CLIMATIC AND TEMPORAL VARIATIONS IN THE NORMAL POLYNUCLEAR COUNT - A STUDY OF THE NEUTROPHIL POLYMORPHONUCLEAR LEUCOCYTES

CONTENTS

I INTRODUCTION

Changes in the neutrophil polymorphonuclear leucocytes of the blood may be quantitative or qualitative. The present investigation will be concerned only with physiological changes and primarily with qualitative changes measured by the degree of nuclear development and subdivision. Quantitative studies of the neutrophil polymorphs will only be considered in relation to such qualitative changes with a view to interpreting their nature.

Arneth's Method.

The numerical study of qualitative variations in the neutrophil polymorphonuclear leucocytes was begun by Arneth in 1904.[1] His method consists essentially of a numerical assessment of the neutrophil leucocyte population of the peripheral blood, based on a subdivision of cells according to the shape of their nuclei. The cells are placed in different groups according to the degree of segmentation of the nucleus. Since then a great amount of literature has accumulated on his method, which has come to be known as the Arneth Count. From the beginning it was known that certain pathological states (infections, in particular) affected the Arneth Count but it was also found that wide variations in the "normal" occurred.

Thus Chamberlain and Vedder (1911)[2] using Arneth's method found a marked left shift (i.e. an increase in the proportion of cells with one or two lobes at the expense of the proportion with three, four and five lobes) in Filipinos. Breinl and Priestley (1914-15; 1915; 1916-17)[3] by Arneth's method found a shift to the left in European children living in Queensland, in native adults and children of New Guinea and aboriginal children of North Australia, as compared with the "normal" results in Europe. These authors attributed the difference to climatic conditions. Macfie (1915)[4] found a left shift in Europeans and Natives resident in the Gold Coast, and suggested malarial infection as a possible cause.

Cooke and Ponder's Method.

With the publication of Cooke and Ponder's book on the Polynuclear Count in 1927 [5] their more simple method to a large extent replaced that of Arneth in subsequent investigations. They point out the obvious drawbacks of Arneth's method. Firstly the count is too complex to be of service in clinical medicine, the neutrophil polymorphs being subdivided into 21 classes. Secondly, a great deal of experience is required before reliable results can be obtained. They quote Rayevsky as stating that 40,000 observations were made before he became accurate. Thirdly the personal factor is liable to be very great, so that the results of different observers are of little value for comparative purposes. Lastly the full count as described by Arneth does not provide any more information than the Polynuclear Count of Cooke and Ponder.

Essentially Cooke and Ponder's Polynuclear Count (hereafter referred to as the Polynuclear Count) consists of a division of the neutrophil polymorphonuclear leucocytes into five classes, according to the number of lobes in the nucleus. They insist that each lobe should be joined by nothing more than a filament. The count is written as percentages of cells in various classes; e.g.

I	II	III	IV	V
9	26	48	15	2

For the sake of brevity and for comparative purposes the count is frequently expressed as an index; thus the total of Classes I and II, the one and two lobed cells, may be used;

in the above example the index would be 35. Bushnell and Treuholtz (6) suggested an index calculated by adding half the cells of Class III to the total of cells in Classes I and II.

Both these indices have the disadvantage of chiefly reflecting the cells with few lobed nuclei, though of course the numbers of cells in Classes IV and V will vary inversely with the numbers in the first three classes.

The Weighted Mean (f.1) (which has been used throughout this investigation) is a very sensitive measure of the distribution of the population of neutrophil polymorphs in the blood. It is moreover rather more sensitive to the number of cells in the multiple lobe classes; according to Cooke and Ponder these are the cells to alter first in abnormal states.

The Weighted Means of counts done by Cooke and Ponder's method are much lower than those obtained when Arneth's standards of nuclear subdivision are used, so that results obtained by the two methods are not strictly comparable; for example, many cells which in Arneth's count would be in Class III are in Classes I and II of the Polynuclear Count because of Cooke and Ponder's insistence that a mere indentation does not constitute a subdivision of the nucleus into two lobes.

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1. The Weighted Mean is calculated by multiplying the number of cells in Class I by one, those in Class II by two etc. and dividing the sum by the total number of cells.

The Normal Polynuclear Count (a) In Britain

1. Cooke and Ponder (1927)[5] examined 90 persons of both sexes between the ages of 12 and 55 years. They insisted on a very strict health standard. The average of these counts was:-

I	II	III	IV	V	Weighted Mean
10	25	47	16	2	2.74

Range 2.47 - 3.11. The counts were symmetrically distributed about the mean.

2. Kennedy (1932-33)[7] using a slightly less stringent health standard examined 90 healthy medical students in Scotland and found the following average count:-

I	II	III	IV	V	Weighted Mean
13	30	43	10	4	2.628

Standard Deviation 0.19. There was a statistically significant shift to the left as compared with Cooke and Ponder's results; this he attributed to his use of a less strict health standard.

It may be noted here that in these investigations the time of day is not stated, only one count per person was done, and the time of year, weather or temperature are not mentioned.

On the whole, however, these figures do not greatly differ, but when we come to survey the literature of the "normal values" in different countries wide variations are noted.

The Normal Polynuclear Count (b) In different countries

TABLE 1

The Polynuclear Count of Normal Subjects in Different Localities

LOCALITY	RACE	NO. OF SUBJECTS	AUTHOR	Av. W.M.	HIGHEST	LOWEST	S.E. OF MEAN	STANDARD DEVIATION
New York	American	100	Abels (8)	2.30	2.56	2.14	-	-
Iraq	Iraqis	134	Kennedy (9)	1.994	2.68	1.37	0.024	0.273
Iraq	British	134	Kennedy & Mackay (10)	1.935	2.50	1.35	0.019	0.222
Egypt	British	30	Shaw (11)	2.077	2.46	1.87	0.024	0.135
Egypt	Egyptians	50	Shaw	2.128	2.46	1.84	0.021	0.148
Moukden	Chinese	42	Pai (12)	2.073	2.55	1.80	0.027	0.178
Britain	British	90	Cooke & Ponder	2.740	3.11	2.47	0.019	0.18
Britain	British	90	Kennedy	2.628	3.05	2.18	0.020	0.19
Dublin	European	50	Dewhurst (13)	2.60	-	-	0.024	0.172
Dublin	Non-European	50	Dewhurst	2.60	-	-	0.0210	0.151
Wigan	British	25	MacLeod (14)	2.61	2.99	2.19	0.04	0.20
Australia	Australian	25	do.	2.64	2.96	2.18	0.038	0.19
Florida	American	25	do.	2.58	2.87	2.24	0.032	0.16
California	American	25	do.	2.57	2.84	2.23	0.034	0.17
Alberta	Canadian	25	do.	2.55	2.94	2.13	0.046	0.23
Colorado	American	25	do.	2.45	2.93	1.90	0.046	0.22
South Africa	S. African	25	do.	2.44	2.86	1.67	0.05	0.25
New York	American	25	do.	2.44	2.78	2.18	0.032	0.16
Japan	Japanese	25	do.	2.34	2.86	1.86	0.043	0.20
China	Chinese	25	do.	2.33	2.61	2.02	0.033	0.22
Greece	Greek	25	do.	2.31	2.79	1.78	0.06	0.27
N. Syria[1]	Alouites	326	Shanklin (15)	1.48	1.84	1.04	0.04	0.72
Calcutta	Indian	50	Dharmendra [illegible]	2.014	2.37	1.80	0.019	0.132
Bengal[1]	Indian	50	Das Gupta (17)	1.84	2.29	1.40	0.029	0.205
Tanganyika[1]	Various	37	Burke-Gaffrey (18)	2.65	-	-	-	-
Bengal & E. Africa	East African	500	Dewhurst	2.40	-	-	-	-

1. A lax health standard was used in selecting subjects

From the results shown in Table 1 it is clear that great variations in the normal value of the Polynuclear Count occur, and it is now proposed to examine the various factors known to affect the count (apart from pathological states) with a view to explaining these differences and perhaps throwing light on the physiology of the polymorphonuclear neutrophil. In addition mention will be made of factors which might be expected to affect the Polynuclear Count, but in fact, have been shown to have no effect.

Factors Influencing the Polynuclear Count

1. Climate and Location.

In order to attempt to understand the way in which climate affects the Polynuclear Count the relevant literature and diverse opinions will be critically reviewed.

Abels (1933-34) working in New York and using Kennedy's health standard, studied 100 subjects and found an average Weighted Mean (W.M.) of 2.30 with a range of 2.14 to 2.56. Theseresults were quite incompatible with those of Kennedy in Britain. He discusses possible fallacies of technique, but points out that Ponder and Kennedy worked together, and their counts agree; and Ponder checked Abels' technique personally, which makes this error unlikely. He concludes that locality is responsible for the difference.

Peterson (1934)[19] working in Michigan followed two subjects every second day (excepting holidays) from December to January, and from this deduces complicated relationships between the blood count and the weather. Except for one chart he gives no record of the Polynuclear Count, and readings cannot be made from this chart, as there is no scale. He suggests correlation between eosinophilic peaks and "periods of stimulation" with a shift to the left in the Polynuclear Count.

Kennedy (1934-35)(9) and Kennedy and Mackay (1935-36)(10) investigated the Polynuclear Counts of 134 normal Iraqis and 134 normal R.A.F. personnel in Iraq. They found a very marked left shift as compared with Kennedy's own results in Britain. There was no significant difference between these two groups in Iraq. They also noted that pathological Polynuclear Counts in Iraqis and British subjects who were ill in Iraq, were shifted more to the left than would be expected in similar groups in Britain.

The maximum shade temperature varied from 98-116°F during the Iraqis' investigations, and from 100-115°F during the British series in Iraq. It would thus appear that race does not affect the count but that some factor (or factors) operates in Iraq, which does not occur in Britain. These authors suggest that as both temperature rise and ultra-violet radiation (vide infra) are known to affect the count under certain conditions, these may be important factors in accounting for the left shift (relative to the British "normal") found in Iraq.

Pai (1935) examined, first of all, 60 "apparently healthy" Chinese of both sexes, between the ages of 13 and 50 years; of these he eliminated 18 who had a rather more marked left shift than he expected. He did this "in order to avoid exaggerating the difference between the two series". The specimens of blood were taken over a period of 3 years, between the hours of 9 a.m. and noon, and during summer and winter. The average W.M. of the 42 remaining subjects was 2.073 which was significantly different from the normal in Britain.

Pai then made 9 counts on 4 healthy British subjects in Moukden, where he had carried out the previous investigation. He found that they had a left shift of the same order as that found in the Chinese living there.

He also noted that the Polynuclear Counts of two healthy Chinese subjects altered from the Chinese "normal" to the British "normal" when they travelled from China to Britain. The counts were not done during the voyage but two were done in Moukden and seven in Britain. Finally, Pai noted a shift to the right in the summer at Moukden; four counts done in the summer gave a W.M. of 2.245 as compared with the average of 38 counts in the winter which gave a W.M. of 2.050. Unfortunately the small number of cases means that this difference is not statistically significant. It is to be noted that it is cold and dry in winter at Moukden, while dry and wet heat alternate in the summer. Pai cautiously suggests climate as the cause of the summer-winter variation.

MacLeod (1935) approached the subject somewhat differently and collected groups of 25 blood films from many parts of the world. The subjects were all "normal" adults by Kennedy's health standard; a few were rejected because of indications of abnormality in the white cells. The highest average W.M. was 2.64, in Australia, and the lowest, 2.31, in Greece. MacLeod found that the means for Australia, Wigan, Florida, Alberta and California did not differ significantly. The means for New York and Colorado were significantly different from those of the above localities, and were in the same class as those of South Africa, Japan, China and Greece. He concluded that these variations were due to differences in locality and not errors in counting. He states that "climatic conditions .... in the ordinary sense ofthe word do not appear to be a factor of much importance, for the climate is not uniformly better in those localities with a high count than in those associated with a low count". He also noted that normal subjects from the same locality are remarkably constant.

It may be objected however that MacLeod studied a very small number of people, and if he wished to consider climatic effects in detail he should have mentioned the climate and the time of day and year when the films were taken.

Shaw (1936) investigated first of all, 68 healthy Egyptians of both sexes, between the ages of 19 and 38, living in Cairo. He insisted on a fairly rigid health standard, and eliminated 18 of those who had minor abnormalities in their blood counts, thus conforming roughly to Kennedy's health standard. The blood was taken between the hours of 9 a.m. and 1 p.m. during the winter months, October to January inclusive, when the maximum shade temperature ranged from 65-81°F. He found an average Weighted Mean of 2.128 with a Standard Deviation of 0.148.

Secondly, he studied 30 male British adults in Egypt, the blood being taken in May, October, January and February (during which period it may be noted, the temperature varies considerably in Egypt). These subjects had been in Egypt for periods of two weeks to five years. He found a Weighted Mean of 2.077 with a Standard Deviation of 0.135. Thus Egyptian and British groups in Egypt did not differ significantly from one another, but showed a significant left shift compared with Kennedy's British results.

Thirdly, Shaw studied two persons travelling from Egypt to England and back: he found that within a few weeks of arrival in England the Polynuclear Count had reverted to the normal value for Britain. Similarly on return to Egypt, within a few weeks the count was much shifted to the left, corresponding with his normal values for that country. (It may be noted that in this last experiment only 7 blood counts on 2 persons were done.)

Shaw thinks that temperature cannot be responsible for the initial shift to the left in Egypt, Iraq or China, although it may account for the difference in its degree. His results also agree with those of Pai, Kennedy and Mackay in that race is not a factor in accounting for the different values of the Polynuclear Count in different countries.

Dharmendra (1941) who did not insist on a very strict health standard, examined 50 Indians in Calcutta, and found an average Weighted Mean of 2.014, with a Standard Deviation of 0.132. He again suggests temperature or ultra-violet radiation as the most likely factors causing the shift to the left relative to the "normal" in Britain; he could not however reconcile Pai's shift to the right in the summer with the fact that the hot climate in Iraq was associated with a left shift.

From 1944-1946 Dewhurst (1949) carried out Polynuclear Counts on 500 East African natives in the Highlands of Kenya and later in Bengal. A shift to the left was observed in both Kenya and Bengal. He also noted no difference between two groups of fifty subjects, one European and the other Non-European, in Dublin, again confirming that race is of no significance in determining the value of the Polynuclear Count.

2. Temperature and Infra-Red Irradiation.

Kennedy and Mackay[10] state that a Turkish bath gives rise to a left shift, but according to Arneth (1920)[20] a hot bath does not. Bierman (1934)[21] found a left shift after artifically induced hyperpyrexia. Dewhurst (1949) stresses the action of infra-red radiation on the body, and states that its mode of action is by heating the tissues. He performed a series of experiments in which guinea pigs were exposed to infra-red radiation of 4,000 to 40,000 Angström units and a temperature of 105-115°F. After 9-12 hours all the guinea pigs had a significant left shift; with short periods of exposure the effect on the Polynuclear Count was more varied, and some of the animals had a shift to the right. He concluded that a left shift could be produced by infra-red radiation and suggested that this may be an important factor in accounting for the left shift observed in the Tropics.

3. Ultra-Violet Radiation and Serum Calcium.

Exposure to ultra-violet radiation was shown to produce a left shift in animals by Kennedy and Thompson (1927-28)[22] and in children by Sanford (1929).[23] Further studies of the mechanism of this left shift by Climenko (1930 a and b)[24] showed that in rabbits ultra-violet light produced a left shift and a rise in serum calcium, and that the maximum rise in serum calcium and the maximum left shift coincided in time and extent. (The serum calcium estimations were done by the reliable method of Kramer and Tisdall.[25]) He also found that he could produce this left shift and the rise in serum calcium by giving injections of irradiated ergosterol or collosal calcium; further, these substances, given by routes which did not result in an effective rise of serum calcium, failed to produce a left shift. It was concluded that the mode of action of ultra-violet radiation was therefore, not by the production of a specific substance which stimulated the bone marrow, but by the changes in serum calcium levels produced.

No evidence has been found in a review of the literature to show that prolonged exposure to ultra-violet radiation will maintain a left shift.

4. Heredity and Species.

A familial form of left shift having no effect on health was first described by Pelger (1928),[26] although according to Tilestone (1937)[27] this original communication to the Dutch

Pathological Society merely alludes to a demonstration of two patients with a rare anomaly of the leucocytes which is not described in detail. Pelger does not appear to have published any further work on the subject. According to Huët (1932)[28] who described three families, the familial form of left shift is transmitted by the mother and latent carriers were not found in his series. Tilestone in reporting one case without a familial history, reviews the literature and concludes that the condition is transmitted as a non sex-linked Mendelian dominant. In no case have both parents been proved to be bearers of the trait.

The author has examined films from a heterozygous strain of rabbits showing Pelger-Huët type of left shift; the homozygous strain is difficult to breed as the young are sickly and are quickly eaten by their elders.

An interesting study of the influence of heredity on the Arneth formula was made by Turpin, Caratzali and Piton (1940).[29] They examined the blood of 39 pairs of twins, 17 uniovular and 22 binovular, and found that the counts of the uniovular pairs bore a statistically significant similarity to one another; this was not so with the members of the binovular pairs.

It might be noted here that the Polynuclear Count varies in different animal species, and in the same species it varies from place to place, as in man. Kennedy and Climenko (1931)[30] give an average Weighted Mean of 2.35 for rats. The values for cattle and sheep in Scotland, according to these authors are 2.34 and 2.52 respectively; the corresponding weighted means in New York are 1.28 and 1.24 respectively. (Simpson, (1929)[31])

5. Age.

According to Roberts (1927)[32] the value of the Polynuclear Count is the same in children as in adults. He used a simplified form of Cooke and Ponder's Polynuclear Count, which is useful for clinical purposes. The cells are divided into the non-lobulated (= Class I) and the lobulated (= Classes II to V). The number of counts done however was not large enough to be statistically significant.

6. Menstruation.

Menstruation, according to Roberts (1927)[32] produces a slight physiological left shift, but the non-lobulated cells do not rise above 35% of the total neutrophil polymorphs. No results however are given to illustrate this point.

On three occasions in the course of the author's investigation menstruation occurred in two of the subjects (Subjects 34 and 36 in the Glasgow series); no significant shift to the left was observed.

7. X-Rays.

Exposure to X-rays produces a shift to the left in the Polynuclear Count in rabbits (Cooke and Ponder (1927)[5]; Kennedy and Grover (1927)[33] and in humans (Helde (1946),[34] Nordensen (1946),[35] Marks (1949)[36]).

8. Chemical Factors

Injections of thyroid, colchicine, nucleic acid and trypsin were shown by Cooke and Ponder (1927)[5] to produce a left shift in rabbits. After a single subcutaneous injection of thyroid extract, the change was quite obvious on the following day and on the next day the maximum left shift was observed; this was followed by a shift to the right reaching a peak about 10 days later, after which the Polynuclear Count gradually returned to normal in the following 10 days.

Danzer (1930)[37] also working with rabbits found that injections of extracts of various organs and tissues produced a left shift in the Polynuclear Count, e.g. muscle, liver, testis, brain, haemolysed red cells, leucocytes and serum. Deproteinised extracts and histamine did not have any effect, so that he concluded that the protein contained the active principle of these extracts. The destruction and absorption of tissues in vivo was also found to produce a shift to the left. It is suggested that the continual normal breakdown of tissue in the body is sufficient to provide a stimulus for the steady normal output of neutrophils from the bone marrow.

Administration of various anaesthetics - ether (Ponder ad Flint (1927)[38]) and chloroform (Danzer (1930)[37]) - produces a shift to the left.

Reference has already been made to the effect of a rise in serum Calcium in producing a left shift (Climenko (1930 a and b)[24]). The same author noted that the intravenous injection of sterile hypotonic solutions produced a left shift, while physiological saline had no such effect. It thus appears that a disturbance of the normal electrolyte balance, or possibly of osmotic pressure relations may play an important part in the mechanism of regulating the output of neutrophil polymorphs, or their distribution in the body.

