of the original fellows of the University of London; collaborated with Faraday; FRS; his *Dictionary of Science, Literature, and Art*, 2nd ed. (1852) was in CD's library.

BREWSTER, Sir David (1781-1868; *DNB, DSB*), Scottish physicist; editor of the *Edinburgh Magazine*, 1820; discovered polarisation of light; invented kaleidoscope, 1816; assisted in organising BAAS, 1831; vice-chancellor, Edinburgh University, 1860; president of the Royal Society of Edinburgh, 1864.

BROCKEDON, William (1787-1854; *DNB*), painter, author and inventor; FRS; took out patent for a substitute for corks made with vulcanised india-rubber, and for artificial plumbago for lead pencils; assisted in founding Royal Geographical Society, 1830.

BRODERIP, William John (1789-1859; *DNB*), naturalist, lawyer, and London magistrate; FRS; co-founder and fellow of the Zoological Society; member of the Linnean Society, Geological Society, and Royal Society; his *Zoological Recreations* (new ed. 1849) was in CD's library.

BROOKE, John Mercer (1826-1906; *DAB*), naval officer and scientist; served with Matthew Maury at the Naval Observatory in Washington, 1851-53 when he invented a deep-sea sounding apparatus with which specimens from the ocean bottom were accurately mapped; invented the "Brooke" gun; professor of physics and astronomy at the Virginia Military Institute.

BROUGHAM, Henry Peter Brougham, Baron Brougham and Vaux (1778-1868; *DNB*), lord chancellor; one of the founders of the *Edinburgh Review*; FRS; advocated scientific education for the upper classes; formed Society for Diffusion of Useful

Knowledge, 1825 and London University, 1828; his *Tracts, Mathematical and Physical* (1860) was in CD's library.

BROWN, Robert (1773-1858; *DNB, DSB*), Scottish botanist; librarian to the Linnean Society; naturalist to Captain Matthew Flinders's Australasia expedition, 1801-5; eminent for his investigations into the impregnation of plants.

BROWN, Robert (1842-95; *DNB*), geographical compiler; botanist to the British Columbia expedition and commander of Vancouver expedition, 1864; traveled widely and lectured in natural history.

BROWN, Thomas (1778-1820; *WWW*), philosopher and psychologist; at age twenty wrote criticism on Erasmus Darwin's *Zoonomia*; explained function of mind, and believed muscular sensation gave unity and significance to perception.

BROWNE, Patrick (1720?-1790; *DNB*), naturalist; MD, 1743; settled in Jamaica and published zoological works.

BRUNEL, Isambard Kingdom (1806-59; *DNB*), civil engineer; designed numerous docks and bridges; engineer to the Great Western Railway, 1833; applied the screw propeller to steamships, 1845.

BUCKLAND, Francis Trevelyan (1826-80; *DNB*), naturalist, son of William Buckland; army surgeon in London, 1854; inspector of salmon fisheries; popular science writer and Dickens's contributor.

BUCKLAND, William (1784-1856; *DNB, DSB*), geologist; professor of mineralogy at Oxford, 1813; dean of Westminster, 1845-56; president of the Geological Society, 1824, 1840.

BUFFON, George Louis Leclerc, Comte de (1707-88; *WWW, DSB*), French naturalist; published a French translation of Stephen Hales's *Vegetable Statics*, 1735 and of Sir Isaac Newton's *Fluxions*, 1740; member and a perpetual treasurer of the French Acad. of Sciences; popular science writer; a complete illustrated set of his *Natural History*, 16 vols. (1797-1808) was in CD's library; his name is mentioned in *OCS* (ch. 51; p. 478).

BUNSEN, Robert Wilhelm Eberhard (1811-99; *WWW, DSB*), German chemist and physicist; shared with Kirchhoff the discovery of spectrum analysis in 1859 which facilitated the discovery of new elements including caesium and rubidium.

BUSK, George (1807-86; *DNB, DSB*), scientist; as surgeon in the navy; FRS; treasurer of Royal Institution; Hunterian professor and trustee of the Hunterian Museum; president of Anthropological Institute, 1873-4.

BUSSY, Antoine Alexandre Brutus (1794-1882; *WWW*), French chemist; discovered a method of preparing magnesium by heating magnesium chloride and potassium together, 1831, liquefied several gases previously considered inert, and prepared metallic beryllium in 1828.

CAMPBELL, John Francis (1822-85; *DNB*), of Islay; Gaelic scholar; government official; published *Popular Tales of the West Highlands*, 1860-62, published *Gaelic Texts* (1872), wrote also on natural science.

CARPENTER, William Benjamin (1813-85; *DNB, DSB*), biologist; professor of physiology at the Royal Institution and professor of forensic medicine at University College, London; did research on marine zoology, botany, neurology and physiology; contributed much to scientific journals and cyclopaedia.

CARUS, Carl Gustav (1789-1869; *WWW*), German physician and philosopher.

CASSINI, Giovanni Domenico (1625-1712; *WWW*), French astronomer; professor of astronomy, University of Bologna, 1650; director of Paris Observatory; developed theory on the motion of comets; greatly extended knowledge of the solar system.

CAVENDISH, Henry (1731-1810; *DNB, DSB*), physicist born at Nice; discovered the constitution of water and atmospheric air before 1783; experimented on electricity and the density of the earth, the composition of gases, electricity and geophysics.

CAVENTOU, Joseph-Bienaimé (1795-1877; *WWW, DSB*), French chemist, professor of toxicology and one of the founders of alkaloid chemistry; discovered (with Pierre Joseph Pelletier) strychnine, brucine, quinine, veratrine and colchicine.

CHARLES, Jacques-Alexandre-César (1746-1823; *WWW, DSB*), French physicist, known for his work on balloons and the expansion of gases.

CHÈVREUL, Michel Eugène (1786-1889; *WWW, DSB*), French chemist; notable for his pioneer work on the composition of oils and fats, and natural colouring matters; professor then director of the Museum of Natural History, 1864-79; director of Dyeing at the Gobelin tapestry factory and twice elected President of the Acad. of Sciences.

CHEVALIER, Michel (1806-79; *UC*), economist, interested in decimalisation.

CHLADNI, Ernst Florence Friedrich (1756-1827; *WWW*), German physicist, one of the first to demonstrate the meteorites could not have originated on earth.

CHRISTISON, Sir Robert (1797-1882; *DNB*), toxicologist and public speaker; physician to Edinburgh Infirmary; medical professor at Edinburgh, 1822-77; carried out experiments in water analysis on a large scale; wrote *Treatise on Poisons* (1829), and many other works.

CLARK, James (1788-1870; *DNB*), physician, lawyer's clerk; naval surgeon, 1809-15, MD, Edinburgh, practised in Rome, 1819-26 and then London, 1826-60.

CLAUDET, Antoine François Jean (1797-1867; *DNB, WWW*), born at Lyons; daguerreotype photographer; inventor of a glass-cutting machine and photograph devices; FRS.

CLEGG, Samuel, the elder (1781-1861; *DNB*), gas engineer, apprentice to Matthew Boulton and James Watt's engineering work, Soho; successfully illuminated an entire district of London by gas in 1814; a pioneer of gas-lighting in Yorkshire; invented the water gas-meter.

COLE or COLES, William (1626-62; *DNB*), botanist; entered New College, Oxford, 1642; postmaster of Merton College, 1650-1; resident at Putney; secretary to the bishop of Winchester, 1660; published *Herbal* (1656-57).

COMTE DE LACÉPÈDE, Bernard Germain Étienne de la Ville (1756-1825; *WWW*), French naturalist; in charge of the reptiles and fish department at Natural History Museum, Paris; wrote on electricity.

CONGREVE, Sir William (1772-1828; *DNB, DSB*), inventor, comptroller of the Woolwich Laboratory, 1814-28; invented the Congreve rocket, 1808.

COOKE, Mordecai Cubitt (1825-1914; *UC*); popular science writer on microscopy, fungi, botanical pathology and natural history.

COOPER, William White (1816-86; *DNB*), surgeon-oculist, ophthalmic surgeon to St. Mary's Hospital; published his notes of Owen's lectures at the college of surgeons.

CRANTZ, Heinrich Johann Newpomuk VON (1722-97; *WWW*), obstetrician, born Roodt, Luxembourg, did research and published on tearing of uterus during birth, chemistry, botany and mineral springs.

CUGNOT, Nicholas-Joseph (1725-1804; *WWW, ABF*), French military engineer and pioneer of steam traction.

CULPEPPER, Nicholas (1616-54; *DNB*), physician and astrologer; practised in London in the civil war; published *A Physical Directory* (1654) which was unauthorised translation of the College of Physicians' *Pharmacopoeia*, and *The British Herbal and Family Physician for the Use of Private Families* (1653) which is the basis of herbalism.

CUMING, Hugh (1791-1865; *DNB*), naturalist; collected shells and living orchids in the Pacific, on the coast of Chili, and in the Philippine islands.

CUVIER, Georges Léopold Chrétien Frédéric Dagobert, Baron (1769-1832; *DSB, ABF*), French comparative anatomist and founder of palaeontology; assistant and lecturer at the Muséum d'Histoire Naturelle, Paris; worked on the classification of the animal kingdom; professor of natural history, Collège de France; conducted researches into fossil mammals and reptiles; his *Animal Kingdom* (1827-33) was in CD's library.

DAGUERRE, Louis Jacques Mandé (1787-1851; *DSB*), inventor of the daguerreotype, the first practicable process of photography.

DALTON, John (1766-1844; *DNB, DSB*), chemist; studied mathematics, zoology and botany; founder and president of the Manchester Library and Philosophical Society; tutor at Manchester Academy; formulated the atomic theory to explain chemical reactions as shown in his lectures at the Royal Institute, 1803-4; made discoveries in colour-blindness.

DARWIN, Charles Robert (1809-82; *DNB, DSB*), naturalist, grandson of Erasmus Darwin; wrote *Origin of Species* (1859), based on the theory of evolution by natural selection; the 2nd ed. (1860) of the book was in CD's library.

