PIGMENTATION OF THE HAIR AND EYES

of

CHILDREN SUFFERING FROM THE ACUTE FEVERS

its

EFFECT ON SUSCEPTIBILITY, RECUPERATIVE POWER

and

RACE SELECTION

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INTRODUCTION

During the last half century considerable interest has been taken in and observations made upon the pigmentation of the hair and eyes in man, primarily with regard to the geographical distribution and race elements of the various colour classes.

Shortly after the close of the Franco-Prussian war, Virchow, during a controversy on the racial elements in Germany, induced the German government to authorize an official census of the colours of the hair and eyes of school children throughout the Empire. This seems to have been the first pigmentation survey attempted on a large scale. Later observers have, with modifications, adopted Virchow's methods. In course of time there followed pigmentation surveys of school children in most of the continental countries, and statistics of great extent and value have been accumulated and published. Prior to Virchow, Beddoe had been making personal observations and collecting data from all over the continent. It was not until 1885, however, that he published his

great work[1] on the colour of the hair and eyes, based on personal observations on the adult populations in several districts of the United Kingdom and on the Continent. In connection with these surveys other names might well be mentioned, as Guillame in Switzerland and Ranke in Germany, but the extent of interest taken in the pigmentation of the hair and eyes has been sufficiently indicated.

Pigmentation, however, has been found to have a further importance than merely the separation of race elements. It has been associated with vitality under different conditions and also with disease. Darwin[2] states that complexion and liability to certain diseases are believed to run together in man and the lower animals. Thus, white terriers suffer more than terriers of any other colour from the fatal Distemper. In Virginia white pigs perish from eating certain roots which dark pigs can eat without injury. White chickens are more subject than dark coloured chickens to certain parasitic worms. In cattle susceptibility to the attack of flies is correlated with colour, as also is the liability to be poisoned by certain plants, the white varieties

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(1) Beddoe, The Races of Britain

(2) Darwin, Variation of Animals under Domestication Vol. II, p. 227

suffering most severely.[1] Certain forms of blindness seem to be associated with the colour of the hair: a man with black hair and a woman with light coloured hair, both of sound constitution, married, and had nine children, all of whom were born blind: of these children, five with dark hair and brown iris were afflicted with amaurosis: the four others, with light coloured hair and blue iris, had amaurosis and cataract combined.[2]

Then again the tubercular child is loosely recognized by certain features, including the quality of the skin, the brightness of the eyes and the length and pigmentation of the eyelashes.

Beddoe states that phthisis and cancer are more prevalent among dark-haired persons.[3] Tocher has shown[4] that on an average more persons become insane in parts of Scotland where there is an excess of light-eyed persons in the population, and in a much less degree where there is an excess of dark-haired persons. Lunacy, he states, is distinctly correlated positively to light eyes and in a much less degree to dark hair, and is dis-

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(1) Darwin, Origin of Species, p. 236

(2) Darwin, Variation of Animals under Domestication Vol. II, p. 328

(3) Beddoe, Races of Britain, p. 224

(4) Tocher, Anthropometry of Scottish Insane Biometrika, Vol. V, p. 344

tinctly correlated negatively to red hair, and in a lesser degree to dark eyes. That there is thus a greater tendency to insanity among light-eyed and dark-haired persons, and a lesser tendency to insanity among red-haired and dark-eyed persons, compared in both cases with the general population. He goes on to say that these are only statistical facts, and offers no explanation as to how or why presence or absence of pigment comes to be associated with insanity. When he extended his inquiry(1) to discover whether the excess of any particular hair or eye colour is associated with physical or mental defects such as blindness, deafness and imbecility, he found that the distribution of cases of mental affection differs from that of the last three classes, namely, that excesses in the number of cases of imbecility, blindness and deafness, occur in the region of excesses of blue eyes and of dark and jet black hair.

It is well known that in the lower animals pigmentation has an important function. It seems, especially in the organs of sense, to be essential to their full development. Albinoes in all species are apt to be defective in keenness of sense. Darwin gives numerous examples of the defective senses of such non-pigmented animals.

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(1) Tocher, Pigmentation Survey of School children in Scotland, Biometrika, Vol. VI, p. 198

White cats with blue eyes, he states, are almost always deaf. He cites a remarkable case, in which the iris at the end of four months began to grow dark coloured, and then for the first time the cat began to hear.[1] Histological examinations have shown that in the internal ear of such cats the walls of the perilymph chamber lack pigmentation. In a recent histological examination[2] of a case of albinism, in a child aged ten weeks, no abnormality was found save a complete absence of pigment in the brain, eyes, internal ear, suprarenal gland, skin and hair. Commenting on this case, Pearson[3] makes an interesting suggestion. He remarks that the disappearance of superficial pigment is one of the marks of senility, that it affects the hair and eyes alike. Is it possible, he asks, that this loss of superficial pigment can ever be accompanied by a loss of internal pigment, possibly in the case of the brain centres. Senile imbecility, and in its milder form senility, might possibly be associated with a weakening of the intensity of pigmentation in certain of the brain centres. Is it con-

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(1) Darwin, Variation of Animals under Domestication Vol II, p. 329

(2) J. E. Adler and J. MacIntosh, Histological Examination of a Case of Albinism, Biometrika Vol. VII p. 237

(3) Pearson, Note on Internal Albinism Biometrika, Vol VII, p. 246

ceivable that any forms of imbecility are associated with defective brain pigmentation? Ophthalmoscopic investigation shows a high percentage of incomplete albinism of the eye in the insane. Pearson also suggests that the lack of pigmentation in the internal ear as shewn in the albinotic cat might possibly be associated with deafness.

This association of pigmentation with certain classes of disease seems not unreasonable when it is considered that the ectoderm gives rise not merely to the hair and epidermis, but also to the whole central and peripheral nervous system and other important structures.

The endogenous pigments of the body may be divided into two groups, haemoglobin and its derivatives and other metabolic pigments. The former is outside the scope of this investigation; of the latter the most important group is the melanins. These are dark, black or brown and reddish brown pigments, and exist normally in the hairs, the choroid coat of the eye, the deeper cells of the malphigian layer of the skin, in the chromatophores of the upper layers of the corium and also in the membranes of the brain, especially in the neighbourhood of the choroid plexus. The normal production of melanin in members of the human family has its extremes represented by the fair-haired Saxon and the swarthy

negro. The differences in colour here are due, not to the presence or absence of the cells themselves, but to variations in the amount of pigment therein deposited. In this respect, therefore, the negro differs physiologically rather than anatomically from the European.

A physiological increase in the pigmentation is observed also in pregnant women, even among the fair, and is most marked in brunettes; a similar pigmentation is observed in many cases of exophthalmic goitre and in certain neurotic states. What is regarded as a pigmentation of the same order is met with in Addison's disease. This condition is generally held to be an affection of the abdominal sympathetic system, induced most commonly by disease of the suprarenal bodies. The medulla of the suprarenal body is produced by an ingrowth of cell groups derived from the sympathetic system: these cell groups are derived from the ectoderm. It would seem that in general there is some close connection between pigmentation and the ectoderm, and although pigment is found in certain mesoblastic structures, such as the choroid and stroma of the iris in the eye, the cells of the perilymphatic spaces in the internal ear and the cortex of the suprarenal body, yet even these are closely associated with the ectoderm, and it might be ultimately found that the pigmented cells are ectodermal in

origin. The case of complete albinism already referred to is open to this interpretation; certainly the majority of these normally pigment containing structures are ectodermal in origin, and it might be concluded that the ectodermal derivatives are the chief pigment producing structures in the body. Tocher's findings regarding the relation of pigmentation to insanity suggest an etiological association in this connection, the hair and brain both being ectodermal structures.

From general observation it must be concluded that there is some association between the colour of the hair and the type of skin in the individual. The fresh complexion, easily freckled, met with in red-haired, and the olive and more sallow skin occurring in dark-haired persons, are well known. If we have this association between the colour of the hair and the skin, one of the chief excretory organs of the body, it might reasonably be expected that some definite relationship could be found between pigmentation and the ability to withstand disease. Beddoe found that, in his experience as a physician, on the whole, dark-complexioned children showed more tenacity of life than fair ones.(1)

The same author remarks(2) that pale shades in the

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(1) Beddoe, The Races of Britain, p. 223

(2) " " " " " p. 224

hair, and in the eyes also, are the results of a defect of secretion, but that it does not necessarily follow that they are a mark of weakness. Several facts, however, might point in that direction, such as the physical and constitutional inferiority of albinoes, the comparative lightness of the hair of children and the changes which take place in disease, which are generally in the direction of dulness and paleness of hue.