Reifenstein, Ferguson and Weiskotten (1942)[39] showed that intravenous injections of supernatent fluid from a sterile exudate from the peritoneal cavity of a rabbit, produced a left shift in that animal. The left shift reached a peak 2-4 hours after the injection, but repeated injections were followed by considerably greater and progressively more marked left shifts in 9 of the 11 rabbits; in other words an apparent "summation" effect was produced. Injections of sodium chloride (presumably isotonic) failed to produce a left shift in controls. They suggested that some substance, (other than sodium chloride) in the supernatent fluid, was responsible for the release of more immature granulocytes from the bone marrow.

9. Time of Day and of Year.

The Polynuclear Count does not appear to vary much, if at all in the course of one day. Roberts (1927)[32] found that the "non-lobulated" cells (i.e. Class I of the Polynuclear Count) did not vary with the time of day. He does not however give any results to substantiate this statement. Reifenstein and Hilfinger (1942)[40] note that each rabbit seems to have a characteristic degree of nuclear maturity on the day of counting and hourly counts show little variation.

Cooke and Ponder (1927)[5] state that the Polynuclear Count is very constant in man, but do not seem to have carried out any prolonged investigation of this point. Danzer (1930)[37] gives figures to show that under laboratory conditions the rabbit has a constant count.

Turpin et al. (1940)(29) examined 14 subjects at intervals of 4 days to 4 months, and found no significant difference in counts over that period.

On the other hand, as already mentioned Pai (1935)(12) found a relative shift to the right in the summer in Moukden, although the difference was not statistically significant. Harvey and Hamilton (1934)(41) followed two subjects' counts for four months and found considerable variations, though again there were not enough results to reach a definite conclusion; furthermore the differential leucocyte count of one of his subjects was abnormal.

10. Diet and Meals.

As Shaw (1936)(11) pointed out the British subjects in his study in Egypt ate food similar to that which they would have eaten in Britain, and he could not believe that any dietary difference would be sufficient to account for the left shift in both British and Egyptians in Egypt. Further in the case of the British and Egyptians (Shaw), Iraqis and R.A.F. (Kennedy and Mackay, (9) and (10) Chinese and British (Pai(12)) the indigenous people ate different food from that of the British, and yet both groups showed a similar deflection of the Polynuclear Count.

Cooke and Ponder (1927)(5) state that in the "digestion leucocytosis" which follows meals, there is no left shift, a fact which they attribute to the redistribution mechanism producing this increase in leucocytes.

The Aim of the Present Investigation.

From the analysis of literature presented it is clear that there are great variations in the normal value of the Polynuclear Count; and further, these different values cannot be explained satisfactorily by the facts already known about the physiology of the neutrophil polymorph. No comprehensive study of the changes in the Polynuclear Count during long term variations of temperature and climate has so far been made; it was felt that such an investigation might throw light on the causes and mechanisms responsible for maintaining the "normal" blood picture in different parts of the world.

The aim of this investigation is therefore to study the changes in the white blood cells, and in particular the qualitative changes in the neutrophil polymorphonuclear leucocytes (as measured by the Polynuclear Count) in the blood of healthy young persons subjected to prolonged variations in external temperature, but otherwise living under standardised conditions as regards factors known to affect these cells in the body.

II PROCEDURE

A. On Ships

Age, health standard, diet, living conditions, external temperature recordings, body temperature, solar radiation, race, previous tropical experience, time of day, the Polynuclear Count, method of taking off blood, total white cell count, differential count, barometric pressure, longitude and latitude, effect of the sea, humidity.

Voyages I to V.

B. Ashore

Part 1. Glasgow

Part 2. Cambridge

PROCEDURE

A. On Ships

A total of 32 healthy young male subjects were studied over a period of ten months, travelling between the United Kingdom and various parts of the world.

Age. The subjects were between the ages of 18 and 34 years.

Health. All the subjects were Grade I in the Army or R.A.F. Each give a history of no serious or important illness in the preceding year and clinical examination at the onset of the experiment revealed no significant abnormality. Three subjects were rejected, not because of any physical abnormality, but because their blood pictures did not conform with the accepted normal. During the course of the experiment several of the subjects contracted minor illnesses, such as coryza or diarrhoea (which are noted in the results). When these illnesses did not affect their blood counts, the results were included; otherwise they were excluded until the blood returned to what appeared to be the subject's normal.(f.1) It will be appreciated that perfect health throughout is desirable, but when blood counts are followed daily for months it is inevitable that such minor ailments occur. It will be noted that contrary to Cooke and Ponder's (1927)[5] results, these generally affected the count very little. Indeed one subject (No. 24) whose count had previously been followed .

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1. The author was in some doubt as to whether to exclude some of the rather low Polynuclear Counts at the beginning of Voyage I as some of the subjects had colds; the improvement in their colds may be related to the slight right shift on the first few days, but as will be seen from the analysis no conclusions are drawn from this part of the investigation.

daily for over two months showed a shift to the left of 0.10 - from a Weighted Mean of 2.95 to 2.85, when he had an attack of acute appendicitis, with a tense purulent appendix found at operation. A few of the subjects were seasick, without any effect on their blood counts.

Diet. All the subjects had the same diet throughout each trip, allowing of course for the usual day to day variations for palatability. The Polynuclear Count did not differ in the case of smokers and non-smokers.

Living Conditions. The subjects worked from eight to ten hours daily in the ship's hospital. Sleeping conditions varied from ship to ship but were standard for each person from start to finish on each voyage. Similarly different persons had different standards of comfort on each ship but each was affected relatively to the same degree by change of external temperature.

External Temperature Recordings. The temperature was recorded on each voyage by the use of a wet and dry bulb thermometer on the ship's bridge in a standard meteorological box; the readings were taken four hourly or six hourly. Obviously this is not an entirely satisfactory method of recording the changes of temperature to which an individual is subject; it was chosen chiefly because it was a standard reading comparable on different ships and partly because it was the best approach to an absolute record of environmental temperature. The following drawbacks will be noted:-

1. It is usually cooler on the bridge than elsewhere.
2. These readings did not reflect the effects of wind, e.g. a following wind makes it much hotter below

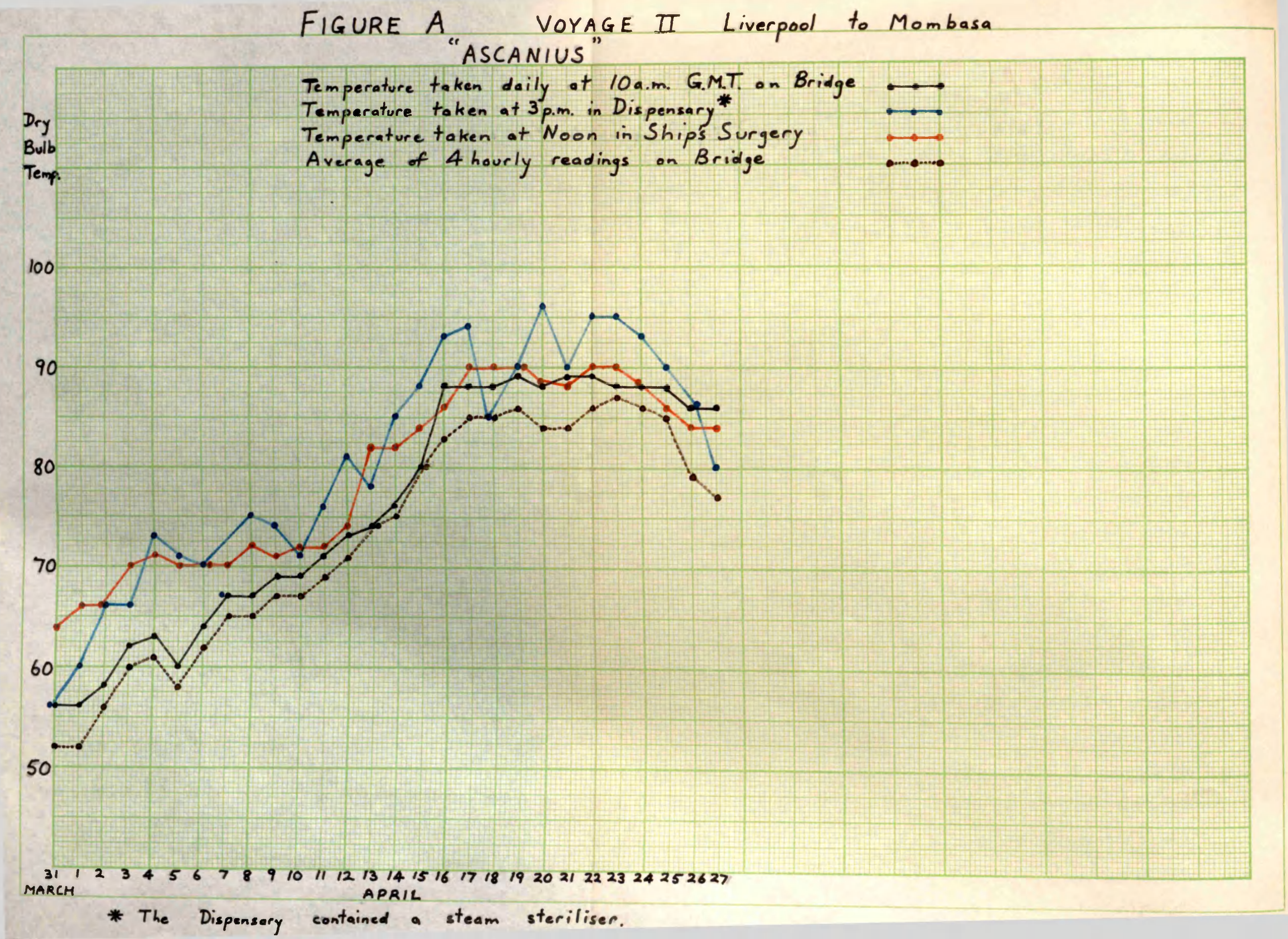
FIGURE A VOYAGE II Liverpool to Mombasa
"ASCANIUS"
Temperature taken daily at 10a.m. G.M.T. on Bridge
Temperature taken at 3p.m. in Dispensary*
Temperature taken at Noon in Ships Surgery
Average of 4 hourly readings on Bridge
Dry Bulb Temp.
100
90
80
70
60
50
31 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
MARCH
APRIL
* The Dispensary contained a steam steriliser.

decks than a head wind, and similarly one side of the ship may be hotter than another, depending on the direction ofthe wind.

3. The extremely cold and extremely hot readings do not reflect the conditions below where there were heating and cooling systems to facilitate comfort. Similarly some cabins, or parts of the ship were less comfortable than others, and more affected by changes of outside temperature.

4. For these reasons the same bridge temperature on different ships does not mean the same environmental temperature for subjects living on these ships. Nevertheless a rise of bridge temperature of, say, $10^{o}F$ on one ship, is roughly comparable to a similar rise of bridge temperature on another ship, and persons living on the two ships will be subjected to the same relative change of temperature.

5. Also as deck and below deck temperature readings show, a ship warms up slowly below decks, (and vice versa) thus temperature below decks tends to lag behind the bridge temperature.

Ideally, of course the temperature of each subject's environment throughout the trip should be noted but this was not possible. Readings in various parts of S.S. Asconius are shown in the appended figure.(Figure A) (The readings in the dispensary are more variable than the others because they depended a lot on how much the steam steriliser had been working.) It will be seen that the bridge temperature readings do reflect fairly well the changes of temperature in different parts of the ship.

It must also be noted that the wearing of suitable clothing alters the actual temperature to which the body has to adjust itself.

For the reasons stated above, it will be clear that small changes of bridge temperature must be ignored as they may not affect the environment of an individual to any noticeable extent.

Body Temperature. These were taken with standardised clinical thermometers, the thermometers used being found to give identical readings for the usual ranges of body temperature 97.0 to 99.8° F. The temperatures were taken orally for five minutes or until two successive readings with at least a minute interval were identical; this occasionally took ten minutes.

Solar Radiation. One factor which was not constant throughout the experiment was the amount of sunlight. It might be useful at this point to consider briefly the nature of actinic radiation.

Solar radiation consists essentially of infra-red, visible light, and ultra-violet rays. Light is visible radiant energy, and infra-red and ultra-violet, the longest and the shortest wave lengths respectively are invisible radiant energy. The intensity of solar radiation reaching the earth's surface is very variable, and depends upon atmospheric transparency, dust and humidity. In this experiment the direct quantitative measurement of solar radiation was not possible, and as it has been noted that infra-red and ultra-violet radiation affect the Polynuclear Count experimentally these factors will be considered later in some detail. For the present, however, a few brief notes will suffice on the manner in which these two factors were taken into consideration.

(a) Infra-red radiation.

Dewhurst (1949)[13] analyses the relative importance of the various fractions of solar energy reaching the earth's surface, and from his discussion it appears that the amount of infra-red radiation is very variable. The total daily amount of infra-red radiation is greater in the tropics than in temperate zones; consequently the temperature is higher. As it is not easy to measure directly the amount of infra-red radiation reaching an individual the present investigation will be confined to measuring its effects by temperature recordings of the environment, and body temperature readings. This is not entirely satisfactory in that other factors besides infra-red radiation affect the environmental temperature, such as wind velocity and direction and the presence of large land masses. On the other hand external temperature recordings constitute a more useful single figure to embrace a number of environmental factors of which infra-red radiation is one.

(b) Ultra-violet radiation.

Unlike long wave radiation, the effect of ultra-violet radiation is virtually nil indoors; the subjects were not exposed much to the sun, as they were working in the ship's hospital during daylight hours and when in the sun, were usually well covered. If they were exposed to the sun for any length of time (an arbitrary period of half an hour's sunbathing or its equivalent was taken as the minimum) this was noted.

Race. All subjects were of British birth and nationality.

Previous Tropical Experience. Some subjects had not formerly experienced tropical conditions, while others had some time previously been in the tropics for variable periods. It will be noted that there is no difference in the behaviour of the blood counts in these two groups. The subjects were studied on board ships throughout. The majority were the permanent staff of the ship and were followed throughout the voyage. In one case (Voyage I return trip) six subjects who had been in the tropics for varying periods (from four to twenty-two months) were studied, and, after an initial difference which will be discussed, their Polynuclear Counts behaved in a similar manner to that of the four permanent staff who were studied simultaneously. (See Appendix B, Fig. 3.)

One subject (R.L.) was studied throughout the whole period, and, on each occasion his blood changes were similar to those of the other subjects.

Thus, exposure to tropical (and sub-tropical) conditions at some previous date does not seem to impair or alter the response of the Polynuclear Count to subsequent environmental changes. The subject of immediately previous tropical experience will be dealt with more fully in the analysis of results.

Time of Day. Although previous literature suggests that the Polynuclear Count does not vary at different times of the day, it was considered advisable to take off blood at the same time each day, namely between the hours of four and five in the afternoon. The blood was taken off daily, missing only those occasional days when the subjects were ashore.

The Polynuclear Count. The method used was that of Cooke and Ponder (1927).[5] In previous work Leishman's stain was tried, as the observer was more familiar with its use; well-stained preparations gave almost identical results to those obtained by Giemsa staining, but if the film was a little too heavily stained, even in parts, there was a tendency to get a shift to the left. (It may be noted that Cooke and Ponder found Leishman unsuitable). On the whole therefore Giemsa was found to be more reliable, although considerable variations in staining time were necessitated by the changing temperatures; when the temperature was high the staining time had to be reduced. It was found that the most satisfactory method was to use Giemsa stain diluted 1 in 10 with a buffer of pH = 6.4 (Haden (1923-24)[42]).

Because of the considerable error and difficulty arising from the use of thick films, care was taken to spread the films thinly and evenly.

Cooke and Ponder's standards of nuclear subdivision were adopted. Thus, if there was any doubt between cells of Class I and II, the cell was counted in Class I; similarly if there was doubt between Class III and IV it was counted as Class III, or between IV and V, it was counted IV. If there was doubt between Class II and III, the cell was not counted. Cells distorted by pressure were discarded. A total of at least 100 neutrophils was counted in every case, and sometimes when 200 cells were counted for a full differential count, 100-170 neutrophils were counted, and the percentages in each class calculated from this number.

Cooke and Ponder found a Probable Error of ± 0.05 - 0.06 on the Weighted Mean of 100 cells, and concluded that this was a sufficient number to count. This is equivalent to a Standard Error of about ±0.09 in their first count of 10 films taken from one person. This error was considerably reduced for comparative purposes by counting 5 to 10 subjects daily in this experiment, and therefore a total of 500-1000 cells. As all the subjects show the same trends this amounts to sampling 500-1000 cells from the same universe; the average of these counts is an approximation to the Weighted Mean of the universe, which although of little value as an absolute index of that universe, can be used for comparative purposes.

Several hundred counts had been done by the author before the present study began, and on several occasions counts were confirmed by experienced haematologists. All counts throughout the experiment were done by the same observer. The Weighted Mean was used as the best single figure for comparison. There was found to be no significant difference in the results when the total of Classes I and II was used as an index.

The observer called out the numbers of the various cell classes to an assistant and was thus more or less unaware of the numbers of cells in each class until the end of the count; a few counts, however, had to be done without any assistance. Care was taken not to ascertain temperature readings until the end of each voyage, to avoid the influence of preformed theories on the results.

The importance of such precautions cannot be over-emphasized;

and yet the subject of unconscious bias does not seem to have been mentioned in the literature on the Polynuclear Count. Marks (1949)(43) found considerable divergence between two series of differential counts on the same blood films, the first being done without help, and the second taken down by an assistant. Furthermore, the author has personally noted a tendency to achieve more "text-book" differential counts on bone marrow smears when doing these without assistance. Fortunately, as a result of reading the literature the author expected a rise of temperature to be accompanied by a shift to the left in the Polynuclear Count, and as will be seen this was not always the case. Two further sources of error were diminished by the employment of an assistant; firstly, the identity of the subject was frequently unknown to the author until the count was finished; and secondly, the unconscious tendency to make the rest of the counts follow the trend of the first few was minimised in this way.

Method of Taking off Blood. Blood was taken from the ear in all cases (with the exception of R.L. where it was more convenient to use the thumb). Only very gentle squeezing was occasionally necessary.

Total White Cell Count. On some trips the total white count was also recorded, and in all a total of 589 counts were done. The method used was the usual one of counting two square mm. areas. Time considerations and the shortage of white cell pipettes unfortunately precluded the counting of larger areas of the slide. As this was merely a subsidiary part of the investigation however, and large numbers of counts were done the use of this quick method was considered justifiable. Furthermore as the results were not used to establish absolute values, but for comparative purposes only, the error thus produced is roughly constant throughout.

Differential Count. This was not done in full, but on three voyages, the cells were subdivided into neutrophils and "the rest", in order to ascertain whether there was any important variation in the neutrophil count, independently of the total count. A battlement edge method of counting the films was used as advocated by MacGregor et al. (1940)[44].

Barometric Pressure. Four hourly barometric pressures were recorded on one trip (Voyage I); as this was found to show absolutely no correlation with blood changes, further investigation along those lines did not seem profitable.

Longitude and Latitude. It was not thought necessary to record these; a brief examination of the course of the voyages will show that neither bears any relation to the results.

Voyage I The "Empress of Australia" 12.1.47 to 7.2.47. Liverpool to Singapore and back, via Port Said, Bombay and Colombo

Four members of the ship's permanent staff were studied throughout the round voyage. Six passengers were studied on the outward voyage and a further six on the return trip. Polynuclear Counts only were done. Ten counts were done daily, making a total of 459 counts. The complete results of this and subsequent work are shown in Appendix A.

Criticism may be levelled at some of the subjects chosen because their initial Polynuclear Counts were low compared with

Kennedy's normal range for Great Britain. (It should be noted that these persons were clincially healthy and conformed to the health standard defined.) Nevertheless, reference to the results, and Fig. 1, Appendix B, will show that their Polynuclear Counts behaved in a manner similar to those with initially higher and more "normal" values. Further, we are not interested here in establishing absolute normal values, but in observing how the blood of clincially healthy individuals changes under certain conditions.

Voyage II "Ascanius" 30.3.47. to 16.6.47.

Liverpool, Port Said, Aden, Mombasa, Mauritius, Durban, Mauritius, Mombasa, Berbera, Port Sudan, Suez.