DARWIN, Erasmus (1731-1802; *DNB, DSB*), physician; wrote *The Botanic Garden: a Poem, in Two Parts* (1791) which includes *The Love of Plants* (1789) and *the Economy of Vegetation* (1791).

DASENT, Sir George Webbe (1817-1896; *DNB*), Scandinavian scholar; British envoy at Stockholm, 1840-45; studied Scandinavian literature and mythology; assistant editor of the *Times*, 1845-70; professor of English literature and modern history at King's College, London, 1853; commissioner of historical manuscripts, 1870.

DAUBENY, Charles (1795-1867; *DNB, DSB*), chemist and botanist; FRS; professor of chemistry at Oxford; professor of botany to the Botanical Garden; investigated mineral and thermal waters, the distribution of potash and phosphates in leaves and fruits, and the effect of varied proportions of carbonic acid on plants; strongly supported Darwin's *Origins* in his paper "On the Sexuality of Plants," to *BAAS*, 1860.

DAVY, Sir Humphry (1778-1892; *DNB, DSB*), chemist and scientific propagandist; one of the founders of the Athenaeum Club and London Zoo; lectured on galvanism and pneumatic chemistry at the Royal Institution, and was its director of chemical laboratory, 1801; FRS; invented safety-lamp, 1815; demonstrated the existence of potassium, sodium, and chlorine using the agency of the galvanic battery, and discovered the constitution of oxymuriatic acid, 1807.

DAVY, John (1790-1868; *DNB, DSB*), chemist, physiologist and anatomist; brother of Humphry Davy; army surgeon and inspector-general of army hospitals; did research on

hydrofluoric acid, corrosive sublimate, glow of phosphorescence, and combinations of metals with chlorine.

DE BLAINVILLE, Henri Marie Ducrotay (1777-1850; *WWW; UC*), French biologist, studied medicine; collaborated with Cuvier on comparative anatomy work; classified animals into three main groups.

De LA RIVE, Arthur-Auguste (1801-73; *WWW*), Swiss physicist; FRS; studied magnetism and electricity; proved that ozone is formed by electrical sparks in pure oxygen.

DE LA RUE, Warren (1815-89; *DNB, DSB*), inventor, FRS; devised "Kew Heliograph" to take daily photographs of sun, 1858; directed expedition to observe solar eclipse and sun-spots; engaged in chemical researches on tar, acid, and electric discharge through gases.

DELAUNAY, Charles-Eugène (1816-72; *DSB*), French engineer; professor of mechanics, mathematics and astronomy at the University of Paris; worked on calculus of variations, perturbations of Uranus and the theory of tide.

DERHAM, William (1657-1735; *DNB, DSB*), vicar of Upminster, Essex; FRS; studied natural history and mechanics; Boyle lecturer, 1711-12, published his Boyle lectures as *Physico-Theology, or a Demonstration of the Being and Attributes of God from His Works of Creation* (1713) which reached a 12th edition in 1754.

DEVILLE, Henri Étienne (Lucien) Sainte-Claire (1818-81; *DSB, ABF*), French chemist, best known for his work on producing aluminum; professor of chemistry at the University of Besançon.

DODOENS, Rembert (1516-85; *WWW, DSB*), Belgium botanist and municipal physician; lectured on pathology and general therapeutics at Leiden University; wrote books on medicine and cosmography.

DONATI, Giambattista (1826-73; *WWW, DSB*), Italian astronomer; discovered the comet of 1858 named after him; did research on stellar spectra.

DOUBLEDAY, Edward (1811-49; *DNB*), Quaker entomologist; made immense collections of insects in America; assistant in the British Museum in charge of collections of butterflies and moths, 1839-49; secretary of the Entomological Society.

DOUBLEDAY, Henry (1808-75; *DNB*), Quaker naturalist and brother of Edward Doubleday; wrote for scientific magazines about mammals, birds, and insects; member of the Entomological Society.

DOUGLAS, John W. (1801-76; *DNB*), naturalist; one of the founders of the Entomological Club.

DRAPER, John William (1811-82; *DNB*), chemist; professor of chemistry and physiology, Virginia; president of the New York University, 1850-73.

DRUITT, Robert (1814-83; *DNB*), physician and medical writer; practised in London from 1837; edited *The Medical Times and Gazette*, 1862-72; president of the Metropolitan Association of Medical Officers of Health, 1864-72.

DU CHAILLU, Paul Belloni (1831-1903; *CBD*), American traveller; explored the interior of West Africa; made important contributions to geographical, ethnological and zoological science, including the natural history of the gorilla.

DUGÈS, Antoine-Louis (1797-1838; *WWW*), French physician; did research on diseases of the new-born, and comparative physiology of men and animals.

DUHAMEL DU MONCEAU, Henri-Louis (1700-82; *WWW, DSB*), French chemist and botanist; conducted research on plant nutrition and diseases, drugs, and animals; first to distinguish between potash and soda, 1736.

DUMAS, Jean-Baptiste-André (1800-84; *WWW, DSB*), French chemist and lecturer; attempted to classify organic compounds.

DUMÉRIL, André Marie Constant (1774-1860; *WWW*), French zoologist, professor of anatomy and pathology, Faculty of Medicine, Paris, 1801; professor of zoology and ichthyology of the Museum of Natural History, Paris; did pioneer research on reptiles and amphibia.

DUPONCHAL, Philogène Auguste (1774-1846; *ABF*), French naturalist.

DUTROCHET, (René Joachim) Henri (1776-1847; *WWW, DSB*), French physiologist; showed that plant cells containing green pigment can absorb carbon dioxide in presence of light, 1837; one of the first to study successfully the production of heat during plant growth; studied evolution of birds.

DWIGHT, Timothy (1752-1817; *DAB*), anatomist of Boston, congregational divine, President of Yale College, 1795-1817; author of *Theology Explained and Defended*, 4 vols. (Newhaven, 1818-19).

EHRENBERG, Christian Gottfried (1795-1876; *WWW, DSB*), German zoologist; founder of protozoology; a pioneer of microscopical research on the lowest forms of life and animalcules including protozoa, bacteria and plant forms; a member and secretary of the Berlin Academy of Sciences.

ÉLIE DE BEAUMONT, Jean-Baptiste-Armand-Louis-Léonce (1798-1874; *WWW, DSB*), French geologist; described the age and origin of mountains; published a geological map of France, 1841.

ELLICOTT, John (1706-72; *DNB*), clockmaker and scientist; FRS; made observation of the transit of Venus, 1761.

ENCKE, Johann Franz (1791-1865; *WWW, DSB*), German astronomer; computed orbit of comet of 1680; orbit and period of comet discovered in 1818 (Encke's comet); calculated the gravitational influences of the planets on the motion of comets; originated new method of determining elliptic orbits from his observations, 1849.

ENDLICHER, Stephan Ladislaus (1804-49; *WWW*), Austrian botanist; keeper of the botany department at the Naturalienkabinet in 1836; professor of botany at the University of Vienna, and director of the botanical garden in 1840.

ENGLEFIELD, Henry Charles (1752-1822; *DNB*), antiquary and scientific writer.

EVANS, Sir John (1823-1908; *DNB*), archaeologist and numismatist; made researches into water supply; collected fossils and antiquities; FRS; president of Geological Society, 1874-76 and Numismatic Society, 1874-1908.

EVANS, Oliver (1755-1819; *DAB*), American inventor, America's first steam-engine builder.

FABER DU FAUR, Adolf Friedrich Von (1826-1918; *WWW*), German engineer, metallurgist, emigrated to U. S., 1850; invented tilting furnace in which crucible remained in furnace when smelting still in use today; used to refine silver from lead, and to smelt gold-silver deposits of cyanic process.

FAHRENHEIT, Daniel Gabriel (1686-1736; *WWW*, *DSB*), Polish experimental physicist; invented the mercury thermometer around 1714; devised the temperature scale named after him; the first to show that the boiling point of liquid varies at different atmospheric pressures.

FARADAY, Michael (1791-1867; *DNB*, *DSB*), experimental physicist; analysed hydrate of chlorine and liquefied it and other gases; discovered benzol and magneto-electricity; researched on electricity; inventor of dynamo; gave public lectures on science at the Royal Institution.

FAYE, Hervé Auguste Étienne, Albans (1814-1902; *WWW*, *DSB*), French Astronomer, member of French Acad. of Sciences; discovered a comet named after him, 1834; developed theory connecting sunspots with weather, 1872; professor of astronomy at the École Polytechnique, 1873; director of the Paris Observatory, 1878; improved methods of astronomical measurement, applied photography and electricity to astronomical study; added to knowledge of sunspots, comets and meteors.

FERGUSON, James (1710-76; *DNB*, *DSB*), Scottish astronomer, popular scientific teacher and lecturer; FRS.; presented to the Royal Society "An Improvement of the Celestial Globe," 14 May 1747 (*Philosophical Transactions*. xlv, 127).

FERGUSON, William (1820-87; *DNB*), botanist and entomologist; member of the Ceylon civil service, 1839-87.

FERGUSON, William (1820-87; *DNB*), botanist and entomologist; member of the Ceylon Civil, 1839-87.

FIELD, Frederick (1826-85; *DNB*), chemist; one of founders of the Chemical Society; worked at copper-smelting works at Coquimbo in Chili and at Guayacan; lectured on chemistry at St. Mary's Hospital; professor of chemistry in the London Institute.

FIGUIER, Louis-Guillaume (1814-94; *WWW*), French science-writer, professor of pharmacy; popularised information on scientific discoveries; wrote *The Insect World* (1868), *The Vegetable World* (1867) and *The World before the Deluge* (1867) which were CD's library.

FIZEAU, Armand Hippolyte (1819-96; *WWW*), French physicist; celebrated for determining of the velocity of light in 1849; demonstrated the use of Doppler principle in determining star velocity in the line of sight; member of French Acad. of Sciences.

FIZEAU, Hippolyte Louis (1819-96; *UC*), wrote on astronomical photography.

FLAMSTEED, John (1646-1719; *DNB*), First Astronomer Royal and author of important star catalogues.