Brownlee[1] found that the Jewish children in Glasgow exhibited a considerable susceptibility to scarlet fever and diphtheria, associated with a high degree of recuperative power.

Ripley,[2] commenting on the large proportion of dark-haired and dark-eyed persons in the continental towns, states that it is not improbable that there is in the dark hair and eye some indication of vital superiority, for it requires energy and courage, physical as well as mental, not only to break the ties of home, but also to maintain one's self afterwards under the stress of city life. After discussing the defects of sense in albinoes he goes on to say that these facts tend to justify the conclusion that pigmentation, if not absolutely necessary,

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(1) Brownlee, Report of the City of Glasgow Fever and Smallpox Hospitals, Belvidere, 1906

(2) Ripley, The Races of Europe, p. 557

at least conduces to acuteness of sense, and that when abundantly present is often an index of vitality. He sums up by stating that the tendency of present knowledge certainly points in the direction of some relation between pigmentation and general physiological and mental vigour. On the other hand, it cannot be forgotten that many conquering and ruling races have been fair, and have subdued races which have been dark. To mention only a few, the Goths, Angles, Norsemen and Saxons, were all dominant races in their time. From the observation of a million soldiers of mixed nationalities in the American Federal Army, Baxter[1] formed the opinion that although nations of superior stature exhibit a majority of blondes, yet in detail among themselves the dark-complexioned exhibit a slight superiority in stature and girth of chest over the fair complexioned.

He concludes that stature depends on race and not upon complexion and that it does not appear that any recognizable relation exists between circumference of chest and stature when complexion is made the basis of classification. On the other hand[2] when the various

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(1) Baxter, Statistics, Medical and Anthropological, of the Provost Marshal General's Bureau, Washington, 1875, Vol. II, p. 24

(2) Baxter, Statistics, Medical and Anthropological, of the Provost Marshal General's Bureau, Vol. I, p. 72

and numerous diseases and injuries for which recruits were rejected are considered in regard to complexion, he finds that almost without exception men of light complexion were more affected than those of dark. He states that, in regard to this almost invariable rule applying to complexion, the fact is submitted without comment. Ripley[1] gives Baxter as his authority for stating that the brunette type, on the whole, opposed a greater resistance to disease and offered more hope of recovery from injuries in the field. Boudin[2] states that, in the French army which invaded Russia, soldiers having a dark complexion, from the southern parts of Europe, withstood the intense cold better than those with lighter complexions from the north. He remarks that this fact is contrary to the opinion generally held.

Darwin[3] states that the colour of the skin and hair is sometimes correlated in a surprising manner with a complete immunity from the action of certain vegetable poisons and from the attacks of certain parasites. After discussing the immunity of the negro from the yellow

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(1) Ripley, Races of Europe, p. 558
The latter statement I cannot find in the pages referred to by Ripley, nor indeed in any of Baxter's records

(2) Boudin, Traite de Geographie Medicales, Tom. I, p. 406

(3) Darwin, Descent of Man, p. 193

fever so destructive in tropical America, and from the fatal intermittent fevers that prevail in parts of the African coast, he says that it is a mere conjecture that this immunity is in any degree correlated with the colour of the skin. The conjecture, however, seemed to him not improbable, and he obtained permission to transmit tables to the surgeons of the various regiments on foreign service asking for particulars of the colour of the hair of all the men in their regiments and also of those who suffered from the various tropical fevers. In this way he hoped to find out whether any relation existed between the colour of the hair and constitutional liability to tropical diseases. Unfortunately he received no returns, and at present there exists great divergence of opinion as to whether light-haired persons with florid complexions or dark-haired persons with sallow complexions suffer less from the diseases of tropical countries.

With a view to ascertaining how far any of these statements or suggestions could be justified in the case of some of the acute fevers, and also to find if any one pigmentation type was more liable to one or any of these fevers than another, the present inquiry was begun. This inquiry was made possible by comparison by the publication of a pigmentation survey of school children

in Scotland in 1908.[x]

METHODS OF OBSERVATION

Four of the acute fevers, scarlet fever, diphtheria, measles and whooping cough, have been chosen on which to make these observations. The material to work upon has been collected in The Glasgow Corporation Fever Hospitals, mainly at Ruchill during the past year, 1909-10, and for a few months previously at Belvidere. The colours of the hair and eyes of children suffering from these diseases were carefully noted on admission to hospital by the physician under whose charge they came. These cases in every instance were consecutive, and every case entering hospital was recorded except for a short period during which the observations were interrupted by sickness on the medical staff. No selection was made. Tocher's analytical Tables for hair and eye colours, which are here appended, were closely followed:-

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[x] J. F. Tocher, Pigmentation Survey of School Children in Scotland, Biometrika, Vol. VI, p. 129

ANALYTICAL TABLE FOR HAIR COLOURS

<table>
<tr><td><u>Red</u></td><td colspan="3">Not red
The hair is not red. It is either fair, brown or dark</td></tr>
<tr><td></td><td><u>Fair</u></td><td colspan="2">Not fair</td></tr>
<tr><td>The hair is red; either light red, bright red or dark red All colours which approach more to red than to brown or flaxen</td><td>The hair is fair, that is white flaxen, or golden yellow only. (A very light brown may be included here)</td><td colspan="2">The hair is not fair. It is brown (medium) or dark</td></tr>
<tr><td></td><td></td><td><u>Medium</u></td><td><u>Dark</u></td></tr>
<tr><td></td><td></td><td>The hair is chestnut brown, brownish, or is neither red, fair nor dark</td><td>The hair is dark brown, or dark or black, but not jet black

Class 4
Jet black only</td></tr>
<tr><td>Class 1</td><td>Class 2</td><td>Class 3</td><td>Class 5</td></tr>
</table>

ANALYTICAL TABLE FOR EYE COLOURS

<table>
<tr><td><u>Pure blue</u>

The eyes are pure blue</td><td colspan="3">Not pure blue

The eyes are not pure blue. They are either brown, grey, very light blue, or mixed</td></tr>
<tr><td rowspan="2">Deep blue or pure blue is

Class 1

(Light blue is Class 2)</td><td><u>Dark</u>

The eyes are hazel brown, dark brown, or simply dark

Class 4</td><td colspan="2">Not dark

The eyes are not brown. They are either grey or mixed. The grey eyes may be either very light blue, light grey, or simply grey. Light grey eyes belong to Class 2, while grey and mixed belong to Class 3</td></tr>
<tr><td><u>Light</u>

The eyes are light grey, very light, blue, or bluish grey

Class 2</td><td><u>Medium</u>

The eyes are neither light grey, very light blue, nor bluish grey, but are either grey, greenish, orange, very light hazel, or mixed. They belong to

Class 3</td></tr>
</table>

These tables are probably as accurate as can be devised but nevertheless they are defective in some ways. In the various colour classes the bulk of cases can be easily placed, but there are others which are more difficult. There is no method of distinguishing mixed colours, fair hair tending to become medium or medium hair tending to dark. Eye colour is more easily distinguished but considerable difficulty has been found in determining the true blue. Taking the pure deep blue as representing this class in accordance with Tocher's table, it is found that only 5.3% of the hospital cases have blue eyes compared with 11.2% of blue eyes in Tocher's statistics for the children inhabiting the area, from which the hospital cases were drawn. This suggests some difference in the personal equation of the observers. Beddoe[x] remarks on the difficulty of determining the limits of the blue eye. Tocher's pigmentation survey takes Glasgow as a whole, but also divides it into sub-districts. Belvidere and Ruchill Hospitals drain different districts. This might have led to difficulties of comparison, but it was found that these districts corresponded closely to Tocher's sub-divisions.