Five members of the ship's permanent staff were studied throughout the whole trip; one further member of the permanent staff was studied for the last nine days of the voyage. Unfortunately it was not possible to follow these subjects' blood changes back to the United Kingdom as the staff were disembarked at Suez, and returned home separately.

Five passengers were studied from Liverpool to Mombasa.

Polynuclear Counts and total white cell counts were done daily on all subjects, as frequently as possible, making a total of 454 Polynuclear Counts and 411 white cell counts.

It will be noted that No. 24 (N.H.W.) had an attack of appendicitis, followed by an appendicectomy at sea on 14.6.47., and as his Polynuclear Count showed little change the results are included in the series.

Voyage III "Cheshire" A. 2.8.47. to 24.8.47
Liverpool, Malta, Port Said, Malta, Liverpool.

Five members of the ship's permanent staff were studied throughout the whole trip. No. 30 (L.W.) was retained because although his count was rather low compared with Kennedy's normal values for this country, it showed changes similar to the others throughout; also it was possible to follow his counts throughout subsequent trips.

Polynuclear Counts, total white cell counts and differential counts were done daily on each individual, making a total of 95 complete investigations.

Voyage IV "Cheshire" B. 2.9.47 to 24.9.47.
Liverpool, Malta, Port Said, Tobruk, Malta, Liverpool.

Five members of the ship's permanent staff were studied throughout the entire voyage; four of these were studied in the previous trip and the same four were again studied on the next voyage (V).

Polynuclear Counts, total white cell counts and differential counts were done as on the previous voyage; 92 such investigations were carried out.

Voyage V "Cheshire" C. 1.10.47. to 22.10.47.
Liverpool, Malta, Port Said, Tobruk, Malta, Liverpool.

Five members of the permanent staff were studied throughout, including the four subjects already observed on Voyages III and IV.

Polynuclear Counts, total white cell counts etc. were done as on the previous voyage, a total of 95 such investigations being carried out.

PROCEDURE (continued)

B. Ashore.

Part 1. Glasgow

Five healthy young subjects, two male, and three female, were studied daily, excepting Sundays and University holidays from January 12th to March 11th, 1948.

Age. The subjects' ages were between 22 and 26 years inclusive.

Health. The health standard was similar to that of the subjects on board ships. No. 34 (E.W.) however suffered occasional functional dyspepsia, but no evidence of organic disease could be found even after repeated radiological examination. Time of menstruation has been noted in the results, and is possibly responsible for a very slight left shift, although this is doubtful.

Diet. Subjects ate the usual diet of this country.

Living Conditions. Four of the subjects were medical students attending classes at Glasgow Royal Infirmary. The fifth was the author (R.L.) who also worked at the Royal Infirmary.

External Temperature Readings. These were read on a screened Wet and Dry Bulb thermometer in the open air in Glasgow. The previous remarks concerning the difficulty of finding a suitable measure of external temperature likewise apply here, and it was felt that such temperature readings were superior to any taken indoors. Nevertheless the subjects spent the greater part of their lives indoors under artificially warm conditions so that they were not directly subject to such wide ranges of temperature as the readings might suggest.

Body Temperature. See previous remarks, under this heading.

Actinic Radiation. See previous remarks. In the smoky atmosphere of Glasgow, ultra-violet radiation was virtually nil at this time of year.

Race. All subjects were of British birth and nationality.

Time of day. For convenience the blood was taken off between the hours of 9 and 10 a.m. daily.

The technique of counting was as before, except that only Polynuclear Counts were done.

Part 2. Cambridge

Polynuclear Counts were done daily on seven healthy young male adults (excepting Sundays):

(a) during the period 31st January to 12th February, 1949, when the weather was fairly cold, and

(b) during the period 17th May to 1st June, 1949, when the temperature was considerably higher.

Unfortunately M.K.A. (No. 38) had a marked left shift in the second series, associated with signs and symptoms of a Glandular Fever type of illness, so that his counts could not be used for comparative purposes.

Age. The subjects' ages were between 23 and 33 years.

Health. The health standard was similar to that of the other experiments, and although three of the subjects developed a mild coryza during a part of the second series, this did not seem to alter their counts.

Diet. Subjects ate the ordinary diet of this country.

Living Conditions. All subjects worked in the Department of Pathology of the University of Cambridge, and all lived in or near Cambridge.

External Temperature Readings. These were read four hourly excepting one reading during the night, in the same manner as before.

Actinic Radiation. See previous remarks. As the subjects were indoors during most of the daylight hours, ultra-violet radiation must have been very small.

Time of Day. For convenience the blood was taken off between the hours of 4 and6 p.m., excepting Saturdays when it was taken in the morning.

III ANALYSIS OF RESULTS

A. The Polynuclear Count and Body Temperature.

B. The Polynuclear Count and Barometric Pressure.

C. The Polynuclear Count and Atmospheric Humidity.

D. The Polynuclear Count and the Effect of the Sea.

E. The Polynuclear Count and Solar Radiation.

(a) Infra-red Radiation.

(b) Ultra-violet Radiation.

F. The Polynuclear Count and External Temperature.

G. The Polynuclear Count and the Total and Differential White Blood Cell Count.

The results of the present investigation (Appendix A and B) show clearly that marked changes take place in the Polynuclear Counts of subjects on board ships going to and from hot climates. These are much greater than the changes in the Polynuclear Count over a three month period in Glasgow, using the same standards of technique and selection. They cannot therefore be attributed to faults in such technique and selection, as these are constant in both groups. They must be due to some factor (or factors) operating on ships, but which does not operate in Glasgow.

In the introductory remarks and the notes on procedure a number of factors have been observed to produce changes in the Polynuclear Count; many of these have been found to do so only under experimental conditions. Nevertheless all relevant factors known to influence the count, or thought likely to do so, will now be considered in relation to the changes observed in this investigation. In particular attention will be paid to those factors which tend to be variable during the voyages, or which operate on ships but do not operate in Glasgow.

A. The Polynuclear Count and Body Temperature.

No significant correlation or suggestion of correlation was found between the Weighted Means of the Polynuclear Count and body temperature. Indeed the changes in the latter were so small in comparison with the changes in the blood, that it was not considered worth calculating correlation coefficients.

B. The Polynuclear Count and Barometric Pressure.

As already noted the recording of barometric pressures was abandoned after the first voyage; there was no suggestion of any relationship between the Polynuclear Count and Barometric pressure. See Fig. 12, Appendix B.

C. The Polynuclear Count and Atmospheric Humidity.

From the observations of Wet and Dry Bulb temperatures the atmospheric humidity was calculated on the first two trips and found to bear no consistent relationship to the blood changes observed. Inspection of Figure 13, Appendix B, gives a first impression of possible negative correlation; closer examination shows however that the correlation is spurious. Whereas in the first half of the voyage a rough negative correlation predominates, in the second half the opposite occurs. Again in the first part of Voyage II (Figure 14, Appendix B) a rough negative correlation occurs; but after that there is little suggestion of any consistent relationship between humidity and the changes in the blood.

In any case the coexistence of persistently high humidities, for example in Glasgow and in the Red Sea area, cannot be correlated with the gross divergence in the observations of the Polynuclear Count in these two places.

D. The Polynuclear Count and the Effect of the Sea.

It might be argued that going to, or being at sea, might have some effect on the Polynuclear Counts. It is not possible to correlate the varied responses on different voyages with the single factor of going to, or being at sea, which was common to all trips. Nor does it seem likely that the initial shift to the right could be explained by the effects of the sea; firstly because subjects who had been at sea for several months had a similar right shift when exposed to the same temperature variations (Voyage II "Ascanius); secondly it would be difficult to explain the differing rates of right shift and the fact that they persist for periods varying from a few days to a few weeks after sailing.

It may be noted here that as most of the subjects were permanent staff of the ships, and had therefore been at sea for some time previously, seasickness was rare; and further the Polynuclear Counts of permanent staff and passengers were identical in behaviour (with the one exception already noted - Voyage I return trip).

E. The Polynuclear Count and Solar Radiation.

(a) Infra-red Radiation.

As already noted this was a very variable factor under the conditions of this investigation. In the notes on procedure, reasons have been given for using external temperature recordings as the best single index of the effects of infra-red radiation. The Polynuclear Count and infra-red radiation may thus be conveniently studied as the relationship between the count and external temperature, and will be considered under that heading.

(b) Ultra-violet Radiation.

Mention has been made of the small amount of ultra-violet radiation likely to reach the subjects during these observations. When subjects were exposed to the sun for any length of time this has been noted in the results. No obvious effects on the Polynuclear Count were observed as a result of such exposure; nor did the counts of those who were subjected to direct solar radiation on any day or over any period differ from those who were not so exposed.

The difficulties of arriving at anything more than a rough approximation to the amount of effective ultra-violet radiation reaching each individual are obvious. The only justifiable conclusion at this stage is therefore that, from the rough measurements used in this investigation, ultra-violet radiation did not appear to have any effect on the Polynuclear Count. That ultra-violet radiation under the conditions of this investigation has no effect, is not a justifiable conclusion; the question of the possible role of such radiation in accounting for the changes in the Polynuclear Count noted here, and in the literature, will be discussed later.

F. The Polynuclear Count and External Temperature.

Firstly Coefficients of Correlation were calculated between the Weighted Means of the Polynuclear Count and Wet and Dry Bulb temperatures respectively. These are shown in Table 2.

Table 2

Coefficients of Correlation between Weighted Means, and Wet and Dry Bulb Temperatures.[f.1]

Voyage	Subjects	W.M. and Wet Bulb Temperature	W.M. and Dry Bulb Temperature
Empress of Australia	Nos. 2, 3, 4 and 5 [f.2]	-0.463 ± 0.115	-0.402 ± 0.122
Ascanius	Nos. 5, 18, 23, 24 and 25	-0.324 ± 0.113	-0.301 ± 0.115
Cheshire A	Nos. 5, 27, 29 and 30	0.102 ± 0.227	0.001 ± 0.229
Cheshire B	Nos. 5, 27, 29 and 30	0.744 ± 0.105	0.713 ± 0.116
Cheshire C	Nos. 5, 27, 29 and 30	0.809 ± 0.079	0.829 ± 0.072
All Cheshire Trips	Nos. 5, 27, 29 and 30	0.539 ± 0.095	0.491 ± 0.101

There is therefore no straightforward and simple correlation between either Wet or Dry Bulb temperature and the Polynuclear Count. It may be noted that the temperature readings in the calculation of the correlation coefficient were not normally

1. See Notes on the Calculation of Coefficients of Correlation (Appendix C)

2. These subjects were selected because they were present throughout the whole of each voyage; inclusion of subjects who only completed part of the trip would upset the validity of the Correlation Coefficient.

distributed, a factor which accounts for some of the discrepancies in the above table. Thus some trips being hotter than others, there is great variation in the number of high temperatures after the initial rise, and as we shall see, in the number of counts showing a left shift. Where therefore the temperature is high throughout most of a voyage, e.g. Empress of Australia and Ascanius, the large number of counts showing a left shift tends to obscure the effects on the correlation coefficient of the smaller number of right shifts; the result is a negative correlation suggesting that rise of temperature is associated with a left shift.

It is clear then, that the Coefficient of Correlation is only of limited value in this analysis. Nevertheless a closer consideration of these statistics, and of the similarity in the changes in the subjects' Polynuclear Counts during comparable changes of external temperature, justifies a more detailed examination of the results. From this, the following conclusions were reached.

(1) All subjects who had been living in a more or less steady temperature of Wet Bulb[f.1] range 51-65°F for at least one week previously, and were subjected to a <u>continuous</u>[f.2] rise of Wet Bulb temperature up to 16-18°F, had a shift to the right in the Polynuclear Count.

(See Appendix B, Figs. 1, 4, 6, 8 and 10. The continuous rises referred to here are indicated by a blue line.)

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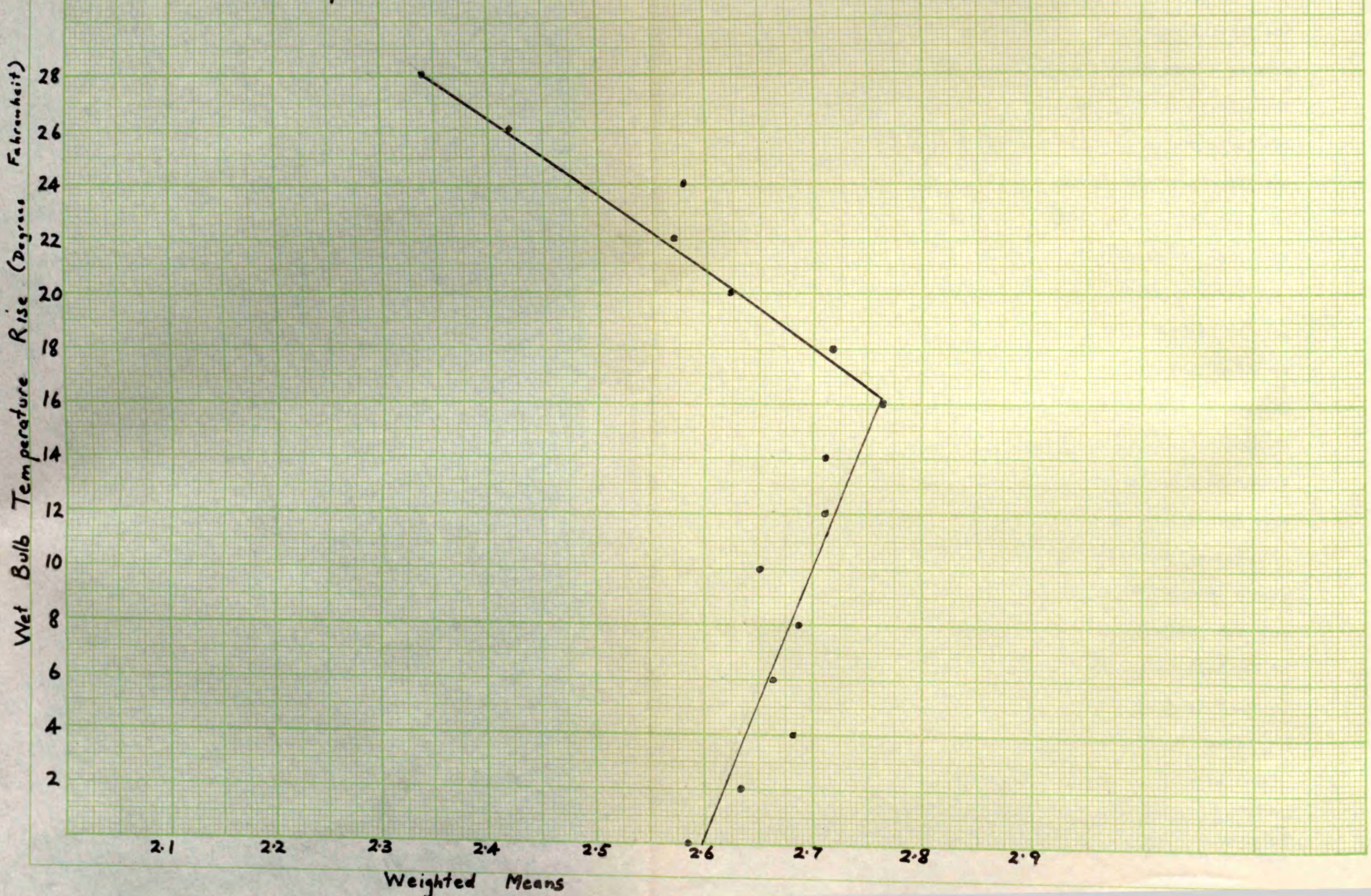
1. The relationship between the Wet Bulb temperature and the Polynuclear Count was more consistent than that between Dry Bulb temperature and the count. See Table 2.

2. I.E., not falling more than 5°F at any point in its ascent.

FIGURE B showing Wet Bulb Temperature Rise and Mean Values of Weighted Means of Polynuclear Counts. The two straight lines describe the relationship between the counts and the temperature rise. Total of 462 counts.



Thus, on all five trips, 25 different subjects each had a shift to the right on one to six occasions, under these conditions. No subject failed to respond in this way to such a change of temperature. A total of 40 right shifts were recorded in the 25 subjects, and a total of 331 Polynuclear Counts were done.

There is a straight line relationship between this rise of Wet Bulb temperature and the Weighted Means of the Polynuclear Counts. The Coefficient of Correlation between Wet Bulb temperature Rise up to 16°F and the Polynuclear Count Weighted Mean is 0.251, $\pm$ 0.052, indicating a significant correlation. See Figure B.

(2a) If the continuous Wet Bulb temperature rise was less than 16-18°F and the temperature then fell, the Polynuclear Count showed a right shift as before and then a left shift beginning when the temperature reversal occurred.

(2b) Similarly if the continuous temperature rise ceased before a 16-18°F Wet Bulb rise, and then remained steady, the right shift in the Polynuclear Counts terminated and the count tended to return to its original, or more likely to a different level, probably more to the right than before. (See also (6) p. 50)

The above changes are illustrated in Figs. 8 to 11 in Appendix B, showing Voyages B and C on the Cheshire. It will be noted that in these examples there is a tendency for the Polynuclear Count to return to its original or possibly to a different level, when the temperature rise ceases.

Also if the above hypothesis is true then under the conditions stated there would be a fairly close correlation between Wet Bulb temperature and the Polynuclear Count. This, in fact, is so for in both these voyages (IV and V) there is a high and significant correlation between Wet Bulb temperature and the count. See Table 2.

Such a correlation, however, between the Weighted Mean and the Wet Bulb temperature only occurs with the relatively simple temperature changes which occur on these two voyages, i.e. a continuous rise of less than 16°F Wet Bulb, and then a fall, with a steady period in between in Voyage IV. Such a correlation would not be expected according to the theory stated above and in the subsequent analysis, and indeed does not occur with the more complicated temperature changes on the other voyages where continuous rises and falls of this nature were not recorded. It is suggested that in Voyages IV and V there is not the same superimposition of one stimulus upon another before the results of the first can be followed through.

(3a) If the temperature went on rising after a continuous rise of 16-18°F Wet Bulb, the subjects then had a left shift in their Polynuclear Counts.

This occurred on every occasion that the Wet Bulb temperature rose continuously for more than 16-18°F in the course of the observations. Thus 23 different persons showed this change (one, R.L. No. 5, showed it three times). Twenty-six such changes were observed and a total of 131 Polynuclear Counts were done during this part of the temperature rise.

If then we correlate rise of Wet Bulb temperature and the Weighted Mean of the Polynuclear Count, we find a straight line relationship and a significant positive correlation up to 16°F. From 16°F to 28°F the relationship between the two is described by a different straight line, and there is a statistically significant negative correlation between the Polynuclear Count and the Wet Bulb temperature rise. The Coefficient of Correlation $= -0.510 \pm 0.065$. See Figure B.

(3b) If the maximum Wet Bulb temperature was maintained at a steady level (f.1) after a continuous rise of 16-18°F or more, the subjects' Polynuclear Counts then showed a left shift.

This occurs twice in the course of the observations. Examination of Figs. 4 and 5 in Appendix B showing the Ascanius voyage will show that the Wet Bulb temperature remains steady (by the above standards) from the 18th April to the 2nd May. During the preceding period of this voyage the subjects' Polynuclear Counts had already undergone a right shift along with a Wet Bulb temperature rise of 16-18°F ((1) above) and a left shift along with a further temperature rise. ((3a above) They now show a continuation of the left shift, which however is not quite so rapid in its progress as before. (f.2)

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1. I.e. not falling more than 5°F without regaining the previous level.

2. In this case however an alternative explanation is possible; during this period the Wet Bulb temperature is steady but the humidity shows a very close negative correlation with the Polynuclear Count (See Figure 14, Appendix B). As suggested later (p. 63) under such conditions the rise of humidity increases the heating effect of the atmosphere on the body, and may be the cause of this left shift.

Similarly in the second part of the Ascanius voyage, the subjects' counts had undergone a right shift along with rising temperature from Durban. This right shift reached a peak on the 9th June corresponding with the summit of the Wet Bulb temperature rise; after this the temperature remains fairly steady for the next four days, during which all the subjects' counts undergo a marked shift to the left.