FLINDERS, Matthew (1774-1814; *DNB*), naval captain, hydrographer and discoverer; made the first survey of a large part of the Australian coast, 1801-03.

FLOURENS, Pierre Jean (1794-1867; *WWW*), French physiologist, secretary of the French Acad. of Sciences, and professor of natural history at the Collège de France; elected to the Chamber of Deputies, 1838 and made a peer of France, 1846; wrote on neurophysiology and animal instinct, and was the first to demonstrate the functions of the different parts of the brain.

FOISSAC, Pierre (1801-86; *ABF, UC*), French scientist; wrote on meteorology, physiology and hygiene.

FORBES, Edward (1815-54; *DNB*; *DSB*), naturalist; FRS; professor of botany at King's College, London, professor of natural history in Edinburgh; lecturer of the Geological Society; Palaeontologist of the Geological Survey, 1844; attacked Chambers's concept of evolution; FRS.

FORBES, James David (1809-68; *DNB*), Scottish physicist and glaciologist; abandoned law for his interest in science; jointed Brewster in founding British Association, 1831; professor of natural philosophy at Edinburgh University, 1833 and principal of St. Andrews College, 1859; studied spectra and glaciers.

FORTUNE, Robert (1813-80; *DNB*), traveller and botanist; visited China for the Horticultural Society, 1842.

FOUCAULT, Jean Bernard Léon (1819-68; *WWW*), French physicist; determined the velocity of light by the revolving mirror method and proved that light travels more slowly in water than in air, 1850; using a freely suspended pendulum he proved that the earth rotates, constructed the gyroscope and improved the mirrors of reflecting telescopes.

FRANKLIN, Benjamin (1706-90; *DAB*), US Statesman, publisher, and scientist, most famed for his proof that lightning is electrical in nature; was also interested in radiant heat, thermal conduction, hydrodynamics, meteorology and much else.

FRANKLIN, Sir John (1786-1847; *DNB*), Arctic explorer

FRAUNHOFER, Josef Von (1787-1826; *WWW*), German scientist, remembered for his investigation of the dark lines in the solar spectrum, and for his development of the telescope.

FRÉMY, Edmond (1814-94; *WWW*), French chemist; one of the first to prepare fluorine, but could not collect it; prepared anhydrous hydrogen fluoride, and artificial rubies; conducted research on ferrates, stannates, plumbates, and colouring of flowers.

FRESNEL, Augustin Jean (1788-1827; *WWW*), French physicist, distinguished in the wave theory of light and applied optics; his study led to the celebrated multi-faceted lighthouse lens.

FROMENT, Paul-Gustave (1815-65; *WWW*), French engineer; made precision instruments; built pendulum and gyroscope used by Foucault, and the telegraphic apparatus of Hughes.

FULTON, Robert (1765-1815; *DAB*), American civil engineer, inventor and artist; steamboat pioneer; was the first to apply steam to inland navigation successfully; constructed the first steam warship.

GAUDIN, Marc Antoine Augustine (1804-80; *WWW*), French scientist; the calculator of Burides longitudes; wrote about astronomy, mineralogy, photography, gun cotton, fermentation, molecular structure of minerals, etc.; conducted research on silica fused with an oxyhydrogen blowpipe; the first one to make artificial rubies and sapphires and a malleable alloy of iridium and platinum; also the first to do research on silver chloride and silver iodide emulsions in photography.

GAVARRET, Jules (1809-90; *UC*), French authority on electricity and telegraph.

GEOFFROY SAINT-HILAIRE, Étienne (1772-1844; *WWW*), French naturalist; professor of zoology at the Faculty of Sciences, Paris, 1809; member of French Acad. of Sciences, 1807 and its president, 1833; believed that a single type of structure exists in animals rather than in modification of species.

GEOFFROY SAINT-HILAIRE, Isidore (1805-61; *UC, ABF*), wrote on natural history.

GERARD, John (1545-1612; *WWW*), herbalist who wrote *The Herball, or General Historie of Plants* (1597), had medical garden with more than 1000 species of plants.

GIRARD, Philippe de (1775-1845; *WWW*), French inventor; invented an achromatic telescope, 1806, a flax spinning machine, 1812, and a rotating steam engine and steam cannon, 1813.

GOSSE, Philip Henry (1810-88; *DNB*), zoologist whose aunt was herself a scientific woman and the mother of professor Thomas Bell; devoted himself to the study of birds, insects, rotifera and orchids; wrote on microscope.

GOULD, John (1804-81; *DNB*), ornithologist, publisher, curator and taxidermist to the Zoological Society, 1827; FRS; travelled in Australasia, 1838-40 and made observations and collections; exhibited collection of humming-birds, 1851; published 41 folios on birds and numerous monographs; FRS.

GRAY, Thomas (1787-1848; *DNB*), railway pioneer; published *Observations on A General Railway, with Plates and Maps* (1820).

GREEN, Charles (1785-1870; *DNB*), balloonist; made the first ascent with carburetted hydrogen gas, 1821; made 526 ascents, 1821-52.

GREGORY, William (1803-58; *DNB*), chemist, professor of medicine and chemistry at King's College, Aberdeen, and Chair of Chemistry at Edinburgh.

GROVE, Sir William Robert (1811-96; *DNB*), physicist, electrochemist and jurist; FRS; invented Grove "gas voltaic battery," 1839 and the earliest form of filament lamp intended for use in mines; professor of experimental philosophy at the London Institute, 1841-64; member of the royal commission on law patents, 1846; published *On the Correlation of Physical Forces* (1846) and established a theory of mutual convertibility of forces, 1853.

HAAST, John Francis (Franz) Julius von (1824-87; *DNB, DSB*), geologist and explorer; discovered coal- and gold-fields in New Zealand, 1859; discovered the Southern Alps; founder of Canterbury Museum; FRS.

HAHNEMANN, Christian Friedrich Samuel (1755-1843; *WWW, DSB*), German physician and founder of homeopathy.

HALL, Marshall (1790-1857; *DNB, DSB*), physiologist, fellow of the Royal College of Physicians; did research on physiology of reflex functions and wrote about many aspects of medicine, including the circulation of the blood and respiration; FRS.

HALLEY, Edmond (1656-1742; *DNB, DSB*), astronomer and mathematician; discovered the motions of the stars and periodicity of comets.

HARGRAVES, Edward Hammond (1815-91; *DNB*), colonialist and pioneer of gold-mining in Australia in 1851.

HARRIS, Moses (fl. 1760-85; *DNB*), entomologist and artist whose works include *The Aurelian or Natural History of English Insects* (1766), *English Lepidoptera* (1775), *Exposition of English Insects* (1776) and *Natural System of Colours* (1811).

HARRIS, Sir William Cornwallis (1807-48; *DNB*), engineer and traveller; superintending engineer of Northern Provinces of India, 1844; made expedition to country between Orange River and the Matabele chief Moselikatze's kraal, 1836-37.

HARVEY, William (1578-1657; *DNB, DSB*), physician; discoverer of the circulation of the blood; studied the embryo.

HARVEY, William Henry (1811-66; *DNB, DSB*), Irish botanist; the curator of the Herbarium and professor of botany at Trinity College, Dublin; visited India, Australia and the South Seas, 1853-56, to collect seaweeds and became an authority on algae.

HASSALL, Arthur Hill (1817-94; *Boase*), wrote a series of articles for the *Lancet* on subject of adulteration, 1850-54, which led to passing of the Anti-adulteration act and appointment of public analysts; also wrote on water supply; fellow of the Linnaean Society.

HAWES, William (1736-1808; *DNB*), physician to London Dispensary; MP; founded Royal Humane Society, 1774.

HELMHOLTZ, Hermann Ludwig Ferdinand von (1821-94; *DSB, WWW*), German physiologist, physicist, mathematician and experimentalist; celebrated for his contributions to physiology and theoretical physics; his study of animal heat led him to investigate the conservation of energy; also studied physiological optics, investigated colour and the problem of colour blindness.

HENSLOW, John Stevens (1796-1861; *DNB, DSB*), botanist; Cambridge professor of mineralogy and botany; recommended Darwin to the *Beagle*; wrote books on scientific agriculture and botany; presided over the discussion of the *Origins* at BAAS, 1861.

HERSCHEL, Sir John Frederick William, first baronet (1792-1871; *DNB, DSB*), astronomer, son of William Herschel; FRS; secretary to Royal Society, 1824-27; president of Astronomical Society, 1827-32; discovered many double stars, nebulae and clusters;

described new graphical method of investigating stellar orbits; measured solar radiation; assisted in Royal Commission on Standards, 1838-43, the Great Exhibition and the Universities Commission, 1850; the 3rd ed. of his *Outline of Astronomy* (1850) was in CD's library.

HERSCHEL, Sir William (1738-1822; *DNB, DSB*), astronomer; constructed optical instrument; discovered Uranus, 1781; FRS; first president of the Astronomical Society; discovered more than 2,000 nebulae, over 800 double stars and the translation of the solar system towards a point in Hercules; investigated rotation of Mars; made observations of comets of 1807 and 1811; discovered infra-red solar rays, 1800.

HIND, Henry Youle (1823-1908; *MDCB*), Canadian geologist and explorer; went on the Red River expedition, 1857, the Assiniboine and Saskatchewan expedition, 1858, the Labrador expedition and other geological surveys.

HIRN, Gustave Adolfe (1815-90; *WWW, DSB*), French physicist and engineer; investigated speed of steaming gas, developed a method for studying heat-motors and mechanical heat theory; believed that heat and work were interconvertible, sought the "exchange rate," 1847, and measured the mechanical equivalent of heat.

HOBBS, Thomas (1588-1679; *DNB, DSB*), philosopher; wrote scientific papers.

HOEFMANN, August Wilhelm VON (1818-92; *WWW, DSB*), German organic chemist, Liebig's assistant and later professor in the New College of Chemistry, London; worked on compounds obtained from coal tar, their derivatives and reactions.