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[x] Beddoe, The Races of Britain, p. 77

TABLE

Showing the percentages of the various hair and eye colours of the school children in the areas drained by Belvidere and Ruchill Hospitals

HAIR COLOUR

	Black	Dark	Medium	Fair	Red
Ruchill Area, Boys	.9	25.4	46.5	21.7	5.6
" " Girls	1.2	28	44.1	21.6	5
" " Boys & Girls combined	1.1	26.7	45.3	21.7	5.3
Belvidere Area, Boys	1.3	26.8	45.5	21.5	5
" " Girls	1.2	28.6	44.8	20.8	4.6
" " Boys & Girls combined	1.3	27.7	45.1	21.1	4.8
Belvidere & Ruchill areas combined (Boys & Girls)	1.2	27.2	45.2	21.4	5

EYE COLOUR

	Dark	Medium	Light	Blue
Ruchill Area, Boys	24.2	32.5	31.6	11.7
" " Girls	24.6	32.3	30.8	12.2
" " Boys & Girls combined	24.4	32.4	31.2	12
Belvidere Area, Boys	24.9	35.5	29.6	10.1
" " Girls	24.3	35.5	29.4	10.9
" " Boys & Girls combined	24.6	35.5	29.5	10.5
Belvidere & Ruchill areas combined (Boys & Girls)	24.5	34	30.3	11.2

It will be seen from the above table, constructed from Tocher's statistics for the Glasgow sub-divisions, that there is very little difference in the percentages of hair and eye colours between the Belvidere and Ruchill areas. Taking this fact into consideration, these areas are for convenience sometimes considered separately and sometimes combined in this inquiry. From the same table it will be seen also that the percentages of hair and eye colours of boys and girls taken as separate units show only a slight difference.

Tocher[x] states that on an average any excess or defect in the boy population from the general mean in any locality is accompanied in about 70-90% of the cases by a corresponding excess or defect in the girl population and vice-versa. Such being the case, boys and girls have been combined in this inquiry. In scarlet fever alone are the boys and girls treated as separate units.

In all, 3,535 observations have been made, namely, 1,864 on scarlet fever patients, 700 on diphtheria patients, 661 on measles patients and 310 on whooping cough patients.

ON THE POSSIBILITY OF COMPARING THE HOSPITAL RESULTS WITH THOSE OF TOCHER

In comparing the results obtained in hospital with those of Tocher a difficulty is met with in regard to the age difference of the subjects of these investigations. In hospital the majority of the children, on whom observations were made, were between the ages of 2 and 12. Tocher gives the age of the school children

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[x] Tocher, Pigmentation Survey of School Children in Scotland, Biometrika Vol. VI, p. 199

considered in his survey as between 6 and 18. The difference in age is considerable and might be thought to give rise to inaccuracy when comparing the results of these different observations, but authority can be given for considering the age difference as of little importance and liable at the most to give rise to only a very small error, where the comparison is based on the pigmentation of the hair and eyes.

Ripley[1] states that a great defect in all such investigations in children lies in the tendency to a darkening of the hair and eyes with growth; that from 10-20% of blond children at maturity develop darker hair or eyes. Beddoe[2] remarks, however, that the broad results are not affected by this flaw. He gives statistics of school children under and over 11 years of age, showing a very slight augmentation of the darker colours in the older children. Pearson[3] collating statistics, concludes that there is little change in hair or eye colour with children under 14, but after 14 there is even before 19 a more marked change, the correlations still, however, remaining low. This change is much more con-

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(1) Ripley, The Races of Europe, p. 222

(2) Beddoe, The Races of Britain, p. 77

(3) Pearson, Miscellanea, Biometrika, Vol. III, pp. 464-465

siderable in the case of hair than of eye colour, though sensible in both. Commenting on Dr Pfitzner's results on the pigmentation of the hair and eyes of children in Lower Elsass he states that they are quite comprehensible if there be a positive correlation between fairness and disease in childhood, that this is exactly what British school children show - there is a correlation between health and darkness of hair colour. "Hence if we do not follow up individuals, noting their pigmentation at different ages, but simply correlate age of different individuals with hair colour, we are liable to exaggerate the correlation between age and pigmentation, and this will be especially the case, if we use hospital returns. Hence it is probable that our neglect of a selective death rate, based upon the known correlation between general health and pigmentation, really emphasises the values found for correlation between pigmentation and age. Further, while it is probable that if we take adult life into account we should find this correlation increased, the value deduced from Pfitzner's observations may be safely considered to mark in the first place a selective death rate, i.e., a correlation between fitness in childhood and dark pigmentation."

In conclusion Pearson, commenting on a table exhibiting the results for age and hair and eye colour of

British school girls from 7-19 years of age, states that "it would seem doubtful, having regard to the paucity of individuals dealt with, whether we can assert significant changes in the percentages of medium-eyed girls having fair or brown hair at different ages. Nor would it be wise to insist that the changes of percentages in red-haired girls with light or dark eyes are significant. Red-haired girls with medium eyes seem to become continuously fewer with age: light-eyed girls with fair-hair become significantly fewer, and brown-haired girls with light eyes more numerous. Dark-eyed girls with fair or brown hair become significantly fewer and dark-eyed girls with dark hair become more numerous, and probably light-eyed girls with dark hair also. The medium-eyed girls with dark hair remain much the same in percentage. Thus, except in the case of red-haired girls, those with medium eye colour change least; the fair-haired girls with light eyes tend to become brown or even dark, and the dark-eyed girls with fair or brown hair to become dark-haired. How far these changes are influenced by a selective death rate still remains to be determined."

It would therefore be expected that, if there is any discrepancy from the age difference in comparing the results of this inquiry with those of Tocher's survey

of school children, a proportion of fair and possibly medium dark takes the place of medium and dark at the more advanced age. An appreciable but not large number of the children observed in hospital are considerably younger than the children on whom Beddoe and Pearson base their results as given above. All the evidence, however, tends to show that the colour of the hair and of the eyes to a lesser degree darkens with age, in which case a slight excess of fair-haired children should be found entering hospital, when compared with Tocher's statistics for school children, unless such a result be upset by some correlation between the colour of the hair and susceptibility to the diseases considered. This excess is certainly present, except in scarlet fever, but it is not great, the percentage of fair-haired children varying from 19.3% in scarlet fever to 27.8% in measles as compared with Tocher's figure for school children for the same area of 21.4%. How much of this discrepancy is accounted for by the age difference and how much by some correlation between the colour of the hair and susceptibility to the diseases considered cannot be definitely stated. As will be shown later, however, there is a distinct negative correlation between dark hair and susceptibility, and there is no reason why the excess of fair-haired children entering

hospital should not be due as much to some such correlation between fair hair and susceptibility as to any error from age difference.

THE INCIDENCE OF THE DISEASES CONSIDERED IN THE DIFFERENT PIGMENTATION TYPES

It was thought that, by comparing the percentages of the various hair and eye colours of children suffering from scarlet fever, diphtheria, measles and whooping cough with the percentages of the various hair and eye colours given by Tocher for the areas corresponding to the areas from which these children were drawn, some definite result might be obtained, indicating the pigmentation type most liable to suffer from any of these diseases.

TABLE 1

Showing the percentages of the various hair and eye colours in the diseases considered as compared with the general population

HAIR COLOUR

	Black	Dark	Medium	Fair	Red
General population	1.2	27.2	45.2	21.4	5
Scarlet Fever	.6	15.5	59.4	19.3	5
Diphtheria	.1	13.9	57.7	24.1	4.2
Measles	0	12.9	55.5	27.8	3.8
Whooping Cough	.6	11.3	61.3	23.6	3.2

EYE COLOUR

	Dark	Medium	Light	Blue
General population	24.5	34	30.3	11.2
Scarlet Fever	15	62	17.8	5.2
Diphtheria	15.2	44.4	35.3	5.1
Measles	14.5	60.2	22.1	3.2
Whooping Cough	15.2	38.1	35.8	11

As will be seen from Table 1 there is, with regard to the colour of both hair and eyes, a striking similarity between the percentages of each colour attacked by each of the fevers considered, and these percentages differ considerably from Tocher's percentages of the general population for the same area.

With regard to the pigmentation of the hair, in every case the medium is considerably in excess, the dark deficient and the fair and red about equal when compared to their proportional representation in the general population. The colour of the eyes shows a similar result, the medium considerably in excess, the dark and blue deficient, the light being the only variable colour, being in excess in diphtheria and whooping cough and deficient in scarlet fever and measles as compared with the general population.

SCARLET FEVER

In considering the scarlet fever cases, as elsewhere, boys and girls and Belvidere and Ruchill patients have been grouped together, and compared with Tocher's

statistics for the combined areas. In addition the boys and girls in the Ruchill cases have been separated and compared with Tocher's statistics for the boys and girls in the Ruchill area. This accounts for the slight difference in the* theoretical percentages.