(4a) There was a tendency for the Polynuclear Count to have a 'pendulum-like' action; after any marked shift to the left or right the movement continued a little in the same direction after the temperature change ceased, and then tended to swing back to a neutral position.

In Figure 2 (Appendix B) showing the Moving Averages of Weighted Means on the first part of Voyage I we can see an example of this where the left shift seems to swing too far, and from the 2nd to the 5th February, while the temperature remains steady, shows signs of returning to a new level.

Further examples of this can be seen in Figure 5 (Appendix B) at the end of Voyage II, in Figure 7 (Appendix B) in the middle of Voyage III; and finally two very good examples of the 'pendulum-action' are seen in Voyages IV and V (Figs. 8-11, Appendix B) where after the initial right shift with rise of temperature the Weighted Means tend to swing back again during the following periods of steady temperature (See (2b) above).

(4b) The response of the blood at any given point to further temperature change may be related to previous changes of temperature.

Thus the five persons on the Cheshire on the 8th August (Figure 6, Appendix B) show a great left shift when subjected to a small rise of 4°F. The response of the same five persons was much different six days previously when a similar rise of temperature accompanied a shift to the right.

A similar phenomenon has already been mentioned ((3b)). The ten subjects on the Ascanius were living in a fairly stable temperature between the 18th and 26th April (Fig. 4, Appendix B). Yet during this period they all had a progressive left shift, which may be explained by the previous temperature changes to which they had been exposed.

Again the slight divergence for the first week or so, between the counts of the 6 passengers and the 4 permanent staff on the return trip from Singapore (Voyage I, Figure 3, Appendix B) is probably the result of a difference in the temperature changes to which each group had been subjected, before the return voyage began. The 6 passengers had come from different parts of Malaya, where the temperature varied a good deal, while the others had been on board the ship on the outward voyage.

This difference in response does not seem to depend upon the absolute temperature level within the ranges observed here, but rather upon the changes in temperature which precede the change under consideration. For the right shifts corresponding to temperature rise begin at Wet Bulb temperatures which vary from 51-65°F and continue up to 81°F. Also it will be noted that the same rise of Wet Bulb Temperature (from 70 to 80°F) occurred twice on the Ascanius; in the first instance it was accompanied by a left shift and in the second by a right shift. (Fig. 4, Appendix-B)

Similarly the left shifts which follow the original right shifts again do not appear to depend on absolute temperature at their onset, as they begin at Wet Bulb temperatures ranging from 62-81°F. It seems that they are more related to preceding temperature change, and in each case the onset of the left shift follows a Wet Bulb temperature rise of 16-18°F.

It is however possible that when the Polynuclear Count is stablised at higher ranges of temperature, sufficient to maintain a persistent left shift, the blood may react differently to temperature rise, but there was no opportunity of observing this (See also (5) below.)

Because of the biphasic response to temperature rise, the 'pendulum-like' action, and the effect of previous temperature change on the response at any given moment, it is not surprising that there is no straightforward correlation between external temperature and the Polynuclear Count. Nevertheless, where these factors do not operate, or do so only slightly we can find quite a close correlation for considerable periods of time, e.g., on the Ascqnius - the second part from the 14th May to the 9th June; Cheshire B, and Cheshire C. (Figs. 4 and 5, and 8-11, Appendix B; also Table 2.)

(5) Unfortunately it was not possible to study continuous fall of temperature as fully as rise.(f.1) The available data,

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1. The reasons for this were of a practical nature, e.g., dismantling ship's hospital, preparation for disembarkation, and the impossibility of continuing the study after disembarkation.

however, though not statistically significant suggest the following.

Firstly, it has previously been shown (2a) that the subjects who had merely responded by having a right shift in their Polynuclear Counts had a left shift when the temperature fell (Cheshire B and C, Figs. 8, 9, 10 and 11, Appendix B).

On the other hand all the subjects who had been in the warmer climate for some time, and had previously undergone right and left shifts in their counts, reacted by having a right shift when the temperature fell. (See Figs, 1, 4 and 6; the falls of temperature are indicated by a brown line.) Thus 18 different subjects showed a right shift and a total of 20 such changes were recorded; 275 Polynuclear Counts were done during this phase.

It is tentatively suggested that all subjects who have been living for some time in a stable temperature sufficiently high to maintain a left shift (compared with U.K. standards) respond to a fall of temperature by having a shift to the right. It seems likely by analogy with the effects of temperature rise, that this will be followed by a left shift, to reach a new level, but it was not possible to follow the effects of temperature fall long enough to be sure of this.

The probability is that those subjects whose count remains deviated to the right by temperature (see (6) below) may react differently and return to their previous level directly without changes in two directions, i.e. the converse of the way in which they reached their present level. This seems the only reasonable hypothesis to fit all the facts.

(6) After these changes in the Polynuclear Count corresponding to marked variations in temperature, a new level is reached, for a fairly stable temperature.

(i) Consideration of the curves showing the changes in the Polynuclear Count on the Empress of Australia (Figs. 1 and 2, Appendix B) the Ascanius (Figs. 4 and 5, Appendix B) and the Cheshire first voyage (Figs. 6 and 7, Appendix B) suggest that the curve of the Weighted Means is swinging back to a new level, more to the left than the original. The number of counts done daily was too small to make any valid comparison with known values for the normal Polynuclear Count of the population in the regions visited.

(ii) If the above hypothesis is true we would expect to find some seasonal variation in the value of the normal Polynuclear Count in this country, provided that the temperature changes met with are sufficiently great, and not too well compensated by such artificial means as central and other heating, clothing, ventilation, etc. For this reason the investigations in Glasgow and Cambridge were performed.

Firstly the Polynuclear Counts of five persons were followed daily for three months in Glasgow. There was found to be a statistically significant shift to the right in the counts done when the Wet Bulb temperature was 38°F and over, as compared with the other half of the counts done when the Wet

Bulb temperature readings were under 38°F (Table 3).

Table 3

Wet Bulb Temperature	Number of Polynuclear Counts	Mean	Standard Deviation
37°F and under	114	2.68	0.140
38°F and over	120	2.74	0.146

Standard Error of difference between means = 0.019

Difference between means = 0.06, which being more than three times its standard error, is significant.

Also the Coefficient of Correlation between Wet Bulb temperature and the Weighted Means of the Polynuclear Count was fairly significant, although this figure may be accepted with some reserve in view of the many complicating factors already mentioned in connection with the correlations on ships.

Coefficient of Correlation between Weighted Means and Wet Bulb temperature in Glasgow = 0.525 ± 0.107.

It is to be noted however that the conclusion from this is identical with that already made, i.e. that higher temperatures (of the degree noted here) are associated with higher Weighted Means (or a shift to the right)(f.1)

Secondly, in Cambridge a statistically significant shift to the right was found in the Polynuclear Counts of seven

1. It was not worth while calculating the correlation between the Polynuclear Count and Dry Bulb temperature separately as Wet and Dry Bulb temperatures at these levels were roughly the same.

subjects in the spring, as compared with their counts in the winter.

The winter series consists of daily counts on Subjects 5,37,38,39 and 40 for ten days, and three daily counts on Subject 42, making a total of 53 Polynuclear Counts.

On account of the abnormality in his count it was not possible to include No. 38 (M.K.A.) in the spring series. It will be noted that the average of his ten counts in the first series is 2.758, and that of No. 41 (G.B.) is 2.640. As G.B. tends to be more to the left than M.K.A. it was considered legitimate to substitute ten counts on him for comparative purposes in the second series; any error arising therefrom would tend to reduce, rather than exaggerate the right shift.

The spring series then consists of ten daily counts on Subjects 5,37, 39, 40 and 41, and three counts on Subject 42, again making a total of 53 Polynuclear Counts. The results are shown in Table 4.

Table 4

Average Temperature Dry Bulb	Wet Bulb	Series	No. of Polyn. Counts	Mean	Standard Deviation
39	38	Winter	53	2.698	0.150
59	55	Spring	53	2.809	0.160

Standard Error of difference between means = 0.03

Difference between means = 0.111 which is more than three times its standard error and is therefore significant.

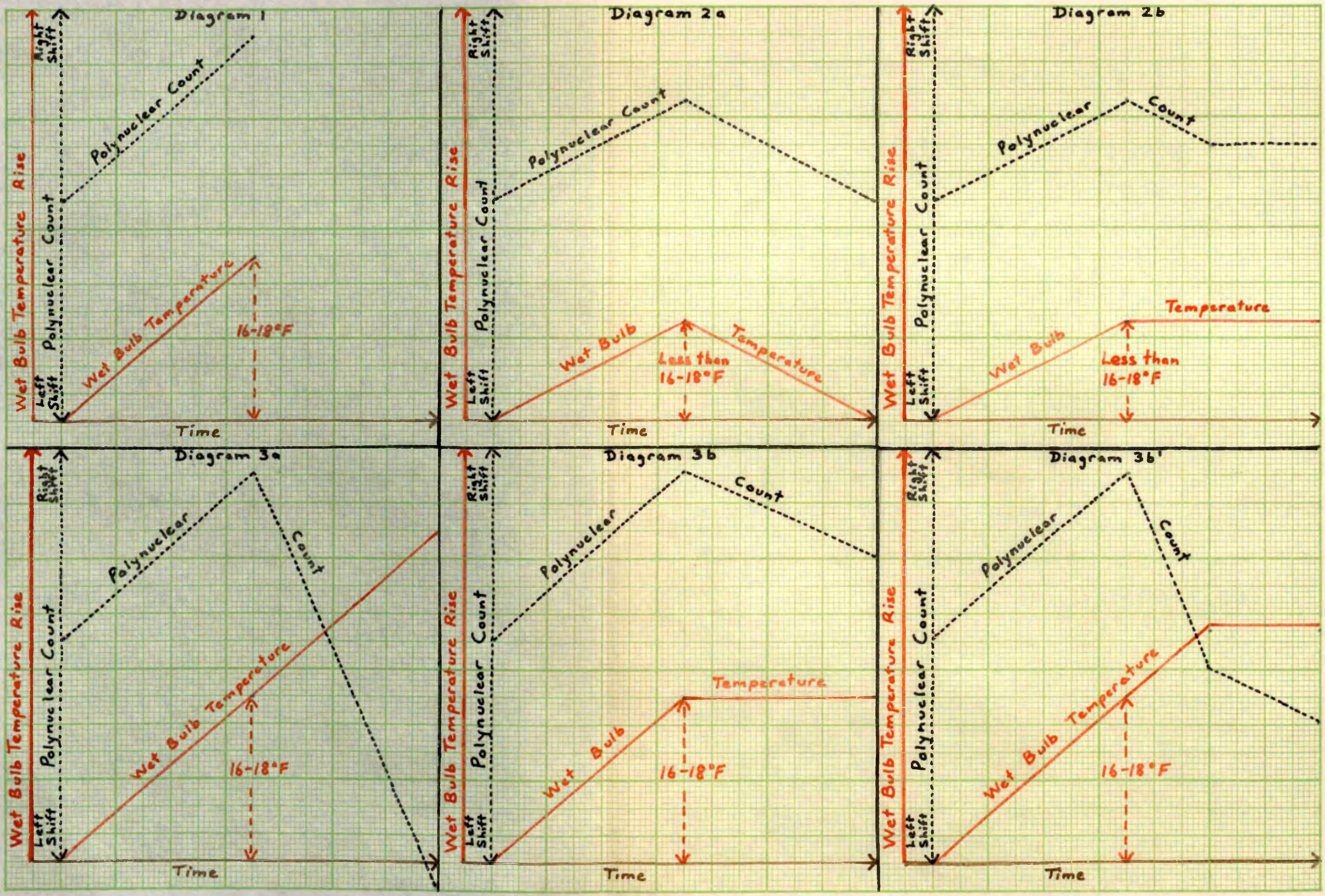

Diagram 1
Right Shift
Left Shift
Wet Bulb Temperature Rise
Polynuclear Count
Polynuclear Count
Wet Bulb Temperature
16-18°F
Time
Diagram 2a
Right Shift
Left Shift
Wet Bulb Temperature Rise
Polynuclear Count
Polynuclear Count
Wet Bulb
Temperature
Less than 16-18°F
Time
Diagram 2b
Right Shift
Left Shift
Wet Bulb Temperature Rise
Polynuclear Count
Polynuclear
Count
Wet Bulb
Temperature
Less than 16-18°F
Time
Diagram 3a
Right Shift
Left Shift
Wet Bulb Temperature Rise
Polynuclear Count
Polynuclear
Count
Wet Bulb Temperature
16-18°F
Time
Diagram 3b
Right Shift
Left Shift
Wet Bulb Temperature Rise
Polynuclear Count
Polynuclear
Count
Wet Bulb
Temperature
16-18°F
Time
Diagram 3b'
Right Shift
Left Shift
Wet Bulb Temperature Rise
Polynuclear Count
Polynuclear
Count
Wet Bulb Temperature
16-18°F
Time

SUMMARY OF PRECEDING ANALYSIS

(1) All subjects who have been living in a more or less steady temperature of Wet Bulb range 51-65°F for at least one week previously, and are subjected to a continuous rise of Wet Bulb temperature of 16-18°F have a shift to the right in the Polynuclear Count. Diagram 1.

(2a) If the continuous Wet Bulb temperature rise is less than 16-18°F, and the temperature then falls, the Polynuclear Count shows a right shift as before and then a left shift beginning when the temperature reversal occurs. Diagram 2a.

(2b) Similarly, if the continuous temperature rise ceases before a 16-18°F Wet Bulb rise, and then remains steady, the right shift in the Polynuclear Counts terminates and the count tends to return to its original, or more likely to a different level more to the right than before. (See also (6)) Diagram 2b.

(3a) If the temperature goes on rising after a continuous rise of 16-18°F Wet Bulb, the subjects then have a left shift in their Polynuclear Counts. Diagram 3a.

(3b) If the maximum Wet Bulb temperature is maintained at a steady level after a continuous rise of 16-18°F or more, the subjects' Polynuclear Counts then show a left shift. Diagrams 3b and $3b^1$.

(4a) There is a tendency for the Polynuclear Count to have a 'pendulum-like' action; after any marked shift to the left or right the movement continues a little in the same direction, and then tends to swing back to a neutral

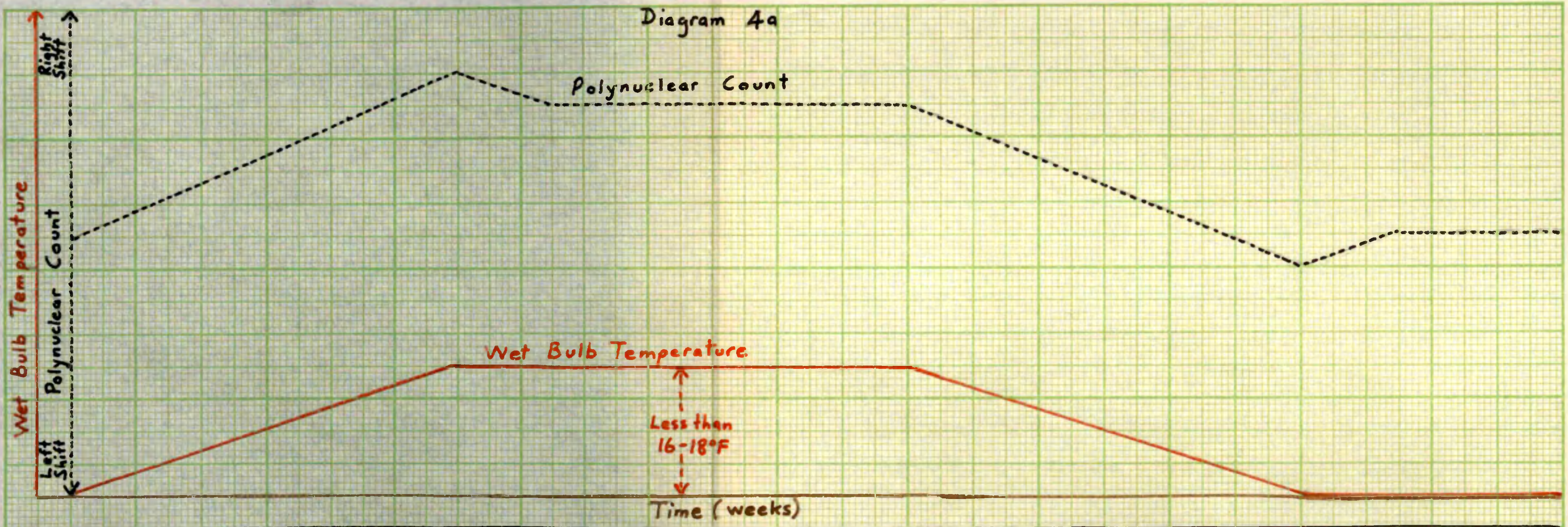
Diagram 4a
Polynuclear Count
Wet Bulb Temperature
Less than 16-18°F
Right Shift
Left Shift
Wet Bulb Temperature
Polynuclear Count
Time (weeks)

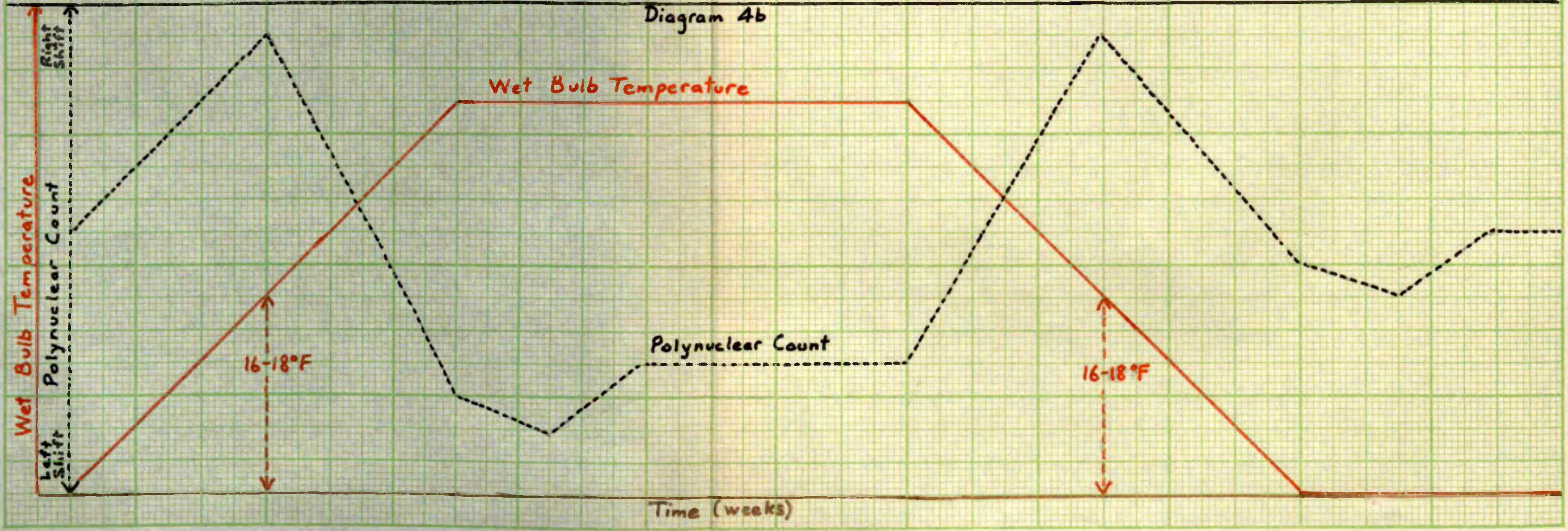
Diagram 4b
Wet Bulb Temperature
Polynuclear Count
16-18°F
16-18°F
Right Shift
Left Shift
Wet Bulb Temperature
Polynuclear Count
Time (weeks)

position. See Diagram 4. (For the sake of simplicity the pendulum-like action has not been shown in Diagrams 1, 2 and 3.)