HOME, Sir Everard, first baronet (1756-1832; *DNB, DSB*), surgeon; keeper of Hunterian collection, first president of Royal College of Surgeons, 1821; destroyed Hunter's manuscripts after using them.

HOOKE, Joseph Dalton (1817-1911; *DNB, DSB*), botanist and traveller; went on Antarctic expedition, 1839-43; as an intimate of Charles Darwin, collaborated with him in researches into the origin of species from 1843; greatly advanced the knowledge of geographical distribution of species; assistant director at Kew, 1855.

HOOKER, Sir William Jackson (1785-1865; *DNB, DSB*), botanist; Regius Professor of Botany at Glasgow, 1820; the first director of Kew Gardens, 1841-64; collected specimens, mostly mosses, in Scotland and Iceland.

HOWARD, Luke (1772-1864; *DNB*), pioneer in meteorology; chemist in London; began to keep meteorological register, 1806; FRS.

HUBER, Daniel (1768-1829; *WWW*), mathematician; professor in Basel, Switzerland; developed the method of least quadrature.

HUBER, François (1750-1830; *WWW*), Swiss naturalist; did research on bees.

HUGHES, Griffith (fl. 1750; *DNB*), rector of St. Lucy's, Barbados; FRS.

HUMBOLDT, Baron Friedrich Wilhelm Heinrich Alexander Von (1769-1859; *WWW; DSB*), German naturalist; his *Kosmos* (1845-62) gives a comprehensive physical description of the universe; formed the basis for scientific formation of physics, geography and meteorology; made observations which led to discovery of periodicity of meteor showers; studied tropical storms; made pioneer investigations on relationship between geological environment and plant distribution.

HUNTER, John (1728-93; *DNB; DSB*), Scottish surgeon, anatomist and biologist; FRS.; lectured on surgery and investigated widely in human pathology; built up a huge collection of specimens to illustrate the processes of plant and animal life that were later bought by the government and administered by the Royal College of Surgeons.

HUYGENS, Christiaan (1629-93; *WWW, DSB*), Dutch physicist, mathematician and astronomer; member of French Acad. of Sciences; presented mechanical model of gravity; discovered laws of centrifugal force; invented pendulum clock.

IZARN, Joseph (1776-1834?; *UC*), French meteorologist.

JACKSON, Charles Thomas (1850-80; *DAB, DSB*), American chemist and geologist; practised medicine in Boston but abandoned it wholly for chemistry and mineralogy; claimed to have suggested to Samuel Morse the principles of the electric telegraph;

suggested to William Morton the use of nitrous oxide and asphyxia for extracting teeth, 1846.

JANSSEN, Pierre Jules César (1824-1907; *WWW, DSB*), French astronomer; went on many eclipse expeditions; greatly advanced spectrum analysis by his observation of the bright line spectrum of the solar atmosphere, 1868; director of an astrophysical observatory at Meudon, Paris; made a remarkable collection of solar photographs.

JARDINE, Sir William, seventh baronet (1800-74; *DNB*), naturalist, published *Illustrations of Ornithology* (1830), edited *Naturalists' Library*, 1833-45 and contributed sections on birds and fish; conducted *Annals and Magazine of Natural History*; joint editor of *Edinburgh Philosophical Journal*.

JEFFRIES, John (1744-1819; *DAB*), American balloonist and physician; made the first balloon crossing of the English Channel with Blanchard, 1785.

JENNER, Edward (1749-1823; *DNB, DSB*), discoverer of vaccination; FRS; pupil of John Hunter; practised at Berkeley, Gloucestershire, 1773; MD, St. Andrews, 1792; first vaccinated from cow-pox, 1796.

JENYNS, Rev. Leonard, see **Blomefield, Leonard**.

JILEK, August Ritter Von (1818?-98; *UC*), physician, wrote on malaria and epidemiology.

JOHNSON, Charles (1791-1880; *DNB*), botanist, lectured on botany at Guy's Hospital; published monographs on British ferns, poisonous plants and grasses.

JONES, Henry Bence (1814-73; *DNB*), physician and chemist; FRS; secretary to the Royal Institution from 1860; physician to St. George's Hospital, 1846-62; a biographer of Faraday.

JUKES, Beete Joseph (1811-69; *DNB, DSB*), geologist, geologist surveyor of Newfoundland, 1839-40; naturalist in the survey of the north-east coast of Australia, 1842-46; FRS.

JUSSIEU, Bernard de (1748-1836; *DSB, WWW*), French botanist; arranged the botanical garden of the Trianon based on his natural system; played an important role in the development of the concept of natural relationship as the main basis for classification, opposing the prevalent artificial sexual system of Linnaeus.

KANE, Sir Robert John (1809-90; *DNB, DSB*), Irish chemist; professor of chemistry, Apothecaries Hall, Dublin, 1831-45, and of Royal Dublin Society, 1834-47; President of Royal Irish Academy and of Queen's College, Cork; first director of the Museum of Industry, Ireland.

KEPLER [Keppler], Johannes (1571-1630; *WWW, DSB*), German astronomer, mathematician and physicist, famous for his laws of planetary motion; made discoveries in optics, general physics and geometry.

KINGSLEY, Charles (1819-75; *DNB*), author; professor of modern history at Cambridge, 1860-9; his enthusiasm for natural history is shown by *Glaucus, or the Wonders of the Shore* (1855) and similar works; published *Water Babies* (1863); believed in the possibility of reconciling religion and science.

KIRBY, William (1759-1850; *DNB*), entomologist and botanist; fellow of the Linnean Society; wrote much on theology from the point of view of an orthodox anti-Calvinistic churchman belonging to an earlier age; refused to accept the new geological discoveries; wrote the seventh *Bridgewater Treatise* (1833), also in CD's library.

KIRCHHOFF, Gustave Robert (1824-87; *WWW, DSB*), German physicist; professor of physics, Breslau, 1850-54; distinguished himself in electricity, heat, optics, and spectrum analysis; studied electric currents and light.

KNIGHT, Thomas Andrew (1759-1838; *WWW, DSB*), vegetable physiologist and horticulturist; an original member of the Horticultural Society and its president from 1811 till his death; fellow of the Linnean Society, 1807; FRS.

KNOX, Arthur Edward (1808-86; *Boas*), naturalist; made a fine collection of Sussex birds; authority on falconry; wrote on birds.

KÜTZING, Friedrich Traugott (1807-93; *WWW, DSB*), German botanist; first became a pharmacist; studied marine plants of the Mediterranean and Adriatic, 1835 and taught science.

LAGRANGE, Joseph Louis Comte de (1736-1813; *WWW, DSB*), French mathematician, physicist and astronomer; professor of mathematics at the Artillery School, Turin; member of the French Acad. Sciences; professor of mathematics at the new *École Normale* 1797; he also studied subjects such as metaphysics, the history of languages, chemistry, and botany.

LAMARCK, Jean Baptiste Pierre Antoine de Monet (1744-1829; *WWW, DSB*), French naturalist and pre-Darwinian evolutionist.

LAMBERT, Gustave (d. 1817; *UC*), physician, wrote on locomotion, hydrodynamics, aerodynamics, mathematics and Arctic expedition.

LAMOUREUX, Jean Vincent Félix (1779-1825; *WWW, DSB*), French botanist and zoologist; professor of Natural history; member of the French Acad. of Sciences; did research on sea plants and animals and discovered 140 new zoophyte species.

LANCISI, Giovanni Maris (1654-1720; *WWW, DSB*), Italian physician; professor of the practice medicine; pioneer in the morbid anatomy; studied malaria.

LAPLACE, Pierre Simon (1749-1827; *DSB*), French mathematical physicist; wrote on astronomy; made important discoveries about the solar system; contributed to tidal theory.

LASSELL, William (1799-1880; *DNB, DSB*), astronomer, built an observatory at Starfield near Liverpool; constructed and mounted equatorial reflecting telescopes; discovered many planetary satellites.

LATREILLE, Pierre-André (1762-1833; *WWW, DSB*), French entomologist, known as the father of modern entomology and for his pioneering work on classifying insects and crustaceans; assisted Lamarck and Cuvier in some of their works.

LAVOISIER, Antoine-Laurent (1743-94; *WWW, DSB*), French chemist; named oxygen and claimed to have discovered it with Priestley and Scheele; gave theory of formation of

chemistry compounds; with Laplace, designed an ingenious ice-calorimeter to study the respiration in small animals and showed that the air breathed extracts of carbonaceous matter combined with oxygen from the lungs to form carbon dioxide in 1785.

LEBLANC, Nicolas (1742-1806; *WWW, DSB*), French industrial chemist; did research on crystallisation of neutral salts; found a new way of extracting soda.

LECOUTURIER, Charles Henri (b. 1819; *UC*), wrote on cosmology and astronomy.

LEEUWENHOEK (or Leuwenhoek), **Antony Van** (1632-1723; *WWW*), Dutch microscopist; contributed to disproving theory of spontaneous generation, through his descriptions of the reproduction of weevils, fleas, eels, and shellfish; gave first complete description of bacteria and protozoa; first to discover rotifers; FRS, built microscopes, described and illustrated observations made through them.

LEGALLOIS, Julien Jean César (1770-1814; *WWW, DSB*), French physiologist; did research on relation of vagus nerve to respiration, proved that bilateral section may produce bronchopneumonia, and located centre of respiration in medulla oblongata, 1812.

LE HON, Henri (1809-72; *UC*), wrote on astronomy, geology and evolution.

LEIBNIZ, Gottfried Wilhelm (1646-1716; *DSB, WWW*), German mathematician, physicist and philosopher; known for his part in the foundation of the calculus and attempts at mathematical logic.

LEITH, Charles (1662-1701?), physician and naturalist.

LETHEBY, Henry (1816-76; *DNB*), analytical chemist; lectured on chemistry at the London Hospital; medical officer of health and analyst of foods for the city of London; chief examiner of gas for the metropolis under the board of trade; fellow of the Linnean Society and Chemical Society.

LE VERRIER, Urbain Jean Joseph (1811-77; *WWW, DSB*), French astronomer, calculated variations of planetary orbits for 200,000 year period; constructed tables of movements of Sun, Moon, and planets (especially Mercury); studied irregularities in motion of Uranus.