TABLE 2

Showing the percentages and numbers of the various hair colours of children suffering from scarlet fever as compared with the general population

HAIR COLOUR

	Black	Dark	Medium	Fair	Red	Total
1 Belvidere & Ruchill (Combined)						
Actual numbers	12	289	1109	360	94	1864
Theoretical numbers	22	507	842	399	94	1864
Actual percentage	.6	15.5	59.4	19.3	5	100
Theoretical percentage	1.2	27.2	45.2	21.4	5	100

* The term "theoretical percentage" refers to the percentage given in Tocher's statistics for the same area. The term "theoretical numbers" refers to the numbers which would occur if the cases were admitted to hospital in the same percentage of each colour as in Tocher's statistics for the same area

	Black	Dark	Medium	Fair	Red	Total
2 Ruchill, Girls						
Actual numbers	3	137	389	138	38	705
Theoretical numbers	9	198	311	152	35	705
Actual percentage	.4	19.5	55.2	19.6	5.4	100
Theoretical percentage	1.2	28	44.1	21.6	5	100
3 Ruchill, Boys						
Actual numbers	5	77	360	113	35	590
Theoretical numbers	5	150	274	128	33	590
Actual percentage	.8	13.1	61	19.2	5.9	100
Theoretical percentage	.9	25.4	46.5	21.7	5.6	100

From Table 2 it appears that whether the boys and girls be treated as separate units or combined, the results are similar. Both combined and individually medium hair is considerably in excess, dark and jet black considerably and fair hair slightly deficient and red hair about equal when compared to their proportional representation in the general population. The greater percentage of medium and the smaller percentage of dark-haired cases in hospital, in boys as compared with girls, has a corresponding difference in the general population. It would seem then that the medium-haired child is susceptible to scarlet fever to a greater extent than, the dark and jet black-haired to a less extent than, and the

red and fair-haired child almost equally with its proportional representation in the general population.

TABLE 3

Showing the percentages and numbers of the various eye colours of children suffering from scarlet fever as compared with the general population

EYE COLOUR

	Dark	Medium	Light	Blue	Total
1 Belvidere & Ruchill (Contd.)					
Actual numbers	280	1156	331	97	1864
Theoretical numbers	457	634	564	209	1864
Actual percentage	15	62	17.8	5.2	100
Theoretical percentage	24.5	34	30.3	11.2	100
2 Ruchill, Girls					
Actual numbers	90	400	70	30	590
Theoretical numbers	143	192	186	69	590
Actual percentage	15.3	67.8	11.9	5	100
Theoretical percentage	24.2	32.5	31.6	11.7	100

	Dark	Medium	Light	Blue	Total
3 Ruchill, Boys					
Actual numbers	123	433	117	32	705
Theoretical numbers	174	228	217	86	705
Actual percentage	17.5	61.4	16.6	4.5	100
Theoretical percentage	24.6	32.3	30.8	12.2	100

In scarlet fever whether boys and girls be considered individually or combined, the medium eye is very much in excess, the blue and light eye and to a less extent the dark eye considerably deficient compared to their proportional representation in the general population.

This would indicate that the medium-eyed child is more susceptible to scarlet fever than the dark-eyed child and, even more so, than the blue and light-eyed child. The medium-eyed girl would seem to be more susceptible than the medium-eyed boy, the light-eyed girl being less susceptible to a corresponding degree.

DIPHTHERIA

TABLE 4

Showing the percentages and numbers of the various hair colours of children suffering from diphtheria, as compared with the general population

HAIR COLOUR

	Black	Dark	Medium	Fair	Red	Total
Belvidere & Ruchill						
Actual numbers	1	97	404	169	29	700
Theoretical numbers	8	191	316	150	35	700
Actual percentage	.1	13.9	57.7	24.1	4.2	100
Theoretical percentage	1.2	27.2	45.2	21.4	5	100

In Diphtheria medium hair is considerably and fair hair slightly in excess, red hair is slightly and dark and jet black hair considerably deficient compared to their proportional representation in the general population. This would indicate that the medium-haired child

is susceptible to diphtheria to a greater extent than, the dark and jet black-haired child to a less extent than, and the red and fair-haired child about equally with its proportional representation in the general population.

TABLE 5

Showing the percentages and numbers of the various eye colours of children suffering from diphtheria as compared with the general population

EYE COLOUR

	Dark	Medium	Light	Blue	Total
Belvidere & Ruchill					
Actual numbers	106	311	247	36	700
Theoretical numbers	171	238	212	79	700
Actual percentage	15.2	44.4	35.3	5.1	100
Theoretical percentage	24.5	34	30.3	11.2	100

In diphtheria the medium eye and, to a less extent, the light eye are considerably in excess, the blue eye and, to a less extent, the dark eye considerably deficient, compared to their proportional representation in

the general population. This would indicate that the medium-eyed child and, to a less extent, the light-eyed child is more susceptible to diphtheria than the dark-eyed child and, even more so, than the blue-eyed child.

M E A S L E S

TABLE 6

Showing the percentages and numbers of the various hair colours of children suffering from measles, as compared with the general population

HAIR COLOUR

	Black	Dark	Medium	Fair	Red	Total
Ruchill only.						
Actual numbers	0	85	367	184	25	661
Theoretical numbers	7	176	299	144	35	661
Actual percentage	0	12.9	55.5	27.8	3.8	100
Theoretical percentage	1.1	26.7	45.3	21.7	5.3	100

In measles medium hair and, to a less extent, fair hair, are considerably in excess, red hair and, even more so, dark and jet black hair considerably deficient compared to their proportional representation in the general population.

This would indicate that the medium-haired child, and, to a less extent, the fair-haired child, is more susceptible to measles than the red-haired child and, even more so, than the dark and jet black-haired child.

TABLE 7

Showing the percentages and numbers of the various eye colours of children suffering from measles, as compared with the general population

EYE COLOUR

	Dark	Medium	Light	Blue	Total
Ruchill only.					
Actual numbers	96	398	146	21	661
Theoretical numbers	161	215	206	79	661
Actual percentage	14.5	60.2	22.1	3.2	100
Theoretical percentage	24.4	32.4	31.2	12	100

In measles the medium eye is considerably in excess, the blue eye and, to a less extent, the dark and light eye, considerably deficient compared to their proportional representation in the general population. This would indicate that the medium-eyed child is much more susceptible to measles than the dark and light-eyed child and, even more so, than the blue-eyed child.

WHOOPING COUGH

TABLE 8

Showing the percentages and numbers of the various hair colours of children suffering from whooping cough, as compared with the general population

HAIR COLOUR

	Black	Dark	Medium	Fair	Red	Total
Belvidere & Ruchill						
Actual numbers	2	35	190	73	10	310
Theoretical numbers	4	84	140	66	16	310
Actual percentage	.6	11.3	61.3	23.6	3.2	100
Theoretical percentage	1.2	27.2	45.2	21.4	5	100

In whooping cough medium hair is considerably and fair hair slightly in excess, red hair is considerably and dark and jet black hair markedly deficient as compared to their proportional representation in the general population. This would indicate that the medium-haired child and, to a much less extent, the fair-haired child, is more susceptible to whooping cough than the red-haired child and, much more so, than the dark and jet black-haired child.

TABLE 9

Shewing the percentages and numbers of the various eye colours of children suffering from whooping cough, as compared with the general population

EYE COLOUR

	Dark	Medium	Light	Blue	Total
Belvidere & Ruchill					
Actual numbers	47	118	111	34	310
Theoretical numbers	76	105	94	35	310
Actual percentage	15.2	38.1	35.8	11	100
Theoretical percentage	24.5	34	30.3	11.2	100

In whooping cough the light eye and the medium eye are in excess but not to any marked extent, the blue eye is equal and the dark eye deficient when compared to their proportional representation in the general population. This would indicate that the light-eyed child and the medium-eyed child are more susceptible to whooping cough than the blue-eyed child and considerably more so than the dark-eyed child.

Thus a striking similarity is maintained throughout in these four fevers as regards the susceptibility of the various hair and eye colours.

HAIR COLOUR:

In every case there is a marked excess of medium hair and a marked deficiency of dark and jet black hair. In measles there is a considerable and in diphtheria and whooping cough a slight excess of fair hair. In scarlet fever there is a slight deficiency of fair hair. Red hair is deficient except in scarlet fever, where it equals its proportional representation in the general population.