(4b) The response of the blood at any given point to further temperature change may be related to previous changes of temperature. (cf. Diagrams 4a and 4b)

(5) It is tentatively suggested that fall of temperature is related to the Polynuclear Count in a similar manner to rise of temperature. Thus fall of temperature when the count is deviated only to the right (Diagram 4a) is accompanied by a left shift; and fall of temperature, when the count has undergone right and left shifts to reach a new level more to the left, is accompanied by right and left shifts (Diagram 4b).

(6) After these changes in the Polynuclear Count corresponding to marked variations in external temperature, a new level is reached for a fairly stable temperature.

Diagrams 4a and 4b represent a synthesis of these conclusions in graphical form.

G. The Polynuclear Count and the Total and Differential White Blood Cell Count.

The following statistical relationships were noted:-

The Coefficient of Correlation (f.1) between Weighted Means of the

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1. See Notes on the Calculation of Coefficients of Correlation (Appendix C).

Polynuclear Count and

1. Absolute number of neutrophils = -0.397 ± 0.050

   (Total of 280 counts)

2. Total white blood cells = -0.287 ± 0.035

   (Total of 689 counts)

Thus under the conditions of this experiment a shift to the right is associated with a statistically significant reduction in the number of white blood cells and in particular a reduction in the number of neutrophils; and conversely a shift to the left coincides with an increase in the total white cells, and especially in the neutrophils.

IV DISCUSSION

The Polynuclear Count and Body Temperature, Barometric Pressure, Atmospheric Humidity and the Effect of the Sea.

The Polynuclear Count and Solar Radiation.

The Polynuclear Count and External Temperature.

(a) Absolute External Temperature Levels.
(b) Change of External Temperature.

The Polynuclear Count and the Total and Differential White Blood Cell Count.

The Mechanism of the Changes Observed in the White Blood Cells.

1. Redistribution of the White Blood Cells in the vascular channels.
2. Changes in the blood as a result of haemoconcentration.
3. Changes dependent upon alteration in the rate of production, maturation, destruction or elimination of neutrophils.

The Polynuclear Count and Body Temperature, Barometric Pressure, Atmospheric Humidity and the Effect of the Sea.

Although some possible connection might have been expected between the neutrophil polymorph population and body temperature, or the various elements of environment expressed by barometric pressure and humidity, this was not borne out by the facts; no consistent relationship was observed between the Polynuclear Count and any of these factors.' They may therefore play some part in accounting for variations in the Polynuclear Count under physiological conditions, but they cannot have any major causal significance. In particular, humidity at higher temperatures seems likely to play a subsidiary part; as suggested later its importance under these circumstances probably depends upon the additional strain on the body cooling mechanisms under conditions of high temperature and high humidity. However the efficiency of body temperature regulating mechanisms appears to be very high under the conditions of this investigation because the changes in body temperature were very small and largely independent of the environmental temperatures.

Similarly the mere process of going to sea, or the effects of being at sea could not have been responsible for all the diverse variations noted in the Polynuclear Count on ships; and of course this alteration in environment did not apply in Glasgow or Cambridge.

The Polynuclear Count and Solar Radiation.

The effects of the long or infra-red, and the short or ultra-violet ranges of solar radiation on the Polynuclear Count have already been discussed. (p.13,14) Since these environmental factors must vary considerably under the conditions of this investigtion, the importance of their effects on the blood will now be assessed.

(a) Infra-red Radiation

This has been taken into consideration by measuring the effects of infra-red radiation (among other things) by external temperature recordings, and need not be dealt with separately.

(b) Ultra-violet Radiation

Ultra-violet radiation from the sun, especially under the conditions of this experiment, was considered unlikely to have any significant effect on the Polynuclear Count, for the following reasons.

Firstly, Dewhurst (1949)[13] points out that high humidity and dust greatly decreases the amount of ultra-violet radiation reaching the earth's surface, so that places like Ceylon, Bengal and Malaya actually receive less ultra-violet radiation annually than Great Britain. Similarly, the ultra-violet content of solar radiation is very low in Arabia and around the Red Sea, where the dust content of the atmosphere is high. The marked left shift observed during this investigation in some of these areas, cannot therefore be correlated with an increase in ultra-violet radiation; indeed the greatest degrees of left shift were observed when the Wet and not the Dry Bulb temperature was highest - in other words when the climate was hot and humid. And further the count was frequently much deviated to the left in cloudy, sunless weather (See Voyage I **February 4-5th: Voyage II April 25-30th.**)

Secondly, Dewhurst working first in the Highlands of Kenya and later in Bengal, carried out Polynuclear Counts on 500 East African natives. He noted the same degree of left shift in each country, despite the fact that in Kenya there is a high percentage of ultra-violet radiation owing to the altitude and clear atmosphere, whereas in Bengal the humidity considerably diminishes the amount of ultra-violet radiation reaching the earth's surface.

Thirdly, if ultra-violet radiation, as suggested by Climenko (1930 a and b)[24] acts on the leucocytes through an intermediary calcium metabolism, and if it were effective in maintaining a left shift in those countries in which it occurs, then we might expect to find a higher serum calcium level in these countries. There seems to be no evidence for this.

The normal serum calcium level for this country is given by Harrison (1947)[45] as 9-11 mgms.%; in America the normal is stated by Peters and Van Slyke (1931)[46] to be 9-11.5 mgms.%. In the Chinese Journal of Physiology Report Series (1928)[47] the normal value for Chinese in Peking is given as 9-11 mgms.%, the mean being 10 mgms.%. (150 investigations were done by Kramer and Tisdall's (1921)[25] method.) Working independently Myers (1924)[48] noted the same range in Americans, and Updegaff et al. (1926)[49] found a slightly lower range in California. The left shift in the Polynuclear Count in China and America cannot therefore be correlated with a raised serum calcium. Similarly, it is fairly well established that a left shift occurs in tropical countries, but there seems to be no evidence that serum calcium levels are high in such countries. In fact Ashford and Hernandez (1926)[50] investigating 96 healthy males in Porto Rico, found the serum calcium levels slightly below normal British and American standards.

Lastly, the evidence of this investigation suggests that exposure to ultra-violet radiation could hardly be responsible for the changes observed. Owing to long hours of work below decks direct exposure to the sun was negligible; and when this did take place no significant changes in the counts were noted.

<u>The Polynuclear Count and External Temperature.</u>

A consistent relationship between external temperature and the Polynuclear Count has been described. No comparable relationship has been found in this experiment or in the review of literature presented, between the Polynuclear Count and other environmental factors known, or thought likely to influence the count. It is therefore suggested that there is a causal relationship between external temperature and physiological variations in the Polynuclear Count, although it is quite possible that other factors may play some part in accounting for the changes observed.

(a) Absolute External Temperature Levels and the Polynuclear Count.

At this juncture we may conveniently recall a few points noted earlier:-

(1) The biphasic response of the Polynuclear Count to fairly rapid external temperature rise on the ships.

(2) The fact that in this country fairly stable temperatures were accompanied by fairly stable values for the normal Polynuclear Count: and that for the range of Wet Bulb temperature from below freezing point to 60°F, the higher the temperatures the more the count was shifted to the right.

(3) The well substantiated reports in the literature of left shifts in hot climates.

Taking these facts into consideration it seems reasonable to postulate that for each level of temperature there is a corresponding level for the Polynuclear Count. For the lower ranges, the higher the level of temperature the more the count remains shifted to the right; and after a certain critical point the position is reversed, and the higher the level of temperature, the greater the shift to the left. This would explain some of the peculiar variations noted by different observers throughout the world. Unfortunately very little detailed information is available about climatic conditions in the different countries while the observations of the Polynuclear Count were being made, so that this theory can neither be proved nor disproved by reference to the literature.

It is to be noted that the changes observed in this country, although statistically significant, were not sufficiently great to be of any clinical importance when compared with the accepted range of normality (Weighted Mean of 2.4 to 3.2).

<u>Change of External Temperature and the Polynuclear Count.</u>

The relationship between external temperature change and the Polynuclear Count is complicated by a number of factors which will be discussed.

Firstly, a "summation effect" similar to that noted by Reifenstein et al. (1942)[40] was observed. The continually repeated stimulus of rise of temperature was associated with a progressive trend in the Polynuclear Count; with this difference however, that there appears to be a critical point after which the continuance of the same stimulus produces a reversal in the trend of the count.

Secondly, the 'pendulum-like' action of the count which has already been noted further complicates the relationship with temperature change. An interesting example of this can be found in Cooke and Ponder's book ((5) p.19) where a normal rabbit with a Polynuclear Count Weighted Mean of 2.66 is given an injection of thyroid extract. The count changes as follows:-

Day 1	W.M.	2.09
2		2.14
3		2.38
5		2.52
11		2.90
16		2.82
21		2.67

And thirdly, - which is really a corollary of the other two - previous changes of temperature influence the response of the count at any given moment to further temperature change. Or, since external temperature change and the Polynuclear Count are related, we may state this differently. The response at any given moment depends on the trend of the neutrophil population (including probably the leucopoietic tissues) at the time of stimulation and immediately preceding it.

Previous changes of temperature and of neutrophil population seem to be more important in influencing the further response of the blood, than absolute values of these quantities - at least within the ranges noted in this experiment. It does seem likely however that absolute values of the external temperature (and of the Polynuclear Count) may be a factor in altering the response, outside the ranges observed here; indeed there is some evidence that the response to fall of temperature is not the same at different temperatures (c.f. Diagrams 4a and 4b). If rises of temperature had begun at higher levels than those noted here, the response may well have been different.

Thus the reversal of the right shift always followed a previous continuous rise of Wet Bulb temperature of 16-18°F, and it was not possible to associate this critical point with any definite level of external temperature, any constant time interval, rate of rise, or value of the count. On the other hand it must be remembered that absolute temperature recordings on different ships, are not comparable, and that the 'pendulum' action may obscure the turning point. Nevertheless, when the three Cheshire trips are compared (Figures 6 to 11, Appendix B) it will be seen that only in the first does a true left shift with temperature rise follow a right shift; and it is on this trip only that the Wet Bulb temperature rises above 75°F, suggesting that for these subjects at least, under these conditions the critical point in the biphasic response to temperature rise is around 75°F Wet Bulb.

It is interesting to note that the changes in the Polynuclear Count are more closely related to Wet than to Dry Bulb temperature. This may be connected with the fact that, at the temperatures recorded on ships the Wet Bulb temperature is the best index of comfort. Thus at Berbera when the highest Dry Bulb temperatures were recorded it was fairly comfortable, although very hot, whereas on the previous day, when the Wet Bulb temperature was higher the feeling of heat was almost unbearable.

A high Wet Bulb temperature generally (although not always) indicates a high temperature together with high humidity and little air movement; consequently there is some similarity between Wet Bulb temperature and humidity readings at high temperatures. For this reason there is a suggestion of negative correlation between humidity and the Polynuclear Count at high temperatures, similar to that between Wet Bulb temperature and the count, c.f. Figures 14 and 4 (Appendix B).

Under such conditions of "wet heat" the normal cooling mechanisms of the body - vaporisation from skin and lungs, radiatio and convection - are at the greatest disadvantage. The actual heating effect of the environment is therefore best measured by the Wet Bulb temperature because it is a convenient index of heat and humidity combined. The absence of a consistent correlation between the Polynuclear Count and humidity is therefore not surprising since, per se, humidity does not seem likely to affect body processes to any great extent. When however humidity becomes an adjuvant to high temperature, increasing the efficiency of its heating effect on the body, it probably plays some part in accounting for the accompanying changes in the blood. In this connection it is noteworthy that the greatest left shifts observed in this experiment are associated with increases in the higher ranges of Wet Bulb temperature and humidity, e.g., the steep left shift from 25.1.47. to 30.1.47. in Voyage I accompanies a slight rise of Wet Bulb temperature and a steady rise in humidity (See Appendix A and Figures 1 and 13, Appendix B); again the main left shift on the Ascanius coincides with rise of Wet Bulb temperature and humidity. (See Figures 4 and 14, Appendix B, 10th-16th March.)

If these changes in external temperature are responsible for changes in the blood, it is not surprising that the Polynuclear Count should be more closely related to Wet than to Dry Bulb temperature, since the former gives a better indication of the effect of temperature on the body.

The Polynuclear Count and the Total and Differential White Blood Cell Count.

A statistically significant negative correlation has been noted between the Polynuclear Count and firstly the total leucocyte count, and secondly the absolute number of neutrophil polymorphs. That is the higher the weighted mean the smaller the number of neutrophils in the peripheral blood; and conversely the greater the shift to the left, the larger the number of neutrophils.

The implications of this will be considered later in the discussion, but it may be noted that Kennedy and Mackay (1936)[51] observed a reduction in the number of neutrophils in the subtropical climate of Iraq and this was associated with a left shift. Russell and Russell (1928)[52] found a similar reduction in neutrophils after soldiers were transferred from a temperate climate to the tropics. Also Dewhurst (1949)[13] found a reduction in the number of neutrophils along with a left shift after short term exposure of guinea pigs to infra-red radiation.

It should however be remembered that the conditions of the present experiment are not comparable to those under which these authors made their observations. In this experiment the counts were done during long periods of great change of temperature. Whereas Kennedy's counts were done on subjects living in a fairly static temperature, and in Dewhurst's experiment the rise of temperature was much more rapid, and took place in a few hours.

The Mechanism of the Changes Observed in the White Blood Cells.

Quantitative and qualitative variations in the white blood cells may be due to several mechanisms each of which will now be considered.

(1) Redistribution of the white blood cells in the vascular channels.

Vejlens (1938)[53] in a comprehensive study stresses the importance of this mechanism in producing changes in the total and differential white cell count in health and disease. His work suggests that under ordinary conditions the circulating white corpuscles, being the largest particles in the blood, are found in the centre of the flow, surrounded by the axial stream of red cells. If the suspension stability of the blood is altered (e.g. by an increase of fibrinogen) aggregations of the red cells form; these being larger than the white cells cause a reversal of this process. In addition, alteration of the suspension stability causes increase adhesiveness of the polymorphs, causing them to adhere to the vessel wall. A similar reversal of the normal intravascular distribution of red and white cells occurs with a reduction in the velocity of flow. To explain this he postulates a similar "intra-vital" rouleaux formation, together with the relatively greater chance of the marginal polymorphs adhering to the vessel wall when the flow is slower. These changes take place in the para-capillary blood vessels, (i.e. vessels of about 0.300 - 0.020 mm. in diameter) and as they affect the polymorphs in particular, can produce either a neutropenia or a neutrophil leucocytosis in an ordinary sample of capillary blood.

Vejlens however does not state whether there is any difference in the type of polymorph which adheres to the vessel wall, and consequently whether this mechanism could be responsible for a variation in the Polynuclear Count. According to his hypothesis the following conditions would have to be fulfilled if the redistribution mechanism were responsible for the changes in the Polynuclear Count noted in this experiment.

(a) A difference in size and, or, adhesiveness between young and old forms of the neutrophil polymorphonuclear would be essential.

(b) Change of external temperature would have to produce either a change in the suspension stability of the blood, and, or an alteration in the velocity of blood flow in the para-capillary vessels.

In connection with the second, it may be noted that Grayson (1949)[54] observing the effect of short term rise of temperature on the skin circulation noted, 1. an increase in the blood flow up to 36°C, 2. a decrease from 36°F to 40°F, and 3. an increase above 40°C when perspiration begins. Stages 2 and 3 might conceivably be correlated with the right and left shifts observed in this experiment during temperature rise.

Various lines of investigation therefore suggest themselves. The first point ((a) above) could be elucidated by measuring large numbers of neutrophils and by observing their adhesiveness to glass and other surfaces as Vejlens did. Secondly the effects of vasoconstrictor and vasodilator drugs could be noted. In this connection it may be recalled that while Arneth (1920)[20] found no left shift after a hot bath, Kennedy and Mackay (1935-36)[10] state that a Turkish bath is followed by a shift to the left. Perhaps a hot bath of brief duration is only sufficient to produce a vasodilator redistribution leucocytosis; on the other hand the greater heating effect of a Turkish bath is more comparable to the conditions of heat and humidity in the present investigation. Vejlens makes no mention of a change in the Polynuclear Count in the leucocytosis following the administration of adrenaline.

It is not within the scope of this work however to carry such investigation further and indeed it does not seem very likely that such a mechanism would account for the blood changes noted here, for the following reasons.

(i) The mechanism would have to be highly selective. During the biphasic response to temperature rise it would have to be assumed that first of all the young cells adhere to the periphery of the vessels, while the older cells are relatively and progressively increased in the samples of blood taken; during this period the total cells and especially the neutrophils would diminish presumably because of the disappearance of the younger forms from the circulation. Then at the point where the left shift begins the young cells would be progressively returned into the circulation giving rise to a left shift and an increase in the total neutrophils.

(ii) It would be difficult to explain on this hypothesis the differing response of the blood to the same rise of temperature, the changes which take place when the temperature is constant, and the 'pendulum effect'. For it seems unlikely that a redistribution mechanism, if dependent on changes in the peripheral blood flow, would continue to alter the blood picture for several days; more probably, as Vejlens implies, its action would be almost simultaneous with the alteration in blood flow.

(iii) Lastly, it may be recalled that Cooke and Ponder (1927) [5] claim that a redistribution leucocytosis is not associated with a change in the Polynuclear Count, and the concensus of modern opinion seems to favour this view. (Sturgis and Bethel (1943); [55] Whitby and Britton (1946) [56])

(2) Changes in the blood as a result of haemoconcentration.

This would not explain the qualitative variations in the neutrophils except by some secondary redistribution, as already mentioned.

(3) Changes dependent upon alterations in the rate of production, maturation, destruction or elimination of neutrophils.

From the observations of the total and differential leucocyte counts and the Polynuclear Counts in this experiment we have noted two phases during marked temperature rise. Phase (1) a shift to the right and a neutropenia, and Phase (2) a shift to the left and a neutrophil leucocytosis. One additional fact which has been fairly well established by previous investigators (Kennedy and Mackay (1936)[51]; Russell and Russell (1928)[52]) must be added - Phase (3) a shift to the left and a neutropenia at permanently high temperature levels.

The various ways in which external temperature may affect the blood will now be considered to see whether they can explain these phenomena.

A. Action primarily on the peripheral blood alone.

Phase (1), a shift to the right means an increase in the average number of lobes in the cells. It may result in two ways. Firstly, if the older (or multilobed) cells were allowed to live longer; in this case however, the total population would be increased: and this would still be the case if the rate of production and destruction kept pace.

Secondly a speeding up of the rate of maturation would give rise to a right shift and a temporary leucopenia, but in the long run this would mean that the cells would live for a shorter time, and provided that the rate of production and destruction remained relatively equal, (as seems likely if the population is to remain steady) would result only in a neutropenia, with no change in the average number of lobes in the population. As the average life of the neutrophil is probably about 3 to 5 days (Whitby and Britton (1946)[56]) and the shift to the right and neutropenia lasts for periods up to three weeks, this theory cannot explain the facts.

An effect on the peripheral blood therefore cannot explain the initial right shift and neutropenia, nor Phase (2) the left shift and neutrophil leucocytosis, which is the converse. It may be concluded that temperature does not act primarily on the peripheral blood alone.

B. Primary action on the marrow alone.

Phase (1) may be explained by an inhibition of marrow leucopoiesis or an interference with maturation leading to a right shift and neutropenia in the peripheral blood.

Phase (2), the opposite, could be produced by a stimulation of leucopoiesis resulting in a left shift and a neutrophil leucocytosis.

But this would not explain Phase (3) - the coexistence of a neutropenia and a left shift at stable high temperature; for once the transitional period was over a change in the rate of production of cells could only result in an alteration in the total population, if the cells matured and were destroyed in the usual way.

C. Action on the Bone Marrow and the Peripheral Blood.

Phase (1) Marrow inhibition with or without a decreased destruction in the peripheral blood would account for the initial right shift with rise of temperature; the former would have to predominate to account for the neutropenia.

Phase (2) A reversal of this phenomenon would explain the left shift and neutrophil leucocytosis.

Phase (3) Lastly, the disappearance of the marrow effect and the persistence of the increased destruction of older forms, would explain the leucopenia and the left shift noted in the tropics.