LIEBIG, Justus Von (1830-73; *WWW, DSB*), German chemist; contributed much to the early systematization of organic chemistry, and the application of chemistry to biology, chemical education, and agricultural chemistry.

LINDLEY, John (1799-1865; *DNB, DSB*), botanist and horticulturist, assistant secretary to the Horticultural Society of London, 1822-41, professor of botany at University of London, 1829-60; his chief work was *The Vegetable Kingdom* (1846); FRS.

LING, Per Henrik (1776-1839; *EB*), Swedish physician, wrote on medical-gymnastics.

LINNAEUS (or von Linné), **Carl** (1707-78; *DSB, WWW*), Swiss scientist; made important contributions to botany, zoology, geology and medicine; professor of medicine and botany at Uppsala, 1741; introduced binomial system of nomenclature for scientific naming of species of plants and animals.

LISTER, Martin (ca. 1639-1712; *DSB*), zoologist and geologist; classified spiders; also worked on mollusks, parasites, anatomy and taxonomy.

LORRY, Ann-Charles (1726-83; *WWW, DSB*), French physician; practised in Paris; physician to Louis XV in his last illness; wrote on dermatology.

LOW, William (1814-86; *DNB*), civil engineer; engaged under Brunel in construction of Western Railway; colliery engineer.

LUDWIG, Karl [Carl] **Friedrich Wilhelm** (1816-95; *WWW*), physiologist; member of French Acad. of Sciences; inventor of an instrument for measuring speed of blood stream, 1867; inventor of mercurial blood-gas pump for separation of gases from blood; studied role of nervous system in circulation, glandular secretions.

LUKE, Howard (1772-1864; *DNB*), pioneer in meteorology; chemist in London; began to keep meteorological register, 1806.

LUNARDI, Vincenzo (1759-1860; *WWW*), Italian aeronautical pioneer; made several successful ascents in 33-foot hydrogen balloon from London, Edinburgh and Glasgow, 1784-85; first aerial journal in Britain in hydrogen balloon from London to Standon, 1784.

LYELL, Sir Charles, first baronet (1797-1875; *DNB, DSB*), Scottish geologist; secretary of the Geological Society, 1823-26; FRS; published *Principles of Geology* (1830-34) finally discrediting the catastrophic school of geologists; the 3rd ed. of his *Geological Evidence of the Antiquity of Man* (1863) was in CD's library.

LYONNET, Pierre (1707-89; *ABF*), French naturalist.

MACGILLIVRAY, William (1796-1852; *DNB*), naturalist; conservator of the Royal College of Surgeon's Museum, Edinburgh, 1831-41; professor of natural history, Aberdeen, 1841; wrote *A History of British Birds*, 5 vols. (1837-52) and other works on botany and geology.

MACGILLIVARY, John (1822-67; *DNB*), son of William Macgillivray; naturalist on various government surveying expeditions, 1842-55; studied natural history in Australasian islands.

MAILLET, Beneit (Benoist, Bernard), de (1656-1738; *WWW*), French natural philosopher; precursor of ideas of evolution, transformism and extinction of species; maintained that all land plants and animals had origin in marine forms that survived the flood; suggested modification of organism by environment and hereditary transmissions of those modifications.

MALLET, Robert (1810-81; *DNB, DSB*), civil engineer and scientific investigator, FRS; conducted many engineering works in Ireland including the building of the Fastnet Rock lighthouse, 1848-49; edited the *Practical Mechanics' Journal*, 1865-69; contributed to *Philosophical Transactions*, and published works on engineering.

MALUS, Étienne Stephen Louis (1775-1812; *WWW*), French physicist; discovered polarisation of light; explained theory of double refraction.

MANBY, Charles (1804-84; *DNB*), civil engineer; joined his father at Horsely ironworks, and assisted in building the first iron steam-boat; superintended the erection of the first pair of oscillating marine engines ever made; went to Paris to take charge of the gas works

established there by his father; civil engineer in London, 1835; secretary to the Institution of Civil Engineers, 1839-56, and elected a fellow in 1853; FRS.

MANSON, Sir Patrick (1844-1922; *DNB, DSB*), physician and parasitologist, MB, CM, Aberdeen, 1865; medical officer for Formosa to Chinese Imperial Maritime Customs, 1866; propounded his mosquito-malaria theory; published works on tropical diseases; considered to be the "father of tropical medicine."

MANTELL, Gideon Algernon (1790-1852; *DNB, DSB*), geologist; FRS; made a noted collection, wrote books, and wrote geological works and papers for the Royal and Geological Societies.

MARIGNAC, Jean Charles Galissard de (1817-94; *WWW, DSB*), Swiss chemist; member of French Acad. Sciences; studied atomic weights and discovered true nature of ozone.

MARTIN, Aimé (1767-1846; *UC*), popular science writer.

MASON, Francis (1837-86; *DNB*), surgeon and lecturer at Westminster and St. Thomas's hospitals; president of Medical Society, 1882; published medical works.

MAURIN, Selim Ernest (b. 1838; *UC*), medical writer on cholera, hygienics and epidemiology.

MAURY, Matthew Fontaine (1806-73; *DAB, DSB*), American oceanographer, superintendent of the Depot and Charts and Instruments at Washington Naval Observatory and Hydrographical Office; He issued *Wind and Current Chart of the North Atlantic* (1847) and in the revised chart in 1853 claimed to cut the average passage between England and Australia from 124 to 97 days; wrote on the Gulf Stream, ocean currents, and Great Circle Sailing.

MAXWELL, James Clerk (1831-79; *DNB; DSB*), physicist; creator of the electromagnetic theory of light.

MAYER, Julius Robert Von (1814-78; *WWW, DSB*), German physicist and physician; determined quantitatively mechanical equivalent of heat; studied independently the

principle of conservation of energy (first law of thermodynamics), also extended it to include living phenomena and applied it to many cosmic and terrestrial phenomena.

MAYO, Herbert (1796-1852; *DNB, DSB*), physiologist; professor of anatomy and surgery to Royal College of Surgeons, 1828-29; FRS; professor of anatomy at King's College, London, 1830-6; founded medical school at the Middlesex Hospital, 1836.

MELLONI, Macedonio (1798-1854; *WWW, DSB*), Italian physicist; noted for work on radiant heat.

MERIAN, Maria Sibylla (1647-1717), German naturalist; worked on insects of Europe, visited Surinam, Dutch Guiana, 1666-1701, wrote *Metamorphoses of Insects of Surinam* (1705).

MEUNIER, Victor (1817-1903; *UC*), wrote on fishing, hunting and history of science.

MICHELET, Jules (1798-1874; *BD*), French romantic and nationalistic historian; wrote monumental historical works; also collaborated with his wife Adèle Mialaret to write several nature books including *L'Oiseau* (Paris: L. Hachette, 1856) and *L'Insect* (Paris: L. Hachette, 1857).

MILLER, Hugh (1802-56; *DNB, DSB*), Scottish geologist, writer and pioneer of popular works on geology; his *Testimony of the Rocks* (1850) was in CD's library.

MILNE-EDWARDS, Henri (1800-85; *WWW, DSB*), Belgian zoologist and physiologist; did research on crustaceans, polyps, fossil birds, and held the doctrine of special creation rather than evolution.

MITCHELL, David William (1813-59 *DNB*), ornithologist and zoological artist; the sixth Secretary of the Zoological Society of London, 1847-95; Fellow of the Linnean Society; published *A Popular Guide to the Gardens of the Zoological Society* (1852).

MONGE, Gaspard (1746-1818; *WWW, DSB*), French mathematician and physicist; inventor of descriptive geometry; undertook important research in differential geometry, especially in theory of curvature; provided solution to partial differential equations by means of his theory of surface.

MONTAGU, George (1751-1815; *DNB*), writer on natural history; had been a captain in the army during the war with the American colonies; devoted himself at Easton Grey to scientific study.

MONTGOLFIER, Jacques Étienne (1745-99; *WWW, DSB*), French inventor; pioneer of lighter-than-air-flight; invented parachute; raised first model hot-air balloon to a height of seventy feet on 15 Nov. 1782; built with his brother the first successful man-carrying balloon using hot air, 1783.

MONTGOLFIER, Joseph Michel (1740-1810; *WWW, DSB*), built with his brother Jacques the first successful man-carrying balloon using hot air, 1783.

MORREN, Charles-François-Antoine (1807-58), French naturalist.

MORTON, William Thomas Green (1819-68; *DAB; WWW*), American dentist and anaesthetist; on 30 September 1846, he used ether (borrowed from Jackson) on a patient to extract a tooth.

MULDER, Gerardus Joannes (1802-80; *WWW, DSB*), Dutch chemist, professor of chemistry at Utrecht, 1841-68; studied proteins which he named, 1838, and also agricultural chemistry; discovered chlorophyll; identified caffeine and fibrin.

MURCHISON, Sir Roderick Impey, first baronet (1792-1871; *DNB, DSB*), Scottish geologist; FRS; travelled and studied the Silurian System; director-general of the Geological Survey, 1831-32, president of the Royal Geological Society, 1843; professor of geology, Edinburgh; one of the founders of the British Association, and its president, 1846.

MURDOCK, William (1754-1839; *DNB*), engineer and inventor of coal-gas lighting; sometimes supposed to have invented the steam locomotive; made three steam engines.

MURRAY, John (1786?-1851; *DNB*), scientific writer and lecturer; lectured at mechanics' institutions; exhibited at his lectures an experimental safety-lamp.

MURRAY, John (1841-1914; *DNB*), marine biologist and oceanographer; FRS; naturalist in charge of collections on *Challenger* expedition; editor of *Report on the Scientific Results*

of the Voyage of H. M. S. Challenger, 1882-95; explored Scotland and North Atlantic; FRS.

MUSSCHENBROCK, Petrus van (1692-1761; *DSB*), Dutch physicist; lectured on experimental physics; wrote on heat, cohesion, capillarity, phosphorescence, magnetism, and electricity.