The conclusion would seem to be that in scarlet fever, diphtheria, measles and whooping cough, the medium-haired child is more liable to become infected than the red-haired and much more so than the dark and jet

black-haired child, the fair-haired child occupying an intermediate position as regards infection.

EYE COLOUR:

In every case there is an excess of medium eyes, not so marked in whooping cough, and a considerable deficiency in blue and dark eyes, except in whooping cough where blue eyes are equal to their proportional representation in the general population. The light eye occupies an intermediate position, being in excess in whooping cough and diphtheria and deficient in scarlet fever and measles. The conclusion would seem to be that in scarlet fever, diphtheria, measles and whooping cough the medium-eyed child is more liable to become infected than the dark-eyed child and, even more so, than the blue-eyed child, the light-eyed child occupying an intermediate position as regards infection; the light-eyed child seems to be more susceptible to diphtheria and whooping cough than to scarlet fever and measles.

THE RECUPERATIVE POWER

of the

VARIOUS PIGMENTATION TYPES IN THE DISEASES CONSIDERED

Throughout this section no attempt has been made to separate boys and girls or Belvidere and Ruchill cases.

To determine the recuperative power of the various pigmentation types to the diseases considered, the number of patients, the percentage of severe cases and the percentage of deaths in each type have been tabulated. The number of patients includes the severe cases and deaths. The percentage of severe cases includes the percentage of deaths. What have been termed the severe cases will require further definition. In scarlet fever, measles and whooping cough, severity is indicated by the incidence of complications. The complications are chiefly represented in scarlet fever by nephritis, arthritis, adenitis and otitis media, in measles by laryngitis, broncho pneumonia, subsequent tuberculosis and otitis media, and in whooping cough by convulsions, broncho-pneumonia and subsequent tuberculosis. These complica-

tions indicate the severity of the attack. In diphtheria however, there are so many cases with a toxaemia considerably above the average, which yet develop no actual complications, that it has been thought more accurate to consider the degree of toxaemia without reference to complications. In diphtheria, therefore, any case with marked toxaemia, that is with a toxaemia more intense than the average, has been tabulated as severe.

1 RECUPERATIVE POWER AND PIGMENTATION OF THE HAIR

During a two years' experience of children in fever hospitals and before any attempt had been made to arrive at any statistical proof on the subject, I had formed, more or less unconsciously, the opinion that the fair-haired child tended to be more severely attacked by and to succumb more readily to the acute fevers and that the dark-haired child tended to be less severely attacked and offered more resistance to the disease. How far this impression is confirmed by fact will be seen from the accompanying tables.

TABLE 10

Showing the number of patients, the percentage of severe cases and the percentage of deaths in the various hair colours in the diseases considered

HAIR COLOUR

	Black	Dark	Medium	Fair	Red
Scarlet Fever					
Number of cases	12	289	1109	360	94
Percentage of severe cases	8.3	14.2	17.4	20.3	19.2
Percentage of deaths	0	2.1	3.2	5.3	3.2
Diphtheria					
Number of cases	1	97	404	169	29
Percentage of severe cases	0	32	40.1	39.6	41.4
Percentage of deaths	0	9.3	10.6	12.4	3.4
Measles					
Number of cases	0	85	367	184	25
Percentage of severe cases	0	16.4	16.4	23.9	20
Percentage of deaths	0	4.7	7.7	13.6	12

	Black	Dark	Medium	Fair	Red
Whooping Cough					
Number of cases	2	35	190	73	10
Percentage of severe cases	0	11.4	20	21.9	10
Percentage of deaths	0	0	10	13.7	10

It appears that in each of the diseases considered the fair-haired children show the greatest percentage of severe cases and of deaths, and not only is this so, but the greater severity and higher mortality in fair-haired children is marked and constant. The only exception is the slightly greater percentage of severe cases of diphtheria in red and medium-haired children. Next, but not so pronounced, in order of severity and mortality comes the red-haired class. Only in the percentage of deaths in diphtheria, which is remarkably small, and of severe cases in whooping cough is this order changed. But the low death rate in diphtheria is fully made up by the large number of severe cases and the small number of red-haired children with whooping cough renders the observation of little value. The severity and mortality in medium-haired children occupies a mean between the high severity and death rates among the fair-haired and, in a less degree, the red-haired children and the comparative-

ly low severity and death rates among the dark and jet black-haired children. This position is changed in diphtheria where the fair-haired children have a slightly smaller percentage of severe cases and red-haired children a smaller percentage of deaths and in whooping cough where the red-haired have a smaller percentage of severe cases. As with the fair-haired but on account of its smaller severity and death rates the position of the dark and jet black-haired children is marked and constant. The only exception is the lower death rate in diphtheria and the lower severity rate in whooping cough among red-haired children.

To sum up the dark and jet black-haired child occupies one pole, the pole of less severity and mortality, the fair-haired and, to a less degree, the red-haired child occupies the other pole, the pole of greater severity and mortality, while the mean is represented by the medium-haired child. This will be seen conveniently in Table 11, giving the hair colours in order of ascending severity and death rates in the different diseases considered.

TABLE 11

Giving from left to right the hair colours in order of ascending severity and death rates in the diseases considered

(1) SEVERITY RATES

HAIR COLOUR

Disease							
Scarlet Fever	Black		Dark		Medium	Red	Fair
Diphtheria	Black		Dark	Fair	Medium	Red	
Measles	Black		Dark		Medium	Red	Fair
Whooping Cough	Black	Red	Dark		Medium		Fair

(II) DEATH RATES

HAIR COLOUR

Disease						
Scarlet Fever	Black		Dark	Medium	Red	Fair
Diphtheria	Black	Red	Dark	Medium		Fair
Measles	Black		Dark	Medium	Red	Fair
Whooping Cough	Black		Dark	Medium	Red	Fair

2 RECUPERATIVE POWER AND PIGMENTATION OF THE EYES

TABLE 12

Showing the number of patients, the percentage of severe cases, and the percentage of deaths in the various eye colours in the diseases considered

	EYE COLOUR			
	Dark	Medium	Light	Blue
Scarlet Fever				
Number of cases	280	1156	331	97
Percentage of severe cases	17.1	16.8	19	20.6
Percentage of deaths	1.4	3.6	4.2	4.1
Diphtheria				
Number of cases	106	311	247	36
Percentage of severe cases	35.8	37.6	42.9	30.6
Percentage of deaths	13.2	10.3	10.1	8.3

	Dark	Medium	Light	Blue
Measles				
Number of cases	96	398	146	21
Percentage of severe cases	17.7	17.3	22	23.8
Percentage of deaths	7.3	8.8	11	9.5
Whooping Cough				
Number of cases	47	118	111	34
Percentage of severe cases	21.2	16.9	22.5	11.8
Percentage of deaths	10.6	7.6	12.6	5.9

TABLE 13

Giving from left to right the eye colours in order of ascending severity and death rates in the diseases considered

(I) SEVERITY RATES

EYE COLOUR

Disease						
Scarlet Fever	Blue	Medium	Dark	Medium	Light	Blue
Diphtheria			Dark		Light	
Measles		Medium	Dark		Light	Blue
Whooping cough	Blue	Medium	Dark		Light	

(II) DEATH RATES

EYE COLOUR

Disease							
Scarlet Fever	Blue	Dark	Light	Medium	Dark	Blue	Light
Diphtheria				Medium			
Measles		Dark		Medium		Blue	Light
Whooping Cough	Blue			Medium	Dark		Light

Taking into consideration the conclusions drawn between the severity and mortality of the diseases and the pigmentation of the hair, it should follow by analogy that the dark-eyed and the light and blue-eyed children should occupy the extreme poles, the dark-eyed that of less severity and mortality and the light and blue-eyed that of greater severity and mortality with the medium-eyed children representing the mean. As will be seen from Table 12, this would hardly be accurate in detail. On the other hand, if we group together the dark and medium-eyed children and the light and blue-eyed children it is found (Table 14) that the dark and medium-eyed group represent the less severity and mortality, while the light and blue-eyed group represent the greater severity and mortality. The only exception to this is the

death rate in diphtheria which is slightly lower in the light and blue-eyed group. When the eye colours are considered separately, however, the conclusion is not so definite. The dark-eyed child has not the same advantage over the medium-eyed child as the dark-haired child has over the medium-haired child. Only in the death rate in scarlet fever is there a decided advantage, and there is also a slight advantage in the death rate in measles and the severity rate in diphtheria. In the other diseases both the severity and death rates are lower in medium-eyed children, but the difference is not great. The light-eyed child shows the highest severity and mortality, the only exceptions being the severity rate in scarlet fever and measles, which is rather lower than in blue-eyed children, and the death-rate in diphtheria, which is rather lower than in both medium and dark-eyed children. The blue-eyed child is not at all constant; in diphtheria and whooping cough it has the smallest severity and death rates, whereas in scarlet fever and measles it has the greatest percentage of severe cases and, with the exception of light-eyed children, of deaths. It would seem therefore that the advantage is still in favour of the medium and dark-eyed children, but that the blue-eyed children are not so liable to severe attacks of diphtheria and whooping-cough.