In this connection the work of Danzer (1930)[37] may be recalled. He suggested that the products of tissue breakdown, and degenerate leucocytes acted as the stimulus to further leucocyte production. Now if increased tissue breakdown occurs without loss of weight, we must assume increased repair. It might be expected that this would be reflected in the basal metabolic rate.

It is interesting to note that there is a relationship between basal metabolic rate and temperature which is similar, although not identical, to that noted here between the Polynuclear Count and temperature. McConnell, Yagloglou and Fulton (1924)[57] compared the metabolism of a number of men exposed for one or two hours to different "effective temperatures" (actual Dry Bulb temperatures corrected for the effects of humidity and air movement). The basal metabolic rate fell slowly with rise of temperature up to "effective temperatures" of 75-83°F, when it was lowest; above this temperature metabolism rose sharply. On the other hand many observers have noted a decrease in the basal metabolic rate in tropical countries (de Almeida (1920 a and b)[58] Brazil: Mukerjee, (1926)[59] Bengal: Fleming (1923)[60]: Knipping, (1923)[61]).

There would thus seem to be a difference between the effects of short term change of temperature and more prolonged exposure to different levels of temperature.

We may now attempt to incorporate this knowledge into a theory which would explain the relationship between the Polynuclear Count and external temperature, bearing in mind of course that many other factors besides tissue breakdown and repair, and external temperature will influence the basal metabolic rate.

Phase (1) During the first stage of rise of temperature and right shift with neutropenia, it is suggested that tissue breakdown and destruction of neutrophils is decreased, with a resultant predominance of marrow inhibition. This may coincide with the first phase of diminution of metabolic rate noted by McConnell et alia.

Phase (2) During the second stage of rise of temperature and left shift with neutrophil leucocytosis, a reversal of this process occurs, which may coincide with the rise of metabolic rate noted at higher temperatures by McConnell et alia.

Phase (3) And lastly the third stage of permanently high temperature, left shift and neutropenia may be related to the low basal metabolic rate in the tropics. In this case it must be assumed that the stimulus to the marrow of increased tissue breakdown has disappeared, but the neutrophils continue to have a shorter life, with resultant neutropenia and left shift.

It may be said therefore that the evidence favours a primary effect of temperature on the body as a whole, including the neutrophil population with a resultant secondary effect on the bone marrow. Such a mechanism would also be more reconcilable with the peculiar features of the neutrophil response to external temperature variation, e.g. the 'pendulum' effect, the 'summation' effect, and the way in which previous temperature changes (and trends in the Polynuclear Count) affect the response to further alteration of temperature.

V SUMMARY

(1) A relationship is described between changes of external temperature and changes in the neutrophil polymorphonuclear leucocytes in the blood.

(a) A biphasic relationship during continuous rise of external temperature is noted. During a continuous rise of temperature a primary phase of neutropenia with an increased proportion of older cells is followed by a secondary converse phase of neutrophil leucocytosis with an increase in younger forms.

(b) A similar relationship is suggested between continuous fall of temperature and the neutrophil polymorphonuclear leucocytes.

(c) The manner is described in which more complicated changes of external temperature are related to variations in the neutrophil population of the blood.

(2) A relationship between external temperature and the "normal" value of the Polynuclear Count is noted.

(3) In the absence of any correlation between the Polynuclear Count and other factors known, or thought likely to influence the count, it is suggested that temperature may be the main factor governing the physiological variations in the count found in this investigation and, by numerous observers in different parts of the world. The subsidiary role of humidity at high temperatures is discussed.

(4) From the results, and the survey of literature presented, the mode of action of environmental temperature appears to be

primarily on the body tissues as a whole, including the neutrophil population of the blood, and secondarily, as a result of this, on the bone marrow.

VI APPENDIX

A. THE RESULTS

Voyage I "EMPRESS OF AUSTRALIA"

Liverpool, Port Said, Bombay, Colombo, Singapore, and back.

SUBJECTS

Name	Age	Smoking	Previous History	Present Voyage
1. V.P.B.	19	S	First trip*	Liverpool to Colombo
2. E.T.	33	S	Many previous trips	Round trip
3. R.M.	22	N.S.+	do.	do.
4. J.R.	30	S	do.	do.
5. R.L.	25	S	do.	do.
6. K.B.	19	S	First trip	Liverpool to Singapore
7. F.C.	18	S	do.	do.
8. R.L.G.	21	S	do.	do.
9. K.F.	18	S	do.	do.
10. D.J.W.	18	S	do.	do.
11. R.A.L.	20	S	17/12 in Malaya and India	Singapore to Liverpool
12. C.J.C.	33	S	18/12 in Malaya and India	do.
13. K.C.E.	23	S	22/12 do.	do.
14. W.M.	32	N.S.	4/12 in Malaya	do.
15. W.S.W.	34	S	16/12 in Malaya and India	do.
16. W.T.K.	22	N.S.	16/12 in Malaya and India	do.

* Except where otherwise stated, "first trip" means that the subject has not previously been exposed to tropical or semi-tropical conditions.

\+ Non-smoker = N.S. Smoker = S.

Date: 13.1.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.*	BODY TEMP
1	Seasick	12	36	42	9	1	2.51	96.3
2		23	36	32	6	3	2.30	97.3
3		17	34	35	13	1	2.47	96.2
4		12	34	38	15	1	2.59	97.1
5	Mild Coryza	12	25	42	20	1	2.73	98.0
6		15	34	45	6	0	2.42	98.3
7	Mild Coryza	28	38	31	3	0	2.09	98.1
8	Seasick	13	25	53	8	1	2.59	97.7
9	Seasick Mild Coryza	20	31	35	13	1	2.44	97.1
10	Seasick	8	45	34	13	0	2.52	97.6

	W.M.
Average of 10 subjects	2.47
Average of 7 subjects with highest W.M.'s at start, i.e. excluding Subjects 2, 6 and 7	2.55
Moving Averages of W.M.'s of 10 subjects in groups of 3 days	-

Average Barometric Pressure 29.52 mm. Hg. Range 29.09 - 29.84 mm. Hg. (Average of 4 hourly readings)

Average Humidity 73% (Calculated from the average of Wet and Dry Bulb temps.)

External Temp. on Bridge 4 Hourly

	D+	W+
4 a.m.	44	41
8 a.m.	48	42
Noon	48	42
4 p.m.	47	45
8 p.m.	52	47
Mid.	54	52
Average	49	45
M.A.**	-	-

* W.M. = Weighted Mean

\+ D = Dry Bulb Temperature. W = Wet Bulb Temperature. Degrees Fahrenheit. The same order of readings will be kept throughout.

** M.A. = Moving Average (3 day groups)

Date: 14.1.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
1.		17	30	45	8	0	2.44	98.8
2.		22	40	30	8	0	2.24	98.0
3.	Coryza	7	17	60	14	2	2.87	98.3
4.		18	31	38	12	1	2.47	98.0
5.	Slight coryza	17	33	40	10	0	2.43	98.0
6.		16	43	35	6	0	2.31	97.8
7.	Slight coryza improving	23	37	38	2	0	2.19	98.3
8.		7	29	50	12	2	2.73	98.6
9.	Slight coryza	24	38	29	8	1	2.24	97.0
10.		15	31	46	8	0	2.47	98.6

	W.M.
Average of 10	2.44
Average of 7 highest means (initially)	2.52
Moving average of 10	-

Average Barometric Pressure 30.00 mm. Hg.
Range 29.91 - 30.05

Average Humidity 80%

External Temp. on Bridge 4 Hourly

	D	W
	55	52
	55	52
	55	52
	55	51
	54	49
	53	51
Average	54	51
M.A.	-	-

Date: 15.1.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
1		7	35	48	8	2	2.63	98.5
2	Slight coryza	22	28	28	19	3	2.53	97.8
3	Coryza	12	22	49	15	2	2.73	98.1
4		10	34	45	10	1	2.58	98.4
5	Coryza worse	20	36	35	9	0	2.33	98.6
6		21	18	41	18	2	2.62	97.2
7	Slight coryza improving	32	42	24	2	0	1.96	98.0
8		14	32	44	10	0	2.50	98.5
9	Slight coryza	17	29	40	14	0	2.51	98.4
10		29	38	27	5	1	2.11	97.6

	W.M.
Average of 10	2.45
Average of 7 highest means (initially)	2.48
Moving Average of 10	2.45

Average Barometric Pressure 29.95 mm.Hg.
Range 29.89 - 30.03

Average Humidity 82%

External Temp. on Bridge 4 Hourly

	D	W
	56	52
	57	55
	61	57
	60	57
	58	56
	57	54
Av.	58	55
M.A.	-	50

Date: 16.1.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
1		18	30	40	12	0	2.46	98.1
2	Slight Coryza	17	22	47	12	2	2.60	98.6
3	Coryza	12	31	43	13	1	2.60	98.8
4		18	29	36	17	0	2.52	98.6
5	Coryza worse	17	32	35	14	2	2.52	98.1
6		14	34	45	7	0	2.45	98.5
7	Slight coryza improving	17	38	35	9	1	2.39	98.8
8		12	26	50	12	0	2.62	98.5
9	Slight coryza	17	31	38	14	0	2.49	97.9
10		20	29	39	12	0	2.43	98.8

	W.M.
Average of 10	2.51
Average of 7 highest means (initially)	2.52
Moving Average of 10	2.47

Average Barometric Pressure 30.07 mm.Hg.
Range 30.00 - 30.16

Average Humidity 82%

External Temp. on Bridge 4 Hourly

	D	W
	58	54
	58	54
	59	57
	60	58
	59	57
	57	55
Av.	59	56
M.A.	-	54

Date: 17.1.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
1		15	37	40	9	1	2.48	97.8
2	Slight coryza	9	18	47	19	7	2.97	98.6
3	Coryza	10	33	42	15	0	2.62	98.2
4		14	28	38	19	1	2.65	98.4
5	Coryza worse	17	40	33	8	2	2.38	97.9
6	Coryza	23	31	35	11	0	2.34	98.7
7	Slight coryza improving	20	37	35	8	0	2.31	98.3
8		9	33	46	12	0	2.61	98.9
9	Slight coryza	13	33	42	10	2	2.55	98.0
10		22	16	37	20	5	2.70	98.7

	W.M.
Average of 10	2.56
Average of 7 highest	2.57
Moving Average of 10	2.51

Average Barometric Pressure 30.12 mm.Hg.
Range 29.99 - 30.22

Average Humidity 81%

External Temp. on Bridge 4 Hourly

	D	W
	57	54
	56	52
	56	53
	56	52
	56	53
	56	52
Av.	56	53
M.A.		55

Date: 18.1.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
1		14	27	48	9	2	2.58	96.4
2	Slight coryza	26	27	31	14	2	2.39	98.4
3	Coryza	8	28	52	9	3	2.71	99.1
4		16	25	48	9	2	2.56	98.5
5	Coryza I.S.Q.	14	28	43	13	2	2.61	98.0
6	Coryza	29	28	35	6	2	2.24	98.7
7	Slight coryza improving	26	40	29	4	1	2.14	98.4
8		12	26	46	13	3	2.69	98.2
9	Slight coryza	15	36	42	6	1	2.42	98.1
10		13	23	38	19	7	2.84	98.1

	W.M.
Average of 10	2.52
Average of 7 highest	2.63
Moving Average of 10	2.53

Average Barometric Pressure 29.89 mm. Hg.
Range 29.86 - 29.95

Average Humidity 70%

External Temp. on Bridge 4 Hourly

	D	W
	56	52
	56	52
	58	53
	57	51
	56	51
	55	48
Av.	56	51
M.A.	-	53

Date: 19.1.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
1		12	37	39	9	3	2.54	98.4.
2	Slight coryza	15	26	43	15	1	2.61	98.3
3	Coryza	11	23	43	23	0	2.58	98.4
4		13	32	45	10	0	2.52	98.4
5	Coryza I.S.Q.	12	23	42	21	2	2.78	98.4
6	Coryza	26	19	37	17	1	2.48	98.6
7	Slight coryza improving	23	44	28	5	0	2.15	98.7
8		11	24	52	12	1	2.68	97.7
9	Slight coryza	18	33	41	8	0	2.39	98.4
10		9	22	47	18	4	2.86	98.1

	W.M.
Average of 10	2.56
Average of 7 highest	2.62
Moving Average of 10	2.55

Average Barometric Pressure 29.80 mm. Hg.
Range 29.74 - 29.86

Average Humidity 66%

External Temp. on Bridge 4 Hourly

	D	W
	56	49
	57	50
	58	52
	59	53
	59	54
	58	53
Av.	58	52
M.A.	-	52

Date: 20.1.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
1	Headache	31	29	33	7	0	2.16	98.4
2	Slight coryza	10	26	41	22	1	2.78	98.1
3	Coryza	20	15	43	22	0	2.67	97.3
4		12	15	37	32	4	3.01	97.8
5	Coryza I.S.Q.	10	34	37	16	3	2.64	98.1
6	Coryza	19	23	40	17	1	2.58	97.7
7	Slight coryza improving	20	33	42	4	1	2.33	97.7
8		6	34	39	20	1	2.76	98.1
9	Slight coryza	18	37	36	9	0	2.36	98.2
10		12	15	37	31	5	3.02	98.8

	W.M.
Average of 10	2.63
Average of 7 highest	2.66
Moving Average of 10	2.57

Average Barometric Pressure 29.74 mm. Hg.
Range 29.71 - 29.77

Average Humidity 66%

External Temp. on Bridge 4 Hourly

	D	W
	60	55
	60	54
	59	53
	60	53
	58	52
	55	50
Av.	59	53
M.A.	-	52

Date: 21.1.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
1		11	32	45	12	0	2.58	97.7
2	Slight coryza	13	41	40	6	0	2.39	98.2
3	Coryza	6	20	47	26	1	2.96	98.2
4		10	23	39	24	4	2.89	98.0
5	Coryza I.S.Q.	14	36	38	11	1	2.49	98.7
6	Coryza	17	25	47	11	0	2.52	98.3
7	Slight coryza improving	18	40	33	9	0	2.33	99.0
8		11	27	49	12	1	2.65	97.8
9	Slight coryza	15	34	44	7	0	2.39	98.8
10		7	25	39	27	2	2.92	98.0

	W.M.
Average of 10	2.61
Average of 7 highest	2.70
Moving Average of 10	2.60

Average Barometric Pressure 29.74 mm. Hg.
Range 29.67 - 29.77

Average Humidity 62%

External Temp. on Bridge 4 Hourly

	D	W
	53	50
	55	50
	63	54
	64	52
	60	50
	51	48
Av.	58	51
M.A.	-	52

Date: 22.1.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
1		10	47	33	10	0	2.43	96.9
2	Slight coryza	8	23	49	19	1	2.82	98.4
3	Coryza	5	29	43	19	4	2.88	98.6
4		13	43	33	11	0	2.42*	98.6
5	Coryza improving	13	37	41	9	0	2.46	97.8
6	Coryza	11	44	34	10	1	2.56	97.8
7	Slight coryza improving	17	48	31	4	0	2.22	98.7
8		7	34	46	12	1	2.66	98.7
9	Slight coryza	20	50	25	5	0	2.15	98.7
10		4	31	45	20	0	2.81	97.8

	W.M.
Average of 10	2.54
Average of 7 highest	2.54
Moving Average of 10	2.59

Average Barometric Pressure 29.60 mm. Hg.
Range 29.53 - 29.65

Average Humidity 47%

External Temp. on Bridge 4 Hourly

	D	W
	54	46
	59	48
	66	53
	67	57
	67	52
	62	50
Av.	62	51
M.A.	-	52

* Clinical examination revealed no cause for the left shift.

Date: 23.1.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
1		11	26	42	19	2	2.75	97.3
2	Slight coryza	16	20	40	23	1	2.73	98.0
3		7	27	40	23	3	2.88	98.2
4		18	25	35	19	3	2.64	98.3
5	Coryza improving	18	15	33	28	6	2.89	98.2
6		26	29	27	15	3	2.40	98.0
7		10	36	44	8	2	2.56	98.7
8		14	17	41	26	2	2.85	99.2
9	Slight coryza	21	26	35	17	1	2.51	98.2
10		13	11	38	29	9	3.10	98.0

	W.M.
Average of 10	2.73
Average of 7 highest	2.80
Moving Average of 10	2.63

Average Barometric Pressure 29.81 mm. Hg.
Range 29.71 - 29.84

Average Humidity 54%

External Temp. on Bridge 4 Hourly

	D	W
	59	53
	57	51
	62	51
	63	51
	65	56
	66	55
Av.	62	53
M.A.	-	52

Date: 24.1.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
1	S*	9	30	49	10	2	2.66	97.8
2	Slight coryza	21	30	36	12	1	2.42	98.8
3		12	14	53	20	1	2.84	98.6
4		17	31	39	12	1	2.49	98.8
5	Coryza improving	15	23	52	9	1	2.58	97.9
6		14	26	43	16	1	2.64	98.5
7		22	31	39	8	0	2.33	98.6
8		6	25	52	16	1	2.81	98.7
9	Slight coryza	17	33	35	14	1	2.49	98.0
10		12	19	53	14	2	2.75	98.1

	W.M.
Average of 10	2.60
Average of 7 highest	2.66
Moving Average of 10	2.62

Average Barometric Pressure 29.88 mm. Hg.
Range 29.84 - 29.93.

Average Humidity 54%

External Temp. on Bridge 4 Hourly

	D	W
	68	55
	69	57
	73	61
	72	62
	72	64
	72	65
Av.	71	61
M.A.	-	55

* Exposure to sun, as defined.

Date: 25.1.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
1		12	25	39	23	1	2.76	99.0
2	Slight coryza	12	15	53	19	1	2.82	98.8
3		6	22	46	24	2	2.94	99.4
4		11	20	40	28	1	2.88	98.8
5	Coryza improving	7	19	49	23	2	2.94	98.0
6		10	24	50	14	2	2.74	98.5
7		16	38	38	8	0	2.38	98.4
8		8	17	57	17	1	2.86	99.0
9	Slight coryza	13	40	38	9	0	2.43	98.5
10		8	17	45	23	7	3.04	98.6

	W.M.
Average of 10	2.78
Average of 7 highest	2.84
Moving Average of 10	2.70

Average Barometric Pressure 29.78 mm. Hg.
Range 29.74 - 29.82

Average Humidity 63%

External Temp. on Bridge 4 Hourly

	D	W
	76	67
	77	69
	80	70
	78	69
	77	69
	77	71
Av.	77	69
M.A.	-	61

Date: 26.1.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
1		14	27	52	7	0	2.52	98.3
2	Slight coryza	15	24	43	14	4	2.68	98.0
3		18	20	48	13	1	2.59	98.6
4		10	31	44	14	1	2.65	98.5
5	Coryza improving	15	25	41	18	1	2.65	98.0
6		16	28	44	11	1	2.53	98.6
7		21	31	42	6	0	2.33	98.7
8		23	23	35	17	2	2.52	98.6
9	Slight coryza	17	34	40	7	2	2.43	98.7
10		12	23	44	17	4	2.78	98.6

	W.M.
Average of 10	2.57
Average of 7 highest	2.59
Moving Average of 10	2.65

Average Barometric Pressure 29.77 mm. Hg.
Range 29.73 - 29.80

Average Humidity 75%

External Temp. on Bridge 4 Hourly

	D	W
	76	73
	77	72
	80	73
	78	72
	77	72
	76	72
Av.	77	72
M.A.	-	67

Date: 27.1.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
1		10	34	42	13	1	2.61	99.1
2	Slight coryza	16	27	35	21	1	2.64	98.5
3		8	25	48	17	2	2.80	98.3
4		9	36	41	13	1	2.61	98.6
5	Coryza improving	12	26	36	23	3	2.79	98.0
6		15	29	45	11	0	2.52	97.8
7		27	36	32	5	0	2.15	98.1
8		17	30	43	10	0	2.46	98.2
9	Slight coryza S.	16	34	42	8	0	2.42	98.2
10		15	27	37	19	2	2.66	98.0

	W.M.
Average of 10	2.57
Average of 7 highest	2.62
Moving Average of 10	2.64

Average Barometric Pressure 29.80 mm. Hg.
Range 29.77 - 29.83

Average Humidity 59%

External Temp. on Bridge 4 Hourly

	D	W
	76	71
	76	68
	78	69
	80	67
	76	65
	74	66
Av.	77	68
M.A.	-	70

Date: 28.1.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
1		16	28	40	15	1	2.57	98.4
2	Slight coryza	14	23	32	19	12	2.92	98.2
3		12	22	32	28	6	2.94	98.4
4		15	22	41	20	2	2.72	99.0
5	Coryza improving	16	22	36	25	1	2.73	97.9
6		17	31	42	10	0	2.45	97.8
7		17	38	36	9	0	2.37	99.0
8		13	19	49	17	2	2.76	98.3
9	Slight coryza	34	30	31	4	1	2.08	98.4
10		16	21	42	16	5	2.73	98.4

	W.M.
Average of 10	2.63
Average of 7 highest	2.65
Moving Average of 10	2.59

Average Barometric Pressure 29.72 mm. Hg.
Range 29.68 - 29.75

Average Humidity 67%

External Temp. on Bridge

	D	W
	75	68
	75	69
	77	68
	77	70
	77	71
	78	73
Av.	77	70
M.A.	-	70

Date: 29.1.47.