NEILL, Patrick (1776-1851; *DNB*), naturalist; a publisher devoted to botany and horticulture; fellow of Linnean and Edinburgh Royal Society.

NEWMAN, Edward (1801-76; *DNB*), naturalist, one of the founders of the Entomological Club.

NEWPORT, George (1803-54; *DNB, DSB*), naturalist; house surgeon to the Chichester Infirmary; made anatomical researches on insect structure and the generative system; president of the Entomological Society; fellow of the Royal College of Surgeons of England and the Linnean Society; FRS.

NIÉPCE, Joseph Nicéphore (1765-1833; *DSB*), inventor of photography and photomechanical reproduction.

NOBILL, Leopoldo (1784-1835; *WWW, DSB*), Italian physicist; professor of physics at Ducal Museum, Florence; did research into electricity; invented the thermopile which could be used in the measurement of radiant heat; discovered generating colour rings on basis of electrolytic deposits, 1830; studied (with Macedonio Melloni) heat waves, 1831, also developed thermomultiplier.

OWEN, RICHARD (1804-92; *DNB, DSB*), naturalist and leading anatomist of his time; 1st president of Microscopical Society, 1840; 1st Hunterian professor of comparative anatomy and physiology at the Royal College of Surgeons, 1836-56; lectured and wrote on animals dissected at the Zoo, and recent and fossil invertebrates and vertebrates; made distinction between the concepts of "analogy" and "homology" and believed in the production of modern species by degeneration from a divine plan or "archetype"; opposed

to Darwin's *Origin*; his *Memoir of the Gorilla* (1865) and *On the Extent and Aim of a National Museum of Natural History* (1862) were in CD's library.

PAGE, David (1814-70; *DNB*), geologist; "scientific editor" to William and Robert Chambers, 1843; professor of geology at Durham University College of Science, 1873.

PALLEGUOX, DENIS JEAN BAPTISTE (1805-62; *ABF*), missionary and voyager who wrote on Thailand.

PAPIN, Denis (1647-1712; *DSB, WWW*), French chemist; mathematician and physicist; pioneer of the steam engine.

PARKINSON, John (1567-1650, *DNB*), apothecary and botanist.

PARVILLE, Henri de (1838-1909; *UC*), wrote on scientific subjects such as electric engineering and Mars.

PASCAL, Blaise (1623-62; *WWW, DSB*), French mathematician, physicist and natural philosopher; studied mechanical computation, physics and epistemology; obtained the same results as Torricelli about the weight or pressure of the air.

PASSY, Antoine-François (1792-1873; *WWW*), French botanist, member of French Acad. of Sciences, studied geological structure of Europe.

PASTEUR, Louis (1822-95; *DSB, WWW*), French chemist and microbiologist; celebrated for his work on stereo-chemistry, the germ theory of fermentation and disease, and the development of vaccines.

PATTINSON, Hugh Lee (1796-1858; *DNB*), metallurgical chemist; FRS; invented a process for desilverization of lead and patented it, 1833.

PAXTON, Sir Joseph (1801-65; *DNB*), gardener and architect; designed the gardens, and a glass and iron conservatory at Chatsworth, which became the model for the Crystal Palace, 1851.

PAYERNE, P. A. (b. 1806; *ABF*), French inventor.

PEACH, Charles William (1800-86; *DNB*), naturalist and geologist; as a coastguard, discovered many new species of sponges, caelenterates, molluscs, fish and fossils; received the Neill medal from the Royal Society of Edinburgh, 1875.

PELLETIER, Pierre-Joseph (1788-1842; *WWW, DSB*), French chemist, one of the founders of alkaloid chemistry; member of French Acad. of Sciences; made important research in the study of marine invertebrates and in geology; discovered with (Joseph Caventou) strychnine, quinine, brucine and other alkaloids.

PENNANT, Thomas (1726-98; *DNB, DSB*), traveller and naturalist; travelled on the Continent and in Ireland and Scotland; his *British Zoology* (1766) and *History of Quadrupeds* (1781) remained classical works; Gilbert White published *Selborne* in the form of letters to him and Daines Barrington.

PEPPER, John Henry (1821-1900; *DNB*), analytical chemist; professor of chemistry in the Royal Polytechnic institution, London; exhibited the optical illusion known as "Pepper's Ghost"; wrote general scientific books, such as *The Boy's Playbook of Science* (1860) *Cyclopaedic Science Simplified* (1869), *Scientific Amusements for Young People* (1861), *The True Story of the Ghost; and All about Metempsychosis* (1890).

PERRY, Stephen Joseph (1833-89; *WWW*), French astronomer; made magnetic surveys of France and Belgium, 1868-71; teacher of physics and mathematics, Stonyhurst, 1860.

PHILPEAUX, Raymond (b. 1823; *UC*), writer on medical science.

PHIPSON, Thomas Lambe (1833-1908; *ABF, UC*), French chemist and naturalist; member of the chemical Society of Paris.

PIDDINGTON, Henry (1797-1858; *DNB*), meteorologist, commander in the mercantile marine; curator of the Museum of Economic Geology in Calcutta; accumulated important data for determining the course of storms at sea.

PILÂTRE DE ROZIER, Jean François (1756-85; *ABF*) French astronaut.

PLAYFAIR, Sir Lyon, first Baron Playfair of St Andrews (1818-98; *DNB*), Scottish chemist; FRS; took part in organising the Great Exhibition in 1851; secretary for science

to the department of Science and Art, 1853; professor of chemistry at Edinburgh; helped to establish the Royal College of Science and the South Kensington Museum; promoted scientific education, and encouraged industry to make use of scientific advances.

PORRO, Ignazio (1795-1875; *WWW, DSB*), Italian physicist; built reflector micrometer with visible threads, helioscope, speedometer for mine use.

POUCHET, Félix-Archimède (1800-72; *WWW, DSB*), French biologist and natural historian; studied botany, anatomy and physiology; a prolific author on botany, zoology, physiology, and microbiology.

PRICE, James (1752-83; *DNB*), chemist, professed to be able to convert mercury into gold and silver, but in 1783 failed to repeat his experiments and committed suicide.

PRIESTLEY, Joseph (1733-1804; *DNB, DSB*), experimental chemist; the "discoverer" of oxygen, theologian, and educationist; also discovered other gases such as ammonia, sulphur dioxide, carbon monoxide, hydrochloric acid, nitric oxide and hydrogen sulphide; FRS.

PRINGLE, Sir John, baronet (1707-82; *DNB, DSB*), Scottish physician and reformer, elected president of the Royal Society, 1772; his contribution was mainly in the reform of military medicine and sanitation; his *Observations on the Diseases of the Army* (1752) became a military classic.

PRIOR, Richard Chandler Alexander (1809-1902; *UC*), wrote on popular names of plants.

PROCTOR, Richard Anthony (1837-88; *DNB, DSB*), astronomer; abandoned law for science; studied astronomy and mathematics; founded a scientific periodical, *Knowledge*, 1881.

PROUT, William (1785-1850; *DNB, DSB*), chemist and physician who formulated Prout's Hypothesis that all atomic weights are whole numbers; one of the pioneers of physiological chemistry; discovered free hydrochloric acid in the stomach, 1823.

QUATREFAGES DE BRÉAU, Jean Louis Armand de (1810-92; *WWW, DSB*), French naturalist and ethnologist, member of French Acad. of Sciences, 1851, professor of anthropology and ethnography at the Museum of Natural History, Paris, 1855.

QUÉTELET, Lambert-Adolphe-Jacques (1796-1874; *WWW, DSB*), Belgian statistician and astronomer; lecturer at Museum of Science and Literature, professor of mathematics at the Brussels Athenaeum, 1819; professor of astronomy at the Military School, 1836; head and founder of Royal Observatory; wrote *Sur l'homme* (1835, trans. *A Treatise on Man and the Development of His Faculties*, 1842) in which he showed the use that may be made of the theory of probabilities as applied to the "average man"; he advocated the use of statistics to formulate social laws but his views on the mathematical theory of statistics is thought to have been slight, and his methods unsophisticated.

RAMSAY, Sir Andrew Crombie (1814-91; *DNB, DSB*), geologist; President of the Geological Society, 1862-4; professor of Geology at University College, London; FRS.

RASPAIL, François-Vincent (1794-1878; *WWW, DSB*), French chemist; used camphor as an antiseptic in 1845.

RAY, John (1628-1705; *DNB, DSB*), naturalist, botanical and zoological systematist; attempted a systematic description of plants and insects.

RÉAUMUR, René-Antoine Ferchault de (1683-1757; *WWW, DSB*), French naturalist, physiologist, physicist, mathematician and technologist; member of French Acad. of Sciences; investigated the application of science to industry; researched the technology of iron and steel; made fabric from spiders' silk and wrote about it; his thermometer of 1731 used a mixture of alcohol and water instead of mercury, calibrated with a scale 80 degrees between the freezing and boiling points of water.

REICHENBACH, Karl (or Carl) Ludwig (1788-1869; *WWW, DSB*), German natural philosopher on chemistry and speculative science; in 1844 absurdly believed to have discovered "Od," an universal force intermediate between electricity, magnetism, heat and

light and recognizable only by the nerves of sensitive persons; his pamphlet, *Researches on Magnetism and on Certain Allied Subjects*, was in CD's library.

REID, Sir William (1791-1858; *DNB*), major-general and colonial governor; entered the royal engineers, 1809; while in the West Indies, 1831-4, developed the circular theory of hurricanes; wrote also on military subjects.

RICHARDSON, Sir John (1787-1865; *DNB*), Arctic explorer and naturalist; surgeon and naturalist to Franklin's polar expedition, 1819; FRS; physician to the Royal Hospital at Haslar from 1838, published works on ichthyology of the Indo-Pacific region especially and polar exploration.

RIDDLE, Edward (1788-1854; *DNB*), mathematician and astronomer; mathematical master at the Royal Naval Hospital, Greenwich, 1821-51

RIVERS, Thomas (1798-1877; *DNB*), nurseryman; especially noted for his collection of roses at Sawbridgeworth.