TABLE 14

Shewing the number of patients, the percentage of severe cases, and the percentage of deaths in dark and medium eyed children grouped together and light and blue-eyed children grouped together

EYE COLOUR

Disease	Dark & Medium	Light & Blue
Scarlet Fever		
Number of cases	1436	428
Percentage of severe cases	16.9	19.4
Percentage of deaths	3.2	4.2
Diphtheria		
Number of cases	417	283
Percentage of severe cases	37.2	41.3
Percentage of deaths	11	9.9
Measles		
Number of cases	494	167
Percentage of severe cases	17.4	25.3
Percentage of deaths	8.5	12.3

Disease	Dark & Medium	Light & Blue
Whooping cough		
Number of cases	165	145
Percentage of severe cases	18.2	20
Percentage of deaths	8.5	11

3. RECUPERATIVE POWER AND PIGMENTATION OF THE HAIR AND EYES COMBINED

The various combinations of hair and eye colours are so numerous and the number of cases in some combinations so small that only the three main ones have been considered here, namely, the dark-haired children with dark-eyes, the medium-haired children with medium eyes, and the fair-haired children with light eyes.

TABLE 15

Showing the number of patients, the percentage of severe cases and the percentage of deaths in the three main hair and eye combinations

HAIR AND EYE COLOUR

	Dark hair & dark eyes	Medium hair & medium eyes	Fair hair & light eyes
Scarlet Fever			
Number of cases	145	826	165
Percentage of severe cases	12.4	16.6	19.4
Percentage of deaths	1.4	3.6	4.9
Diphtheria			
Number of cases	40	223	97
Percentage of severe cases	37.5	39.9	44.3
Percentage of deaths	12.5	11.7	16.5
Measles			
Number of cases	39	260	70
Percentage of severe cases	20.6	16.1	25.7
Percentage of deaths	5.1	8	14.3

	Dark hair & dark eyes	Medium hair & medium eyes	Fair hair & light eyes
Whooping cough			
Number of cases	16	89	39
Percentage of severe cases	12.5	19.1	28.3
Percentage of deaths	0	7.9	17.9

TABLE 16

Giving from left to right the combined hair and eye colours in order of ascending severity and death rates in the diseases considered

(I) SEVERITY RATES

HAIR AND EYE COLOUR

Disease

Scarlet fever	Medium medium	Dark dark	Medium medium	Fair light
Diphtheria		Dark dark	Medium medium	Fair light
Measles		Dark dark		Fair light
Whooping Cough		Dark dark	Medium medium	Fair light

(II) DEATH RATES

HAIR AND EYE COLOUR

Disease				
Scarlet fever	Medium medium	Dark dark	Medium medium	Fair light
Diphtheria		Dark dark		Fair light
Measles		Dark dark	Medium medium	Fair light
Whooping Cough		Dark dark	Medium medium	Fair light

From tables 15 and 16 it is seen that the result is striking. The dark-haired, dark-eyed children occupy one pole, that of less severity and lower mortality; the fair-haired light-eyed children occupy the opposite pole, that of greater severity and greater mortality, and not only is this so but the greater severity and greater mortality in the fair-haired light-eyed child is marked and constant in each of the diseases considered. The medium haired medium-eyed child occupies the mean between these poles. The only exceptions are found in measles where the medium-haired medium-eyed children show a smaller percentage of severe cases and in diphtheria where they show a slightly smaller percentage of deaths than the dark-haired dark-eyed children.

It has been found then that the dark and jet black-

haired children oppose greater resistance to the diseases than the red-haired children and, even more so, than the fair-haired children, while the medium-haired children occupy an intermediate position. It has also been seen that the medium and dark-eyed children are less severely attacked than the light and blue-eyed children and, further, that combining the hair and eye colours the dark-haired dark-eyed children show considerably more resistance to the diseases than the fair-haired light-eyed children, with the medium-haired medium-eyed children occupying an intermediate position.

From this it must be concluded that the dark-haired dark-eyed type have higher recuperative powers and offer greater resistance to the diseases than the fair-haired light-eyed type, and that, in the various gradations between the extreme dark and extreme fair types, the closer the type approximates to fair, the less recuperative power it has and the less resistance is offered in the diseases here considered:

SPECIAL CASES

1 The incidence of nephritis in the various pigmentation types in scarlet fever

TABLE 17

Showing the number of cases and the percentage developing nephritis in the various hair and eye colours in scarlet fever

(1) HAIR COLOUR

	Black	Dark	Medium	Fair	Red
Number of cases	8	214	749	251	73
Percentage with nephritis	0	1.9	2.7	2	4.1

(2) EYE COLOUR

	Dark	Medium	Light	Blue
Number of cases	213	833	187	62
Percentage with nephritis	2.3	2.3	3.2	3.2

The possible connection between the pigmentation of the hair and eyes and the skin has already been considered. The type of skin, as one of the chief excretory systems in the body, might be expected to have an effect on the incidence of nephritis. In 1295 cases of scarlet fever in Ruchill Hospital 32 or 2.5% suffered from true scarlatinal nephritis. In Table 17 the percentages of those occurring in the various pigmentation types are given. The evidence is not very conclusive, but here again the darker type seems to offer more resistance.

2 The incidence of paralysis and the necessity for Tracheotomy in diphtheria.

TABLE 18

Showing the number of cases and the percentage developing subsequent paralysis, also the percentage requiring tracheotomy performed, in the various hair and eye colours in diphtheria

(I) HAIR COLOUR

	Black	Dark	Medium	Fair	Red
Number of cases	1	78	303	134	19
Percentage with paralysis	0	6.4	3.9	4.5	10.5
Percentage requiring tracheotomy	0	5.1	4.9	6	10.5

(II) EYE COLOUR

	Dark	Medium	Light	Blue
Number of cases	86	242	178	29
Percentage with paralysis	4.7	4.1	5.6	3.5
Percentage requiring tracheotomy	4.7	3.7	7.9	6.9

(III) HAIR AND EYE COLOUR COMBINED

	Dark hair & dark eyes	Medium hair & medium eyes	Fair hair & light eyes
Number of cases	31	169	73
Percentage with paralysis	9.7	3.6	4.1
Percentage requiring tracheotomy	3.2	3	4.1

The possible association between the ectoderm and pigmentation has already been mentioned. The peripheral nerves being ectodermal in origin, it was thought that some relationship might be found between the incidence of paralysis in diphtheria and the pigmentation of the hair and eyes. The evidence again is not very conclusive. In Table 18 the percentage of cases with subsequent paralysis, chiefly palatal, and the percentage of cases requiring tracheotomy in 535 children suffering from diphtheria have been tabulated with reference to the colour of their hair and eyes. The figures bear out what has already been said with regard to the severity of the disease, the dark and medium types being less severely attacked; exceptions to this are found in the high percentage of cases of paralysis in dark-haired

and in dark-haired dark-eyed children and in the low percentage of cases of paralysis in blue-eyed children.

PIGMENTATION AS A FACTOR IN RACE SELECTION

By comparing the percentages in each hair or eye class of the total number of severe cases with recovery with the percentage of that class in the general population, an indication is given as to how far that class is handicapped by subsequent disability after severe illness, and by comparing the percentages in each class of the total number of deaths with the percentage of that class in the general population, an indication is given as to how far that class is selected for extermination. The effect of selection is so much alike in each of the diseases considered that it is unnecessary to consider them separately.