Y

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
1		21	31	43	5	0	2.32	98.4
2	Slight coryza	20	22	42	15	1	2.55	98.5
3		14	20	49	16	1	2.70	98.3
4		18	28	44	8	2	2.48	99.0
5	Coryza improving	14	27	46	12	1	2.59	98.4
6		28	29	35	6	2	2.25	98.4
7		25	30	41	3	1	2.25	98.8
8		23	34	39	4	0	2.24	98.7
9	Slight coryza	21	41	34	4	0	2.21	98.7
10		18	24	42	14	2	2.58	98.8

	W.M.
Average of 10	2.42
Average of 7 highest	2.45
Moving Average of 10	2.54

Average Barometric Pressure 29.67 mm. Hg.
Range 29.62 - 29.69

Average Humidity 90%

External Temp. on Bridge 4 Hourly

	D	W
	79	75
	76	75
	80	75
	80	78
	80	78
	80	78
Av.	79	77
M.A.	-	72

Date: 30.1.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
1		20	42	34	4	0	2.22	97.7
2	Slight coryza	18	34	42	5	1	2.37	98.6
3		12	38	38	11	0	2.46	99.0
4		20	27	44	9	0	2.42	98.7
5	Coryza improving	18	35	36	10	1	2.41	98.6
6		14	33	42	11	0	2.50	99.0
7	S.	32	32	32	4	0	2.08	99.0
8		18	33	44	5	0	2.36	99.0
9	S. Slight coryza	22	34	37	7	0	2.29	98.4
10		23	36	31	10	0	2.28	98.1

	W.M.
Average of 10	2.34
Average of 7 highest	2.35
Moving Average of 10	2.46

Average Barometric Pressure 29.69 mm. Hg.
Range 29.65 - 29.73

Average Humidity 86%

External Temp. on Bridge 4 Hourly

	D	W
	81	78
	81	78
	81	78
	83	78
	81	77
	81	77
Av.	81	78
M.A.	-	75

Date: 31.1.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
1		15	45	36	4	0	2.29	98.3
2		21	42	30	7	0	2.23	98.8
3		12	26	55	7	0	2.57	99.2
4		16	28	46	10	0	2.50	99.2
5	Coryza improving	20	29	43	8	0	2.39	98.1
6		17	49	29	5	0	2.39	98.1
7		23	43	34	0	0	2.11	98.7
8		20	35	41	4	0	2.29	99.1
9	Slight coryza	26	23	43	8	0	2.33	97.9
10		14	36	37	12	1	2.50	98.1

	W.M.
Average of 10	2.36
Average of 7 highest	2.41
Moving Average of 10	2.37

Average Barometric Pressure 29.66 mm. Hg.
Range 29.63 - 29.68

Average Humidity 82%

External Temp. on Bridge 4 Hourly

	D	W
	81	78
	81	78
	82	75
	81	75
	81	77
	80	78
Av.	81	77
M.A.	-	77

Date: 1.2.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
1							2.28*	
2	S.	19	43	32	6	0	2.25	98.8
3		25	25	42	8	0	2.33	98.8
4		23	24	47	6	0	2.36	98.7
5	Coryza improving	18	28	45	9	0	2.45	98.2
6	S.	34	30	28	7	1	2.11	98.4
7		24	34	39	3	0	2.21	98.7
8		20	40	35	5	0	2.25	98.6
9	Slight coryza	19	34	38	9	0	2.37	98.6
10		19	35	39	7	0	2.34	98.1

	W.M.
Average of 10	2.30
Average of 9	2.30
Average of 7 highest	2.34
Moving Average of 10	2.33

External Temp. on Bridge 4 Hourly

	D	W
	76	74
	76	74
	86	75
	83	78
	81	77
	81	75
Av.	81	76
M.A.	-	77

Average Barometric Pressure 29.64 mm.Hg.
Range 29.55 - 29.66

Average Humidity 77%

* Average of last 3 readings taken, to obviate tendency to low average in the mean of the 10 weighted means. Not included in scatter diagrams for correlation coefficients.

Date: 2.2.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
1							2.28	
2		31	34	30	5	0	2.09	98.4
3		25	29	33	12	1	2.35	99.0
4		23	34	35	8	0	2.28	98.5
5		28	26	37	8	1	2.28	98.4
6		18	36	36	10	0	2.38	99.0
7	Sinusitis	24	30	42	4	0	2.26	99.0
8		16	29	47	8	0	2.47	99.1
9	Slight coryza	21	37	32	9	1	2.32	98.4
10		25	30	34	10	1	2.32	98.5

	W.M.
Average of 10	2.30
Average of 9	2.34
Average of 7 highest	2.33
Moving Average of 10	2.32

Average Barometric Pressure 29.64 mm. Hg.

Range 29.59 - 29.68

Average Humidity 69%

External Temp. on Bridge 4 Hourly

	D	W
	80	74
	81	74
	82	74
	82	74
	81	74
	80	72
Av.	81	74
M.A.	-	76

Date: 3.2.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
1							2.28	
2		16	32	40	10	2	2.50	98.6
3	Headache	10	29	50	11	0	2.62	99.2
4		13	32	39	15	1	2.59	98.6
5		17	25	40	16	2	2.61	98.4
6		23	39	31	7	0	2.22	98.2
7		38	37	21	4	0	1.91	99.0
8		5	30	46	19	0	2.79	99.0
9	Slight coryza	20	19	45	16	0	2.57	98.4
10		18	24	37	18	3	2.64	97.3

	W.M.
Average of 10	2.47
Average of 9	2.49
Average of 7 highest	2.59
Moving Average of 10	2.36

Average Barometric Pressure 29.64 mm. Hg.
Range 29.61 - 29.66

Average Humidity 74%

External Temp. on Bridge 4 Hourly

	D	W
	80	72
	81	74
	84	76
	83	77
	83	77
	83	78
Av.	82	76
M.A.	-	75

Date: 4.2.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
1							2.28	
2	S.	26	34	34	6	0	2.20	99.1
3	Headache	25	43	27	5	0	2.12	99.0
4		14	47	30	9	0	2.34	98.6
5		17	33	41	9	0	2.42	98.4
6		21	30	45	4	0	2.32	99.2
7	Sinusitis Slight diarrhoea	27	46	23	4	0	2.04	99.0
8		5	37	52	6	0	2.59	99.2
9		16	31	38	15	0	2.52	99.1
10		17	34	36	12	1	2.46	98.0

	W.M.
Average of 10	2.33
Average of 9	2.33
Average of 7 highest	2.39
Moving Average of 10	2.37

Average Barometric Pressure 29.66 mm. Hg.
Range 29.62 - 29.69

Average Humidity 74%

External Temp. on Bridge 4 Hourly

	D	W
	82	76
	81	77
	85	78
	85	77
	84	77
	73	72
Av.	82	76
M.A.	-	75

Date: 5.2.47. Arrive Singapore*

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
1							2.28	
2		13	32	42	11	2	2.57	98.4
3		20	27	43	9	1	2.44	99.2
4		18	32	39	10	1	2.44	99.0
5		19	38	38	4	1	2.46	98.2
6		16	32	40	12	0	2.48	99.2
7		21	48	26	5	0	2.15	98.5
8		19	31	44	6	0	2.37	99.4
9		31	34	27	7	0	2.13	98.6
10		18	34	36	12	0	2.42	97.8

	W.M.
Average of 10	2.37
Average of 9	2.38
Average of 7 highest	2.36
Moving Average of 10	2.39

Average Barometric Pressure 29.64 mm. Hg.
Range 29.61 - 29.67

Average Humidity 81%

External Temp. on Bridge 4 Hourly

	D	W
	79	76
	78	75
	83	76
	82	76
	78	75
	77	75
Av.	80	76
M.A.	-	76

* Average daily temp. readings on bridge while in dock at Singapore:-

6.2.47. Dry 77 Wet 74 M.A. (Wet) 75 8.2.47. Dry 79 Wet 75 M.A. (Wet) 75
7.2.47. Dry 77 Wet 75 M.A. (Wet) 75 9.2.47. Dry 83 Wet 77 M.A. (Wet) 76

Date: 10.2.47. Sail from Singapore.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
2		21	34	35	10	0	2.34	98.9
3		19	33	38	10	0	2.39	98.7
4		23	40	33	4	0	2.18	98.8
5		22	37	31	9	1	2.30	99.0

	W.M.
Average of 4 (permanent staff)	2.30

Average Barometric Pressure 29.66 mm. Hg.

Range 29.62 - 29.71

Average Humidity 79%

External Temp. on Bridge 4 Hourly

	D	W
	78	75
	77	75
	89	80
	83	77
	82	77
	81	76
Av.	82	77
M.A.	-	76

Date: 11.2.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
2	S.	18	35	38	9	0	2.38	98.7
3		15	32	43	10	0	2.48	98.4
4		17	42	34	7	0	2.31	98.4
5	Bed bug bites	18	35	35	12	0	2.41	98.9
11		13	26	36	23	2	2.75	99.1
12		11	37	35	17	0	2.58	98.6
13	*	14	35	35	15	1	2.54	99.0
14		15	31	46	8	0	2.47	98.7
15	S.	20	40	34	6	0	2.26	98.0
16	S.	16	43	35	7	0	2.35	98.1

	W.M.
Average of 4	2.40
Average of 6 (passengers from Malaya)	2.49
Average of 10	2.45

Average Barometric Pressure 29.64 mm.Hg.
Range 29.60 - 29.68

Average Humidity 79%

External Temp. on Bridge 4 Hourly

	D	W
	81	77
	82	78
	83	78
	85	78
	82	76
	80	76
Av.	82	77
M.A.	-	77

* One week history of coryza; now slight, and improving.

Date: 12.2.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
2	S.	18	20	37	24	1	2.70	99.0
3		12	32	40	13	3	2.65	98.3
4		16	36	36	11	1	2.45	98.6
5	Bed bug bites	13	41	34	11	1	2.46	98.7
11		10	22	44	24	0	2.82	99.2
12		20	31	37	11	1	2.42	99.4
13	Slight coryza improving	18	31	36	16	0	2.52	98.8
14		16	28	43	11	2	2.55	98.7
15	S.	20	40	33	7	0	2.27	99.1
16	S.	15	42	36	7	0	2.35	98.0

	W.M.
Average of 4	2.56
Average of 6 (passengers from Malaya)	2.49
Average of 10	2.52

Average Barometric Pressure 29.65 mm. Hg.
Range 29.61 - 29.68

Average Humidity 72%

External Temp. on Bridge
4 Hourly

	D	W
	81	77
	81	77
	85	78
	88	78
	83	77
	83	77
Av.	84	77
M.A.	-	77

Date: 13.2.47.*

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
2	S.	18	27	38	17	0	2.54	98.7
3		15	36	39	9	1	2.45	98.6
4		19	42	33	6	0	2.26	98.8
5	Bed bug bites	12	50	29	9	0	2.35	98.4
11		12	29	42	15	2	2.66	99.1
12		18	41	39	2	0	2.25	98.0
13	Coryza improving	19	38	32	9	2	2.37	98.9
14		11	27	50	10	2	2.65	98.4
15	S.	23	34	34	9	0	2.29	98.6
16		21	37	34	8	0	2.29	97.6

	W.M.
Average of 4	2.40
Average of 6	2.42
Average of 10	2.41
Moving Average (M.A.) of 10	2.46

Average Barometric Pressure 29.65 mm. Hg.
Range 29.63 - 29.69

Average Humidity 72%

External Temp. on Bridge 4 Hourly

	D	W
	82	76
	82	76
	85	79
	87	78
	83	77
	82	76
Av.	84	77
M.A.	-	77

* Arrive and depart Colombo 14.2.47. Bridge Temp. 4 hrly. average for that day = 85° Dry Bulb 77° Wet Bulb M.A. (Wet Bulb) 77

Date: 15.2.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
2		18	24	42	15	1	2.57	98.8
3		9	33	44	13	1	2.64	98.1
4		18	34	39	9	0	2.39	98.2
5		18	31	39	12	0	2.45	98.8
11	Excess sun exposure*	36	36	26	2	0	1.94	98.6
12		11	37	40	11	1	2.54	98.4
13	S. on 14.2.47.	35	31	30	4	0	2.03	99.4
14		5	36	44	14	0	2.70	97.8
15		21	32	36	11	0	2.37	98.6
16	Headache: coryza Rhonchi in chest	31	41	21	7	0	2.04**	101.8

	W.M.
Average of 4	2.51
Average of 6	2.31
Average of 10	2.39
M.A. of 10	2.44

Average Barometric Pressure 29.66 mm. Hg.
Range 29.60 - 29.67

Average Humidity 79%

External Temp. on Bridge 4 Hourly

	D	W
	80	77
	79	76
	85	77
	85	77
	80	76
	82	76
Av.	82	77
M.A.	-	77

* Exposed to very hot sun for 4 hours, wearing trousers only. No sunburn, but felt exhausted.

** Average of three previous readings used for means; i.e. 2.30. Results on 15th, 16th and 17th omitted for correlation etc.

Date: 16.2.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
2		15	39	35	10	1	2.43	98.4
3		8	37	41	14	0	2.61	98.3
4		14	40	38	7	1	2.41	98.7
5		20	35	40	5	0	2.30	98.6
11	See footnote 15.2.47.	39	39	18	4	0	1.87	97.9
12		12	36	46	6	0	2.46	98.7
13		35	38	19	8	0	2.00	98.2
14		5	27	47	21	0	2.84	98.8
15	S.	18	42	32	8	0	2.30	98.2
16		41	45	14	0	0	1.73**	98.4

	W.M.
Average of4	2.44
Average of 6	2.30
Average of 10	2.35
M.A. of 10	2.38

Average Barometric Pressure 29.64 mm. Hg.
Range 29.59 - 29.69

Average Humidity 74%

External Temp. on Bridge 4 Hourly

	D	W
	81	76
	82	77
	83	77
	84	76
	82	75
	81	74
Av.	82	76
M.A.	-	77

** See footnote 15.2.47. W.M.'s for 15, 16 and 17th omitted for correlation, but mean of previous 3 days used to prevent bias of average of 10, for graphing.

Date: 17.2.47. Arrive Bombay*

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
2	S.	10	35	40	14	1	2.61	98.3
3		5	30	47	18	0	2.78	98.2
4		7	37	41	15	0	2.64	98.5
5		11	28	39	21	1	2.73	98.4
11		21	41	31	7	0	2.24	97.5
12	S.	13	34	41	7	2	2.48	97.6
13		39	37	19	5	0	1.90	98.0
14		3	36	46	15	0	2.73	98.1
15		19	34	40	5	2	2.37	98.4
16	S.	39	40	21	0	0	1.82**	97.4

	W.M.
Average of 4	2.69
Average of 6	2.34
Average of 10	2.48
M.A. of 10	2.41

Average Barometric Pressure 29.67 mm. Hg.
Range 29.64 - 29.71

Average Humidity 63%

External Temp. on Bridge 4 Hourly

	D	W
	81	71
	77	71
	78	69
	79	70
	79	70
	75	69
Av.	78	70
M.A.	-	74

* Bridge temp. 4 hrly. averages while in Bombay:- 18.2.47. D 78 W 70: 19.2.47. D 79 W 71. M.A. (Wet Bulb) 72 and 70.

** See previous footnote. Patient recovered very quickly from his mild indisposition, and by 20.2.47 was apparently quite well.

Date: 20.2.47. Depart Bombay

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
2		8	31	47	13	1	2.68	98.4
3		6	24	51	18	1	2.84	97.9
4		7	42	41	9	1	2.55	97.9
5		16	32	38	14	0	2.50	98.5
11		18	36	37	8	1	2.38	98.2
12	S.	9	37	44	10	0	2.55	97.8
13		11	39	42	8	0	2.47	98.4
14		12	41	37	9	1	2.46	98.4
15		12	43	35	10	0	2.43	98.5
16	S.	20	39	32	9	0	2.30	97.7

	W.M.
Average of 4	2.64
Average of 6	2.43
Average of 10	2.52
M.A. of 10	2.45

Average Barometric Pressure 29.75 mm. Hg.
Range 29.71 - 29.79

Average Humidity 71%

External Temp. on Bridge 4 Hourly

	D	W
	74	70
	74	70
	80	74
	83	72
	80	71
	78	73
Av.	78	72
M.A.	-	71

Date: 21.2.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
2		16	31	37	14	2	2.55	98.2
3		4	25	52	19	0	2.86	97.9
4		14	35	35	15	1	2.54	97.8
5		16	27	40	15	2	2.60	98.2
11		17	42	26	14	1	2.40	98.3
12		14	38	37	11	0	2.45	98.4
13		12	35	40	11	2	2.56	98.4
14		10	38	39	12	1	2.56	97.8
15		12	36	43	8	1	2.50	98.4
16	S.	20	37	35	6	2	2.33	98.2

	W.M.
Average of 4	2.64
Average of 6	2.47
Average of 10	2.54
M.A. of 10	2.51

Average Barometric Pressure 29.81 mm. Hg.
Range 29.78 - 29.85

Average Humidity 71%

External Temp. on Bridge 4 Hourly

	D	W
	76	72
	75	71
	80	72
	79	71
	76	70
	75	68
Av.	77	71
M.A.	-	71

Date: 22.2.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
2	S.	6	28	55	11	1	2.75	98.7
3		8	23	52	15	2	2.80	99.0
4		13	41	35	11	0	2.44	98.7
5		11	45	33	10	1	2.45	98.4
11		10	41	35	14	0	2.53	98.5
12		11	35	45	9	0	2.52	98.4
13		12	34	37	16	1	2.60	98.7
14		8	28	44	17	3	2.79	97.9
15	S.	12	42	35	11	0	2.45	98.5
16	S.	24	38	30	7	1	2.25	97.8

	W.M.
Average of 4	2.61
Average of 6	2.52
Average of 10	2.56
M.A. of 10	2.54

Average Barometric Pressure 29.83 mm. Hg.
Range 29.81 - 29.86

Average Humidity 67%

External Temp. on Bridge 4 Hourly

	D	W
	74	69
	74	69
	83	73
	81	72
	79	72
	76	71
Av.	78	71
M.A.	-	71

Date: 23.2.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
2	S.	9	23	47	18	3	2.83	98.7
3		9	38	41	12	0	2.56	98.7
4		13	32	41	14	0	2.56	98.4
5		12	36	46	5	1	2.47	98.4
11		12	39	37	12	0	2.49	98.1
12		9	32	43	13	3	2.69	98.4
13		17	27	45	11	0	2.50	98.7
14		10	34	40	16	0	2.62	98.2
15	S.	9	35	42	14	0	2.61	98.4
16	S.	24	27	35	12	2	2.41	98.4