ROBBERDS, John Warden (*UC*), Norfolk writer who wrote on the country's geology, 1826.

ROBINSON, Sir Tancred (d. 1748; *DNB*), physician and naturalist; FRS; wrote on natural history.

ROCHFORT, Charles de (1604-83; *ABF*), naturalist and voyager.

ROMAIN, Pierre Ange (d. 1785; *ABF*), aeronaut.

RONDELET, Guillaume (1507-66, *WWW, DSB*), French naturalist and physician.

ROSIER, Jean F. Pilâtrede, see **PILÂTRE DE ROZIER, Jean François**.

ROSS, Sir John (1777-1856; *DNB*), Arctic navigator; published works on nautical subjects.

ROSSE, third Earl of, William PARSONS (1800-1867; *DNB, DSB*), astronomer, commenced experiments for improving the reflecting telescope, 1827; began to make his observations with his great telescope erected at Parsonstown in King's County, 1845; discovered spiral nebulas; president of the Royal Society, 1848.

RUSSELL, Patrick (1727-1805; *DNB*), physician and naturalist; FRS; botanist to East India company in Carnatic, 1785-9.

SABINE, Edward (1788-1883; *DNB*), geophysicist.

ST. JOHN, Charles George William (1809-56; *DNB*) sportsman and naturalist; devoted himself to sport, chiefly in Scotland.

SAMUELSON, James (b. 1829; *UC*), miscellaneous writer on natural history; edited *The Journal of Science and Annals of Astronomy, Biology, Geology, Industrial Arts, Manufactures and Technology*, 1864-85.

SANTORIO, Santorio (1561-1636; *WWW, DSB*), Italian physician; professor of theoretical medicine, Padua; introduced balance thermoscope with scale, pulsimeter into medical practice; laid foundation of modern study of metabolism; inventor of string hygrometer, pulsimeter, and instrument for extracting stones from bladder.

SAUSSURE, Horace Bénédict de (1740-99; *DSB*), Swiss physicist and geologist; professor of physics and philosophy at Geneva, 1762-88; travelled in Germany, Italy and England, and crossed the Alps by seven routes and ascended Mont Blanc, 1787; wrote *Voyages dans les Alpes* (1779-96) describing his observations on mineralogy, geology, botany and meteorology.

SCHEINER, Christoph (1575-1650; *WWW*), astronomer, discovered (independently of Galileo) sunspots, 1611; inventor of refracting telescope and parallactic machine; improved helioscope; supported theory of stable earth with moving sun; researched on physiology of vision.

SCHLEIDEN, Jacob Mathias (1804-81; *WWW, DSB*), German botanist; followed further the ideas of Robert Brown on the nucleus and arrived at his theory of free-cell formation and the conclusion that cells developed from nuclei and then became encased in cell walls.

SCHWANN, Theodor Ambrose Hubert (1810-82; *WWW, DSB*), German botanist; famous for his development of a "cell theory"; recognised egg as cell, 1838; demonstrated that all organisms were constructed of cells with individual limited life span.

SCORESBY, William (1789-1857; *DNB*), mariner; FRS; made extensive observations of natural phenomena in the Arctic.

SCOUTTETEN, Henri (1799-1871; *UC*), French physician; wrote on medicine.

SEDGWICK, Adam (1785-1873; *DNB*), geologist; professor of geology at Cambridge; president of Geological Society, 1831; founder of the Cambrian system; .

SELLA, Quintino (1827-84; *WWW*), Italian crystallographer; professor of mineralogy and a member of Royal Academy of Science; drew up accurate geological map of Biella region.

SHARP, Samuel (1814-82; *DNB*), geologist; wrote on geology and antiquities.

SIMON, John (1816-1904; *DNB*), pathologist and sanitary reformer; surgeon at St. Thomas's Hospital, the chief medical officer to the General Board of Health, 1855-58, and of the Privy Council under Public Act, 1858-71; demonstrated the advantages of compulsory smallpox vaccination.

SIMPSON, Edward (1815-80; *Boase*), geologist and surgeon; collected fossils and forged flints and antiquities; well-known as Flint Jack.

SIMPSON, Sir James Young, first baronet (1811-70; *DNB*), Scottish obstetrician and pioneer of anaesthesia; made important contributions to science of obstetrics; his *Five Pamphlets on Anaesthetics* were in CD's library

SISMONDI, Jean Charles Leonard Simonde de (1773-1842; *WWW*), French economist and historian.

SLOANE, Sir Hans (1660-1753; *DNB*), British physician and naturalist; physician to the governor of Jamaica, 1685-86 and collected a herbarium of 800 species; the secretary to the Royal Society, 1693-1713; founded the Chelsea Physic Garden in 1721.

SMEATON, John (1724-92; *DNB*), civil engineer; FRS; studied canal and harbour systems of Holland, 1754; constructed Eddystone lighthouse and bridges.

SMEE, Alfred (1818-77; *DNB*), surgeon interest in chemical and electrical science; FRS; invented "Smee's battery" (Zinc and silver in sulphuric acid) largely employed for commercial purposes and wrote *Elements of Electro-Biology* (1849) and *Instinct and Reason* (1850) on electrical physiology; devoted to horticulture.

SMITH, Sir Andrew (1797-1872; *DNB*), director-general, Army Medical Department; wrote on zoology of South Africa.

SMITH, Angus (18??), Manchester chemist.

SMITH, Southwood (1788-1861; *UC*), writer on animal physiology, epidemics and sanitation.

SMYTH, Charles Piazzi (1819-1900; *WWW, DSB*), astronomer born in Italy; astronomer royal for Scotland, and professor of practical astronomy at Edinburgh University, 1845-88; FRS; member of Royal Astronomical Society.

SOMERVILLE, Mary née Fairfax (1780-1872; *DNB, DSB*), Scottish scientific writer; was in intellectual and scientific circles in London from 1816, and corresponded with foreign scientists; wrote on the spectrum, Laplace, and several expository works on science; supported the emancipation and education of women.

SOUBEIRAN, Eugène (1797-1858; *WWW*), French pharmacologist; professor of school of pharmacy, Paris; discovered (independently of Liebig) Chloroform, 1831.

SOWERBY, John Edward (1825-79; *DNB*), botanical draughtsman; illustrated botanical works, and brought out an *Illustrated Key to British Wildflowers*, 1865.

SPALLANZANI, Lazzaro (1729-99; *DNB*), Italian biologist and naturalist; professor of Mathematics and Physics at Reggio University; held chair of natural history at the University of Pavia; did various experiments on subjects such as digestion, reproduction in animals, respiration and wrote monographs on natural history and experimental biology; disapproved the theory of spontaneous generation.

STANLEY, Edward (1779-1849; *DNB*), bishop of Norwich, lectured on geology; advocated Church reform, 1831.

STEVENSON, Alan (1807-65; *UC*), engineer; wrote on the construction of lighthouses.

STEPHENSON, George (1781-1848; *DNB*), inventor and founder of railways; designed safety lamps, 1815; vice president of mechanical science section, British Association, 1838; first president of Institution of Mechanical Engineers, 1847.

STEPHENSON, Robert (1803-59; *DNB*), civil engineer, the only son of George Stephenson; built the bridge over the Dee, railway bridges, the Britannia bridge over the Menai Straits, another at Conway, some in Egypt, and the Victoria tubular bridge over the St Lawrence at Montreal.

STEWART, Dugald (1753-1828; *DNB*), Edinburgh philosopher, held the Glasgow chair of moral philosophy; taught mathematics in Edinburgh; wrote *Elements of the Philosophy of the Human Mind*, 3 vols. (1792), the 3rd ed. (1843) of which was in CD's library.

STOKES, George Gabriel (1819-1903; *DNB, WWW*), mathematician and physicist; studied the behaviour of fluids and the phenomenon of fluorescence; examined principles of polarisation; worked on concept of luminiferous ether; pioneer in spectrum analysis; sought to determine chemical composition of sun and stars.

STRAUSS, Gustave Louis Maurice (1807?-87; *DNB*), miscellaneous writer, chemist, politician, dramatist and surgeon, born in Lower Canada, obtained a doctorate in Berlin, assistant surgeon in the French army, banished from France for having supported the revolution, and came to London in 1839, well-known as "the Old Bohemian"; one of the founders of the Savage Club in 1857, and editor of the *Pharmaceutical Times*.

SWAINSON, William (1789-1855; *WWW, DSB*), naturalist and bird illustrator; travelled in Brazil, 1817-1818; with the new technique of lithography, he produced *Zoological Illustrations*, 3 vols. (1820-23), *Naturalist's Guide* (1822), *Exotic Conchology* (1822), 11 vols. for Lardner's *Cabinet Cyclopaedia* (1830-44) and 3 vols. for Jardine's *Naturalist's Library* (1833-45).

SWAMMERDAM, Jan (1637-80; *WWW, DSB*), Dutch naturalist; studied circulatory system; made pioneering use of microscope; investigated in detail insect microanatomy and habits, and classified them; considered as the founder of modern entomology.

SYMINGTON, William (1795-1862; *DNB*), engineer; improved steam-engine, 1787; devised the first steam-boat for practical use, 1802.

TALBOT, William Henry Fox (1800-77; *DNB, DSB*), inventor of the negative/ positive process of photography, and mathematician; patented photoglyphy in 1852, a method of photo-etching on steel or copper plates.

TAYLOR, Alfred Swaine (1806-80; *DNB*), medical jurist, much consulted as a witness in criminal investigations in cases of suspected murder by poison; advocated the adoption of a system of experts as assessors whose independence would make them impartial.

TELFORD, Thomas (1757-1834; *DNB*), civil engineer who built canals, roads and bridges; first president and one of the founders of the Institute of Civil Engineers, 1818.

TEMPLETON, John (1766-1825; *DNB*), naturalist; member of the Linnean Society, Belfast Society for Promoting Knowledge, and Belfast Natural History Society; worked on natural history, his collection of mosses and lichens being very extensive.