(I) HAIR COLOUR

TABLE 19

Showing the percentages of the various hair colours in the general population and in hospital patients, also the percentages in each colour of the total number of severe cases with recovery and of deaths

HAIR COLOUR

	Black	Dark	Medium	Fair	Red
Percentage in general population					
Belvidere & Ruchill areas	1.2	27.2	45.2	21.4	5
Scarlet Fever					
Percentage in hospital patients	.6	15.5	59.4	19.3	5
Percentage of total severe cases with recovery	.4	13.4	59.9	20.6	5.7
Percentage of total deaths	0	9.4	56.3	29.7	4.7

	Black	Dark	Medium	Fair	Red
Diphtheria					
Percentage in hospital patients	.1	13.9	57.7	24.1	4.2
Percentage of total severe cases with recovery	0	11.1	60.2	23.2	5.6
Percentage of total deaths	0	12.2	58.1	28.4	1.4
Whooping cough					
Percentage in hospital patients	.6	11.3	61.3	23.6	3.2
Percentage of total severe cases with recovery	0	13.8	65.6	20.7	0
Percentage of total deaths	0	0	63.3	33.3	3.3
Percentage in general population					
Ruchill area only	1.1	26.7	45.3	21.7	5.3
Measles, Ruchill only					
Percentage in hospital patients		12.9	55.5	27.8	3.8
Percentage of total severe cases with recovery		15.9	50.8	30.2	3.1
Percentage of total deaths		6.6	46.7	41.7	5

Table 19 shows that the medium-haired class is undoubtedly selected both for handicap by its greater number of severe cases with subsequent disability, and for extermination by its greater number of deaths.

This is the case in every one of the diseases con-

sidered, but to a less extent in measles where the fair-haired class suffers more severely. At the expense of the medium-haired and, to a much less extent, of the fair-haired, the black and dark-haired class is least selected for such handicap and extermination. The fair-haired and the red-haired class suffer about equally, the fair-haired rather more and the red-haired rather less than their proportional representation in the general population. In measles, as has been mentioned, the fair-haired class suffers most severely.

This result is somewhat at variance with the idea commonly held that the fair-haired class is being exterminated in the towns. That there is some degree of adverse selection is obvious from Table 19, but there is yet more adverse selection among the medium-haired class. It would seem therefore that the current beliefs of the inability of the fair-haired person to stand the town life is not supported to any great extent by fever statistics.

Tocher[K] found that there was a positive correlation between the death rate and medium hair, and another between the death rate and dark eyes in Scotland. This

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[K] Tocher, Pigmentation Survey of School Children in Scotland. Biometrika, Vol. VI, 1908-09, p. 188

result, he states, was to be expected since density is similarly associated with colour and the denser the population, the greater the death rate; the denser the population the greater the excess of medium hair, and therefore the greater the excess of medium hair, the greater the death rate. This, however, is obviously not the sole factor, as it is found that the rate at which medium-haired children develop infectious disease is considerably greater than the average.

(II) EYE COLOUR

TABLE 20

Showing the percentages of the various eye colours in the general population and in hospital patients, also the percentages in each colour of the total number of severe cases with recovery and of deaths

EYE COLOUR

	Dark	Medium	Light	Blue
Percentage in general population				
Belvidere & Ruchill Areas	24.5	34	30.3	11.2

	Dark	Medium	Light	Blue
Scarlet fever				
Percentage in hospital patients	15	62	17.8	5.2
Percentage of total severe cases with recovery	16.8	58.4	18.7	6.1
Percentage of total deaths	6.2	65.7	21.9	6.2
Diphtheria				
Percentage in hospital patients	15.2	44.4	35.3	5.1
Percentage of total severe cases with recovery	12.1	42.9	40.9	4.1
Percentage of total deaths	18.9	43.2	33.8	4.1
Whooping cough				
Percentage in hospital patients	15.2	38.1	35.8	11
Percentage of total severe cases with recovery	17.2	38	38	6.9
Percentage of total deaths	16.7	30	46.7	6.7
Percentage in general population				
Ruchill area only	24.4	32.4	31.2	12
Measles, Ruchill only				
Percentage in hospital patients	14.5	60.2	22.1	3.2
Percentage of total severe cases with recovery	15.9	54	25.4	4.8
Percentage of total deaths	11.7	58.4	26.7	3.3

Table 20 shows that the effect of selection in the

various eye colours follows closely that of the hair colours. The medium-eyed class by a very large margin is selected both for handicap by its large number of severe cases with subsequent disability and for extermination by its large number of deaths. The only exception to this is in whooping cough where the light-eyed class suffer more severely. With the exception of the light-eyed class in diphtheria and whooping cough the other colours all suffer less by handicap or extermination than their proportion in the general population, and this happens at the expense of the medium-eyed class.

Next to the medium the light-eyed class is selected for handicap and extermination, the dark-eyed less so, and the blue-eyed least of all. This order is maintained throughout with well marked degrees of diminution of adverse selection from the medium-eyed to the blue-eyed class.

(III) HAIR AND EYE COLOUR COMBINED

The effect of selection on the race with regard to hair and eye colour combined is not at present possible as no statistics are available of the different combina-

tions of hair and eye-colour in the school children of Glasgow.

N O T E

In connection with pigmentation and the severity of these diseases, the following facts given by Clemow[x] are of interest. "Scarlet fever", he states, "is essentially a disease of temperate climates. In the tropics it is almost unknown. The influence of race is uncertain. People so ethnologically distinct as the Chinese, the natives of South Africa and the inhabitants of the principal European countries all suffer considerably from the disease. But it is certain that some races are more susceptible than others. The statistics of recent censuses in the United States of America tend to show that the disease is less prevalent and less fatal among the negroes and Red Indians than among the whites. In

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[x] Clemow, The Geography of Disease

the few cases of scarlet fever observed in India, almost all have occurred among Europeans, and a very small number in natives of the country. In Egypt the disease is rare, but the infection is not infrequently imported, and when it does attack Egyptian children is of a mild character.

Diphtheria bears a close resemblance to scarlet fever in its distribution. The influence of race has never been fully determined. All the great divisions in the human family, including pure Mongols and full-blooded negroes, seem to be susceptible to the disease, though probably both their susceptibility to attack and their power of recovery vary greatly. In China, for example, the disease is said to be much more intense and fatal in natives than in European residents, while in the United States the white races suffer much more than the black.

Measles is one of the most widely prevalent of all diseases. In its relation to race, it appears to be as indifferent as in its relation to most other external conditions. All races are susceptible, and it seems to be as capable of attacking the Chinaman, the Hindu and the Negro as the European. It appears, on the whole, to be decidedly less common in the African Negro than in most other races.

"Whooping cough has an extremely wide distribution. Racial susceptibility appears to be a factor of little importance, for all races are affected, though some more severely than others. In the United States the Negro inhabitants fall victims to it much more readily than those of other races."

It would appear from Clemow's facts that scarlet fever and diphtheria are less prevalent and less fatal among the darkly pigmented races, but on the other hand measles and whooping cough seem to be equally severe, irrespective of colour.

It seems that the statistics on pigmentation on which the results of this inquiry are based as regards susceptibility and recuperative power, although probably holding approximately for the European races, do not necessarily hold good among other races. The dark-haired Chinaman, for instance, suffers more severely from diphtheria than the European. It would be unwise, therefore, to draw any conclusions by analogy as to susceptibility and recuperative power in these fevers among the various races according to their pigmentation.

CONCLUSION

From the statistics already given it has been shown in the four acute fevers here considered, namely, scarlet fever, diphtheria, measles and whooping cough, that among Glasgow school-children,

1 The medium-haired child is more liable to become infected than the red-haired and, much more so, than the dark-haired and jet black-haired child. The fair-haired child occupies an intermediate position as regards infection

2 The medium-eyed child is more liable to become infected than the dark-eyed and, much more so, than the blue-eyed child. The light-eyed child occupies an intermediate position as regards infection. The light-eyed child appears to be more susceptible to diphtheria and whooping cough than to scarlet fever and measles.

3 The dark-haired and jet-black-haired child has higher recuperative power than the red-haired, and, much more so, than the fair-haired child. The medium-haired child occupies an intermediate position as regards recuperative power.

4 The medium-eyed and dark-eyed child has higher recuperative power than the light-eyed and blue eyed child.

5 Combining the hair and eye colours the dark-haired dark-eyed child has considerably more recuperative power than the fair-haired light-eyed child. The medium-haired medium-eyed child occupies an intermediate position as regards recuperative power.

6 In the various gradations between the extreme

dark and extreme fair types, the closer the type approximates to fair, the less recuperative power it has and the less resistance it offers to the diseases.

7 The medium-haired class is undoubtedly selected both for handicap by its greater number of severe cases with subsequent disability, and for extermination by its greater number of deaths. The jet black and dark-haired class is least selected for such handicap and extermination, while the fair-haired class is selected rather more and the red-haired class rather less than their proportion in the general population.

8 The medium-eyed class is undoubtedly selected both for handicap by its greater number of severe cases with subsequent disability and for extermination by its greater number of deaths. The light-eyed class is next in order adversely selected, the dark-eyed class less so and the blue-eyed class least of all.

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S T A T I S T I C S

on which

THE CONCLUSIONS OF THIS INQUIRY ARE BASED

SCARLET FEVER

Ruchill and Belvidere cases. Total number, 1864

HAIR COLOUR

	Black	Dark	Medium	Fair	Red
Actual numbers	12	289	1109	360	94
Theoretical numbers	22	507	842	399	94
Actual percentage	.6	15.5	59.4	19.3	5
Theoretical percentage	1.2	27.2	45.2	21.4	5
x Severe Cases					
Actual numbers	1	35	157	54	15
Percentage of total	.4	13.4	59.9	20.6	5.7
Percentage of same colour	8.3	12.1	14.2	15	16
Deaths					
Actual numbers	0	6	36	19	3
Percentage of total	0	9.4	56.3	29.7	4.7
Percentage of same colour	0	2.1	3.2	5.3	3.2

x The severe cases do not include deaths.

EYE COLOUR

	Dark	Medium	Light	Blue
Actual numbers	280	1156	331	97
Theoretical numbers	457	634	564	209
Actual percentage	15	62	17.8	5.2
Theoretical percentage	24.5	34	30.3	11.2
Severe cases				
Actual numbers	44	153	49	16
Percentage of total	16.8	58.4	18.7	6.1
Percentage of same colour	15.7	13.2	14.8	16.5
Deaths				
Actual numbers	4	42	14	4
Percentage of total	6.2	65.7	21.9	6.2
Percentage of same colour	1.4	3.6	4.2	4.1

HAIR AND EYE COLOUR COMBINED

HAIR COLOUR

Eye Colour	Dark (including black)			Medium			Fair			Red		
	Numbers	severe	deaths	Numbers	severe	deaths	Numbers	severe	deaths	Numbers	severe	deaths
Dark	145	16	2	117	25	1	11	1	0	7	2	1
Medium	133	18	4	826	107	30	133	19	7	64	9	1
Light	18	1	0	130	20	5	165	24	8	18	4	1
Blue	5	1	0	36	5	0	51	10	4	5	0	0

DIPHTHERIA

Ruchill and Belvidere Cases. Total number, 700

HAIR COLOUR

	Black	Dark	Medium	Fair	Red
Actual numbers	1	97	404	169	29
Theoretical numbers	8	191	316	150	35
Actual percentage	.1	13.9	57.7	24.1	4.2
Theoretical percentage	1.2	27.2	45.2	21.4	5
Severe cases					
Actual numbers	0	22	119	46	11
Percentage of total	0	11.1	60.2	23.2	5.6
Percentage of same colour	0	22.7	29.5	27.2	38
Deaths					
Actual numbers	0	9	43	21	1
Percentage of total	0	12.2	58.1	28.4	1.4
Percentage of same colour	0	9.3	10.6	12.4	3.4

EYE COLOUR

	Dark	Medium	Light	Blue
Actual numbers	106	311	247	36
Theoretical numbers	171	238	212	79
Actual percentage	15.2	44.4	35.3	5.1
Theoretical percentage	24.5	34	30.3	11.2
Severe cases				
Actual numbers	24	85	81	8
Percentage of total	12.1	42.9	40.9	4.1
Percentage of same colour	22.6	27.3	32.8	22.3
Deaths				
Actual numbers	14	32	25	3
Percentage of total	18.9	43.2	33.8	4.1
Percentage of same colour	13.2	10.3	10.1	8.3

HAIR AND EYE COLOUR COMBINED

HAIR COLOUR

Eye Colour	Dark (including black)			Medium			Fair			Red		
	Num-bers	sev-ere	deaths	Num-bers	sev-ere	deaths	Num-bers	sev-ere	deaths	Num-bers	sev-ere	deaths
Dark	40	10	5	57	10	9	7	2	0	2	2	0
Medium	32	8	3	223	63	26	48	13	3	8	1	0
Light	25	4	1	113	43	8	97	27	16	12	7	0
Blue	1	0	0	11	3	0	17	4	2	7	1	1

MEASLES

Ruchill cases. Total number 661

HAIR COLOUR

	Black	Dark	Medium	Fair	Red
Actual numbers	0	85	367	184	25
Theoretical numbers	7	176	299	144	35
Actual percentage	0	12.9	55.5	27.8	3.8
Theoretical percentage	1.1	26.7	45.3	21.7	5.3
Severe cases					
Actual numbers	0	10	32	19	2
Percentage of total	0	15.9	50.8	30.2	3.1
Percentage of same colour	0	11.7	8.7	10.3	8
Deaths					
Actual numbers	0	4	28	25	3
Percentage of total	0	6.6	46.7	41.7	5
Percentage of same colour	0	4.7	7.7	13.6	12

EYE COLOUR

	Dark	Medium	Light	Blue
Actual numbers	96	398	146	21
Theoretical numbers	161	215	206	79
Actual percentage	14.5	60.2	22.1	3.2
Theoretical percentage	24.4	32.4	31.2	12
Severe cases				
Actual numbers	10	34	16	3
Percentage of total	15.9	54	25.4	4.8
Percentage of same colour	10.4	8.5	11	14.3
Deaths				
Actual numbers	7	35	16	2
Percentage of total	11.7	58.4	26.7	3.3
Percentage of same colour	7.3	8.8	11	9.5

HAIR AND EYE COLOUR COMBINED

HAIR COLOUR

Eye Colour	Dark (including black)			Medium			Fair			Red		
	Num-bers	sev-ere	deaths	Num-bers	sev-ere	deaths	Num-bers	sev-ere	deaths	Num-bers	sev-ere	deaths
Dark	39	6	2	37	4	2	17	0	2	3	0	1
Medium	39	3	2	260	21	21	87	10	11	12	0	1
Light	7	1	0	60	5	5	70	8	10	9	2	1
Blue	0	0	0	10	2	0	10	1	2	1	0	0

WHOOPING COUGH

Belvidere and Ruchill cases. Total number, 310

HAIR COLOUR

	Black	Dark	Medium	Fair	Red
Actual numbers	2	35	190	73	10
Theoretical numbers	4	84	140	66	16
Actual percentage	.6	11.3	61.3	23.6	3.2
Theoretical percentage	1.2	27.2	45.2	21.4	5
Severe cases					
Actual numbers	0	4	19	6	0
Percentage of total	0	13.8	65.6	20.7	0
Percentage of same colour	0	11.4	10	8.2	0
Deaths					
Actual numbers	0	0	19	10	1
Percentage of total	0	0	63.3	33.3	3.3
Percentage of same colour	0	0	10	13.7	10

EYE COLOUR

	Dark	Medium	Light	Blue
Actual numbers	47	118	111	34
Theoretical numbers	76	105	94	35
Actual percentage	15.2	38.1	35.8	11
Theoretical percentage	24.5	34	30.3	11.2
Severe cases				
Actual numbers	5	11	11	2
Percentage of total	17.2	38	38	6.9
Percentage of same colour	10.6	9.3	9.9	5.9
Deaths				
Actual numbers	5	9	14	2
Percentage of total	16.7	30	46.7	6.7
Percentage of same colour	10.6	7.6	12.6	5.9

HAIR AND EYE COLOUR COMBINED

HAIR COLOUR

Eye Colour	Dark			Medium			Fair			Red		
	Numbers	severe	deaths	Numbers	severe	deaths	Numbers	severe	deaths	Numbers	severe	deaths
Dark	16	2	0	30	3	5	1	0	0	0	0	0
Medium	8	0	0	89	10	7	19	1	2	2	0	0
Light	5	1	0	61	6	6	39	4	7	6	0	1
Blue	8	1	0	10	0	1	14	1	1	2	0	0