THOMÉ DE GAMOND, Aimé (1807-75; *UC*), French engineer.

THOMPSON, John Vaughan (1779-1847; *DNB*), zoologist, surgeon and medical inspector; studied extinct birds, and made discoveries of the feather-star, polyza, barnacles, and crustacea.

THOMSON, Spencer (1817-86; *UC*), medical doctor; wrote *British Cholera, Its Nature and Cause Considered in Connection with Sanitary Improvement* (1848).

THOMSON, William, Baron Kelvin (1824-1907; *DNB, DSB*), scientist and inventor; formulated the two great laws of thermodynamics between 1851-54; FRS; experimented on electric telegraph cables, 1854; president of Society of Telegraph Engineers, 1879; president of mathematical and physical section of British Association at Glasgow, 1876; president of the Royal Society, 1890-94; chancellor of Glasgow University, 1904.

TIMBS, John (1801-75; *DNB*), the editor of *Mirror of Literature* (1827-38), and *Literary World* (1839-40). He organised the Year-Book of science and art (1839), and was the sub-editor of *Illustrated London News* (1842-58).

TITIUS (TIETZ), Johann Daniel (1729-96; *DSB*; *WWW*), German astronomer and biologist; professor of physics, University of Wittenberg, and its rector, 1768; formulated the law governing the distances between the planets and the sun; systematically classified plants, animals, minerals and the elemental substances.

TORRICELLI, Evangelista (1608-47; *WWW*, *DSB*), Italian physicist and mathematician, discovered the principle of the barometer; invented method of drawing tangents.

TOUSSENEL, Alphonse (1803-85; *ABF*), French journalist and popular science writer.

TREVITHICK, Richard (1771-1833; *DNB*), pioneer of steam traction and "father of the locomotive engine"; improved steam engine; made a double-acting water-pressure engine, 1800; completed first steam-carriage to carry passengers at Redruth, 1801.

TYNDALL, John (1820-93; *DNB*, *DSB*), professor of natural philosophy at Royal Institution; made important investigations in Penrhyn slate-quarries and conducted researches into radiant heat, sound, and light.

URE, Andrew (1778-1857; *DNB*, *DSB*), Scottish chemist and scientific writer, analytical chemist in London, 1830-57.

VALENTINE, MICHAEL BERNHARD (1657-1729; *WWW*), German physician; wrote on medicine, natural history, physics; described properties and artistic and medical uses of minerals, plants and vegetable products, and animals; discussed collections of natural history and art objects, rare plants, animals, birds and fossils.

VERNE, Jules (1828-1905; *UC*), French author of science fiction.

VILMORIN, Pierre Louis François Leveque de (1816-61; *DSB*), the president of the distinguished Paris seed firm Vilmorin-Andrieuxet Cie; conducted research on strawberries.

WALKER, Charles Vincent (1812-82; *DNB*), electrical engineer for the South-Eastern Railway, 1845-82; designed equipment for communication between train passengers and the guard, and other devices for railway signals; introduced improvements in telegraphy.

WALKER, Mary Edwards (1832-1919; *DAB*), physician, woman's rights advocate; assistant surgeon in the army, 1864; practised in Washington, D. C.

WARTMANN, Elie (1817-86; *UC*), professor of Natural Philosophy in the Academy of Lausanne; wrote on electricity, natural history of Geneva, scientific apparatus and instruments and telegraph.

WATERSTON, John James (1811-83; *UC*), wrote on mental functions.

WERTON, CHARLES (1782-1865; *DNB*), naturalist travelled widely abroad; turned his estate in Walton Hall, Yorkshire into a bird sanctuary; wrote on birds and wild animals; his *Essays on Natural History* (1838) and *Wanderings in South America* (1852) were in CD's library; mentioned in D's Preface of *BR*.

WATSON, Sir William (1715-87; *DNB*; *DSB*), physician and one of the early experimenters on electricity; FRS; he was the first to investigate the passage of electricity through a rarefied gas and proved that the electric fluid takes the shortest course, passing through the substance of the best medium of connection and not always on its surface.

WATT, James (1736-1819, *DSB*), Scottish engineer and inventor; mathematical instrument maker, 1757-63; repaired a Newcomen engine, 1763-64 and hit on the expedient of the separate condenser; made improvements in air pump, steam jacket for cylinder, and double-acting engine; a unit of power, the watt, is named after him.

WEBB, Philip Barker (1793-1854; *DNB*), botanist; FRS; made natural history collections in countries including Spain, Portugal, Morocco, Canary Islands.

WECKIR, Hans Jacob (1528-86; *UC*), writer on poison, medicine and natural history.

WELLS, Horace (1815-48; *DAB*), American dentist.

WHEATSTONE, Sir Charles (1802-75; *DNB*, *DSB*), physicist and inventor; professor of experimental physics in King's College, London, 1834; worked on sound and light;

suggested the stereoscope and invented the sound magnifier; collaborated with Sir William Fothergill Cook in producing and improving electric telegraph instruments; FRS; remembered for contributions to acoustics and electric telegraphy.

WHEWELL, William (1794-1866; *DNB*), professor of mineralogy at Cambridge, and of moral theology; Vice-Chancellor of Cambridge; his *Bridgewater Treatise: Astronomy and General Physics* (1852) was in CD's library.

WHITE, Gilbert (1720-93; *DNB, DSB*), naturalist; his works on natural history, including *Selborne* (1789) and the *Naturalist's Calendar* (1795) which had been frequently reissued; a copy of the 1825 ed. of *Selborne* was in CD's library.

WHITWORTH, Sir Joseph, first baronet (1803-87; *DNB*), engineer and inventor; exhibited many tools and machines at the Great Exhibition, 1851; invented a gun of compressed steel, with spiral polygonal bore, 1859; founded Whitworth Scholarships for encouraging engineering science.

WILKINS, John (1614-72; *DNB, DSB*), bishop of Chester and scientist; centre of group of men who formed Royal Society, 1662 and first secretary; master of Trinity College, Cambridge; anonymously published his first work, *The Discovery of a World in the Moon* (1638).

WILLIAMS, Charles James Blasius (1805-89; *DNB*), physician; MD, Edinburgh, 1824; FRS; professor of medicine and physician to University College, London, 1839; took part in founding Consumption Hospital, Brompton, 1841.

WILLIAMSON, Alexander William (1824-1904; *DNB, DSB*), chemist; professor of practical chemistry at University College London, 1849-87; President of the Chemical Society and of the British Academy, 1873; remembered for his ether synthesis which first clarified the relationship of alcohols and ether; FRS.

WILSON, Alexander (1766-1813, *DSB*), Scottish ornithologist.

WILSON, Edward (1814-78; *DNB*), Australian politician; conducted the *Argus*, 1847-64; engaged in journalism at Melbourne; founded Acclimatization Society of Victoria, 1861.

WILSON, George (1818-59; *DNB*) Scottish physician and chemist; president of the Royal Scottish Society of Arts; director of the Scottish Industrial Museum; professor of Technology, Edinburgh; FRSE; suggested the extreme importance of testing railwaymen and sailors for colour blindness in his *Researches on Colour-Blindness* (1855), after which the Great Northern Railway immediately adopted his suggestions.

WILSON, William (1799-1871; *DNB*), botanist; articled to solicitors in Manchester, but under William Hooker's influence turned to study botany, and became a well-known bryologist; wrote *Magnum Opus* (1855), the "Bryologia Britannica," and went on to add over 100 new species of British mosses to the list before his death.

WINSOR (or WINZOR), Frederick Albert (1763-1830; *DNB*; *WWW*), German pioneer of gas-lighting; obtained patents for an "oven" for the manufacture of gas, 1804, and for a gas furnace and purifier, 1807; he was allowed to illuminate a wall of Carlton House garden in celebration of the King's birthday in 1807; founded a gas-lighting company in Paris, 1815.

WITHERING, William (1741-99; *DNB*, *DSB*), physician, botanist and mineralogist; MD, Edinburgh, 1766; FRS.

WÖHLER, Friedrich (1800-82; *WWW*, *DSB*), German chemist, notable for his recognition (with Justus von Liebig) of the benzoyl radical, and for his discovery of the isomerization of ammonium cyanate into urea.

WOLF, Josef (1820-99; *DNB*), animal painter; employed in the British Museum, and illustrated books on birds, and publications of the Zoological Society.

WOLLASTON, William Hyde (1766-1828; *DNB*, *DSB*), physiologist, chemist and physicist, pioneer of power metallurgy, discoverer of rhodium and palladium; secretary of

the Royal Society, 1804-16; published on pathology, physiology, chemistry, optics, mineralogy crystallography, astronomy, electricity, mechanics and botany; FRS.

WOODS, Thomas (1815-1905; *UC*), M. D., wrote *The Monster Telescope Erected by the Earl of Rosse, Parsonston, with An Account of the Manufacture of the Specula and Full Description of All the Machinery Connected with These Instruments*.

YARRELL, William (1784-1856; *DNB*) zoologist; as a newsagent by trade, turned his attention to ornithology and studied zoology systematically; member of Royal Institution, 1817; original member of Zoological Society, 1826; edited White's *Selborne*; wrote a *History of British Fishes* (1836), and a popular history of *British Birds* (1837-43) which was for long a standard text.

YATES, James (1789-1871; *DNB*), Unitarian minister at Glasgow (1812-17), but never ordained. He was a founder of British Association for Advancement of Science (1831). He became a strong advocate of the decimal system, and published many tracts on this subject.

YOUL, Sir James Arndell (1811-1904; *DNB*), Tasmanian colonist; successful agriculturist; induced British government to establish mail service to Australia.

YOUNG, James (1822-83; *DNB*), Scottish chemist and originator of Paraffin industry; set up a small oil refinery at Alfreton, Derbyshire to exploit an oil seepage in a disused coal mine, 1848; joined with Edward William Binney and Edward Meldrum to manufacture naphtha and lubricating oil from oil shale. The plant began producing paraffin oil and solid paraffin in 1856, following Young's discovery that low-temperature distillation of shale yields the maximum amount of these products.

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