	W.M.
Average of 4	2.61
Average of 6	2.55
Average of 10	2.57
M.A. of 10	2.56

Average Barometric Pressure 29.79 mm. Hg.
Range 29.76 - 29.84

Average Humidity 63%

External Temp. on Bridge 4 Hourly

	D	W
	75	70
	76	69
	83	72
	84	73
	77	71
	76	71
Av.	79	71
M.A.	-	71

Date: 24.2.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
2	S.	11	29	47	12	1	2.63	99.0
3		15	31	47	7	0	2.46	98.6
4		16	33	35	16	0	2.51	98.7
5		18	38	36	8	0	2.34	98.4
11		13	29	35	18	5	2.73	98.4
12		10	37	40	13	0	2.56	97.7
13		8	34	44	14	0	2.64	98.3
14		10	31	46	12	1	2.63	97.8
15		9	33	46	11	1	2.62	98.8
16	S.	18	40	33	9	0	2.33	98.1

	W.M.
Average of 4	2.49
Average of 6	2.59
Average of 10	2.55
M.A. of 10	2.56

Average Barometric Pressure 29.67 mm. Hg.
Range 29.58 - 29.75

Average Humidity 68%

External Temp. on Bridge 4 Hourly

	D	W
	76	71
	79	73
	83	74
	85	73
	81	73
	78	74
Av.	80	73
M.A.	-	72

Date: 25.2.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
2	S.	15	29	38	18	0	2.59	98.5
3		4	22	51	21	2	2.95	98.6
4		9	40	37	14	0	2.56	98.7
5		11	31	45	12	1	2.61	98.5
11		13	41	32	12	2	2.49	98.7
12		13	34	42	10	1	2.52	98.7
13		13	36	36	14	1	2.54	98.6
14		12	35	37	14	2	2.59	98.4
15		13	46	27	14	0	2.42	98.1
16	S.	32	32	31	5	0	2.09	97.8

	W.M.
Average of 4	2.68
Average of 6	2.44
Average of 10	2.54
M.A. of 10	2.55

Average Barometric Pressure 29.64 mm. Hg.
Range 29.61 - 29.68

Average Humidity 63%

External Temp. on Bridge 4 Hourly

	D	W
	78	76
	78	75
	80	73
	82	65
	77	68
	76	68
Av.	79	71
M.A.	-	72

Date: 26.2.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
2		9	31	44	15	1	2.68	98.5
3		8	33	44	15	0	2.66	98.6
4		12	32	41	11	4	2.63	98.4
5		17	24	49	10	0	2.52	98.2
11		11	42	36	11	0	2.47	98.8
12		17	38	37	8	0	2.36	98.0
13		12	47	34	7	0	2.36	98.4
14		12	35	37	15	1	2.58	98.4
15		18	42	32	7	1	2.31	98.4
16	S.	24	39	30	7	0	2.20	98.3

	W.M.
Average of 4	2.62
Average of 6	2.38
Average of 10	2.48
M.A. of 10	2.52

Average Barometric Pressure 29.70 mm. Hg.
Range 29.68 - 29.72

Average Humidity 59%

External Temp. on Bridge 4 Hourly

	D	W
	75	65
	73	66
	74	67
	75	67
	73	67
	73	58
Av.	74	65
M.A.	-	70

Date: 27.2.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
2		11	27	47	12	3	2.69	98.0
3		5	32	47	13	3	2.77	98.2
4		10	35	39	15	1	2.62	98.2
5		15	29	39	15	2	2.60	98.7
11		7	40	28	22	3	2.74	98.4
12		12	31	40	17	0	2.62	98.2
13		12	35	35	17	1	2.60	97.8
14		9	27	46	18	0	2.73	97.8
15		19	38	36	7	0	2.31	98.0
16	S.	14	29	43	12	2	2.59	98.7

	W.M.
Average of 4	2.67
Average of 6	2.60
Average of 10	2.63
M.A. of 10	2.55

Average Barometric Pressure 29.75 mm. Hg.
Range 29.71 - 29.81

Average Humidity 53%

External Temp. on Bridge
4 Hourly

	D	W
	67	56
	65	54
	77	61
	78	64
	63	60
	61	60
Av.	69	59
M.A.		65

Date: 28.2.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
2	Tooth extraction	13	39	32	15	1	2.52	99.1
3		10	22	46	12	0	2.60	98.0
4		19	38	37	6	0	2.30	98.3
5		6	38	42	12	2	2.66	98.4
11	Slight coryza	11	34	43	12	0	2.46	99.0
12		15	30	35	18	2	2.62	98.0
13		12	32	43	13	0	2.57	98.0
14		12	32	44	11	1	2.57	97.6
15	Slight coryza	12	41	41	6	0	2.41	98.7
16	S.	8	51	35	6	0	2.39	97.6

	W.M.
Average of 4	2.52
Average of 6	2.50
Average of 10	2.51
M.A. of 10	2.54

Average Barometric Pressure 29.84 mm.Hg.
Range 29.78 - 29.88

Average Humidity 83%

External Temp. on Bridge
4 Hourly

	D	W
	62	59
	62	59
	66	61
	66	63
	65	61
	62	61
Av.	64	61
M.A.	-	62

Date: 1.3.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
2		16	36	45	3	0	2.35	98.8
3		7	32	46	13	2	2.71	98.7
4		17	30	35	18	0	2.54	98.7
5		9	30	45	16	0	2.68	98.2
11	Slight coryza	5	30	42	19	4	2.87	96.8
12		12	40	40	7	1	2.45	98.0
13		16	36	32	14	2	2.50	98.0
14	Coryza	10	37	42	9	2	2.56	98.5
15	Slight coryza	19	44	28	9	0	2.27	98.0
16		25	41	25	9	0	2.18	98.1

	W.M.
Average of 4	2.57
Average of 6	2.47
Average of 10	2.51
M.A. of 10	2.55

Average Barometric Pressure 29.76 mm. Hg.
Range 29.74 - 29.82

Average Humidity 88%

External Temp. on Bridge 4 Hourly

	D	W
	59	57
	58	57
	63	60
	62	59
	60	57
	59	56
Av.	60	58
M.A.	-	59

Date: 2.3.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
2		6	38	45	11	0	2.61	98.4
3		8	36	43	13	0	2.61	98.1
4		15	35	38	10	2	2.49	98.7
5	Coryza	8	45	36	11	0	2.50	98.4
11		7	38	36	17	2	2.69	96.5
12		10	40	44	6	0	2.46	97.7
13		10	42	37	11	0	2.49	98.5
14	Coryza	10	42	40	8	0	2.46	98.1
15	Slight coryza	18	44	33	5	0	2.25	98.2
16		20	40	34	5	1	2.27	97.4

	W.M.
Average of 4	2.55
Average of 6	2.44
Average of 10	2.48
M.A. of 10	2.50

Average Barometric Pressure 29.84 mm. Hg.
Range 29.76 - 29.87

Average Humidity 67%

External Temp. on Bridge 4 Hourly

	D	W
	55	52
	56	53
	66	57
	68	58
	64	58
	62	57
Av.	62	56
M.A.	-	58

Date: 3.3.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
2		13	38	42	7	0	2.43	98.4
3		8	34	42	16	0	2.66	98.5
4		11	33	46	9	1	2.56	98.1
5	Coryza	11	35	39	15	0	2.58	98.5
11		4	30	41	22	3	2.90	97.3
12		11	31	47	11	0	2.58	98.4
13		12	29	38	20	1	2.69	98.7
14	Coryza	9	36	41	14	0	2.60	97.6
15	Slight coryza	23	46	30	1	0	2.09	97.7
16		16	37	39	8	0	2.39	97.8

	W.M.
Average of 4	2.56
Average of 6	2.54
Average of 10	2.55
M.A. of 10	2.51

Average Barometric Pressure 29.60 mm. Hg.
Range 29.44 - 29.82

Average Humidity 67%

External Temp. on Bridge 4 Hourly

	D	W
	61	58
	65	57
	68	59
	71	59
	59	57
	59	57
Av.	64	58
M.A.		57

Date: 4.3.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
2		7	33	43	17	0	2.70	98.1
3		8	32	46	13	1	2.67	98.4
4		11	31	39	17	2	2.68	98.4
5	Coryza	5	26	46	21	2	2.89	98.4
11		6	26	40	24	4	2.94	98.8
12		5	39	43	12	1	2.65	98.1
13		13	29	36	21	1	2.68	98.4
14	Coryza	9	29	40	21	1	2.76	98.0
15	Coryza	16	42	36	6	0	2.32	98.0
16		18	49	28	5	0	2.20	98.0

	W.M.
Average of 4	2.74
Average of 6	2.59
Average of 10	2.65
M.A. of 10	2.56

Average Barometric Pressure 29.51 mm. Hg.
Range 29.48 - 29.54

Average Humidity 82%

External Temp. on Bridge 4 Hourly

	D	W
	59	55
	58	53
	57	54
	60	56
	59	56
	57	55
Av.	58	55
M.A.	-	56

Date: 5.3.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
2		8	25	48	18	1	2.79	98.7
3		7	33	42	16	2	2.73	98.6
4		10	40	38	12	0	2.52	99.2
5	Coryza	7	26	37	30	0	2.90	97.6
11		5	29	46	19	1	2.82	98.0
12		14	31	43	12	0	2.53	98.1
13	Seasick	12	22	50	15	1	2.71	98.0
14	Coryza	11	27	51	11	0	2.62	98.4
15	Seasick; coryza	12	41	39	8	0	2.43	97.3
16	Seasick	15	41	43	1	0	2.30	97.8

	W.M.
Average of 4	2.74
Average of 6	2.57
Average of 10	2.64
M.A. of 10	2.61

Average Barometric Pressure 29.51 mm. Hg.
Range 29.46 - 29.54

Average Humidity 80%

External Temp. on Bridge
4 Hourly

	D	W
	56	54
	56	55
	55	52
	57	52
	51	47
	48	44
Av.	54	51
M.A.	-	55

Date: 6.3.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
2		8	30	49	12	1	2.68	97.9
3		7	20	56	19	2	3.01	98.3
4		9	29	51	10	1	2.65	98.4
5	Coryza	9	32	50	7	2	2.61	97.8
11		6	23	58	13	0	2.78	97.8
12		6	29	47	17	1	2.78	97.9
13		5	25	46	22	2	2.91	97.9
14		9	32	47	12	0	2.62	98.2
15	Coryza	9	47	39	5	0	2.40	98.4
16.	Seasick	16	43	36	5	0	2.30	97.0

	W.M.
Average of 4	2.74
Average of 6	2.63
Average of 10	2.67
M.A. of 10	2.65

Average Barometric Pressure 29.60 mm. Hg.
Range 29.50 - 29.66

Average Humidity 65%

External Temp. on Bridge 4 Hourly

	D	W
	46	42
	44	38
	44	37
	46	39
	43	39
	41	38
Av.	44	39
M.A.	-	48

Date: 7.3.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
2	Slight coryza	9	28	50	13	0	2.67	98.7
3		6	31	50	13	0	2.70	98.2
4		5	36	47	12	0	2.66	98.7
5	Coryza	12	28	44	14	2	2.66	96.7
11		8	24	43	21	4	2.89	98.1
12		8	33	44	12	3	2.69	98.2
13		10	28	42	17	3	2.75	97.7
14		10	20	48	19	3	2.85	96.9
15	Coryza	10	36	45	9	0	2.53	97.0
16		16	46	31	6	1	2.30	96.8

	W.M.
Average of 4	2.67
Average of 6	2.67
Average of 10	2.67
M.A. of 10	2.66

Average Barometric Pressure 29.59 mm. Hg.
Range 29.51 - 29.66.

Average Humidity 76%

External Temp. on Bridge 4 Hourly

	D	W
	41	37
	40	36
	38	34
	41	37
	36	32
	35	32
Av.	38	35
M.A.	-	42

Voyage II "ASCANIUS"

Liverpool, Port Said, Aden, Mombasa, Mauritius, Durban, Mauritius, Mombasa, Berbera, Port Sudan, Suez.

SUBJECTS

Name	Age	Smoking	Previous History	Present Voyage
5. R.L.	As previous trip			Round trip
17. A.C.	23	S.	Returned from 28 days' leave, after 1 year in W. Africa	Liverpool to Mombasa.
18. J.H.	22	N.S.	3rd trip to tropics	Round trip
19. R.A.	20	S.	1st trip	Liverpool to Mombasa
20. F.C.	22	S.	As 17	do.
21. R.A.C.	19	S.	As 17	do.
22. C.A.H.	22	S.	As 17	do.
23. J.G.	34	S.	18/12 at home: much previous tropical experience	Round trip
24. N.H.W.	22	N.S.	Many trips	do.
25. A.S.	20	S.	do.	do.
26. K.W.	21	S.	do.	do.*

* But only observed for last 9 days.

Date: 31.3.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.*
5	Coryza	8	38	37	16	1	2.64	98.4	8600
17		10	35	40	14	1	2.61	98.0	6400
18	Coryza	8	31	47	14	0	2.69	97.0	7600
19		11	39	41	9	0	2.48	98.7	9000
20		9	38	40	12	1	2.58	98.3	8000
21	Coryza	15	47	34	4	0	2.27	97.8	9400
22		18	42	31	9	0	2.31	98.2	6600
23		7	34	48	11	0	2.63	98.1	8600
24		2	33	56	9	0	2.72	97.4	9000
25	Coryza	18	29	42	10	1	2.47	96.8	9200

	W.M.
Average of 10 W.M.s	2.54
Average of 5 (5,18,23 24,25, i.e. the five making the round trip)	2.63
Moving Averages of W.M.s of 10 subjects in 3 day groups	-
Moving Averages of W.M.s of 5 subjects in 3 day groups (Nos. 5,18,23,24,25, who make the round trip)	-

External Temp. on Bridge
4 Hourly

	D	W
	50	45
	50	44
	52	46
	53	48
	54	49
	53	47
Av.	52	46
M.A.≠		

Average Humidity 64%

* White blood cell count

≠ Moving Average (3 day groups)

Date: 1.4.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5	Coryza	4	30	50	16	0	2.78	97.6	*
17		12	31	48	8	1	2.55	98.4	*
18	Coryza	3	34	48	15	0	2.75	97.1	*
19		8	32	52	8	0	2.60	98.2	*
20		15	37	38	9	1	2.44	97.8	*
21	Coryza	13	41	42	4	0	2.37	97.4	*
22		12	43	36	8	1	2.43	97.9	*
23		8	39	44	9	0	2.54	98.7	*
24		6	32	51	9	2	2.69	96.5	*
25	Coryza	19	40	30	11	0	2.33	97.7	*

	W.M.
Average of 10 W.M.s	2.55
Average of 5	2.62
Moving Average of 10	-
Moving Average of 5	-

Average Humidity 69%

External Temp. on Bridge
4 Hourly

	D	W
	51	46
	53	46
	55	49
	52	48
	50	47
	50	46
Av.	52	47
M.A.≠	-	

* Counting impossible owing to roll of ship.

≠ Moving Average

Date: 2.4.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5	Coryza	4	36	53	7	0	2.63	97.3	*
17		10	37	39	14	0	2.57	98.2	*
18	Coryza	9	38	40	13	0	2.57	97.8	*
19		12	27	48	11	2	2.64	98.7	*
20		8	31	50	10	1	2.65	98.0	*
21	Coryza improving	8	41	42	7	2	2.54	96.8	*
22		11	36	46	6	1	2.50	97.8	*
23		4	39	44	13	0	2.66	98.6	*
24		3	25	50	19	3	2.94	97.8	*
25	Coryza	10	49	36	5	0	2.36	97.6	*

	W.M.
Average of 10	2.61
Average of 5	2.63
Moving Average of 10	2.57
Moving average of 5	2.63

Average Humidity 65%

External Temp. on Bridge 4 Hourly

	D	W
	53	49
	54	48
	57	53
	58	52
	56	50
	56	49
Av.	56	50
M.A.	-	48

* Counting impossible owing to roll of ship.

Date: 3.4.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		7	36	44	13	0	2.63	97.8	6600
17		6	28	47	18	1	2.80	98.4	8600
18	Coryza	3	23	60	14	0	2.85	97.8	14200*
19		14	33	44	9	0	2.48	98.9	7600
20		7	29	55	9	0	2.66	98.6	9800
21	,Coryza improving	9	34	42	14	1	2.64	98.1	8200
22		11	39	38	11	1	2.52	98.3	6400
23		8	27	44	18	3	2.81	98.4	7400
24		5	21	51	23	0	2.92	98.4	4000
25	Pharyngitis	23	48	24	5	0	2.11	98.0	7600

	W.M.
Average of 10	2.64
Average of 5	2.66
Moving Average of 10	2.60
Moving Average of 5	2.64

Average Humidity 50%

External Temp. on Bridge 4 Hourly

	D	W
	58	49
	59	51
	63	52
	62	52
	60	50
	59	48
Av.	60	50
M.A.	-	49

* Omitted in scatter diagram because abnormal

Date: 4.4.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		8	33	45	14	0	2.65	98.0	8000
17		12	27	46	15	0	2.64	98.4	9800
18	Coryza	5	35	46	14	0	2.69	97.7	14600*
19		6	30	52	12	0	2.70	98.6	12400
20		3	37	47	13	0	2.70	98.0	8800
21	Coryza improving	4	32	50	13	1	2.75	98.1	7200
22		12	40	40	8	0	2.44	98.1	7800
23		9	39	36	16	0	2.59	98.4	6600
24		4	21	55	18	2	2.93	98.3	3800
25	Pharyngitis	19	45	27	9	0	2.26	97.7	9000

	W.M.
Average of 10	2.64
Average of 5	2.62
Moving Average of 10	2.63
Moving Average of 5	2.64

Average Humidity 62%

External Temp. on Bridge 4 Hourly

	D	W
	59	55
	58	53
	64	56
	63	55
	60	53
	59	53
Av.	61	54
M.A.	-	51

* Omitted in scatter diagram because abnormal

Date: 5.4.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		5	30	46	17	2	2.81	97.8	7800
17		12	30	46	11	1	2.59	98.0	11200
18	Coryza	4	26	58	11	1	2.79	96.7	10000
19		15	45	34	5	1	2.32	98.7	12600
20		6	30	43	21	0	2.79	97.5	9600
21	Coryza improving	6	34	52	8	0	2.62	98.0	9800
22		16	36	41	6	1	2.40	98.3	7600
23		7	29	53	10	1	2.69	97.8	9000
24		4	22	56	17	1	2.89	97.6	5400
25	Pharyngitis	10	33	46	10	1	2.59	96.5	10400

	W.M.
Average of 10	2.65
Average of 5	2.75
Moving Average of 10	2.64
Moving Average of 5	2.68

External Temp. on Bridge 4 Hourly

	D	W
	See footnote	
Av.	58	52
M.A.	-	52

Average Humidity 66%

Unfortunately the complete records of 4 hourly temperatures from 5.4.47 to 21.4.47. were lost. Fortunately the average temperatures, which were recorded separately, were retained.

Date: 6.4.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		5	33	46	15	1	2.74	98.1	6600
17		7	22	47	20	4	2.92	98.0	9800
18	Coryza	4	23	57	15	1	2.86	97.6	10200
19		6	32	50	11	1	2.69	98.4	6600
20		3	41	44	11	1	2.66	97.2	8000
21	Coryza improving	12	31	46	11	0	2.56	97.3	8800
22		12	31	49	8	0	2.53	98.6	7800
23		6	29	57	8	0	2.67	98.0	7600
24		2	22	51	24	1	3.00	97.3	6400
25	Pharyngitis	18	28	50	4	0	2.40	97.0	12000

	W.M.
Average of 10	2.70
Average of 5	2.73
Moving Average of 10	2.66
Moving Average of 5	2.70

External Temp. on Bridge 4 Hourly

	D	W
Av.	62	51
M.A.	-	52

Average Humidity 47%

Date: 7.4.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		7	26	46	20	1	2.82	97.9	7000
17		12	28	48	10	2	2.62	98.0	9800
18	Coryza	2	31	55	11	1	2.78	97.0	8400
19		10	35	46	9	0	2.54	98.8	8200
20		7	33	50	9	1	2.64	97.8	8200
21		9	44	40	7	0	2.45	97.8	8600
22		13	32	42	12	1	2.56	97.7	7800
23	Slight diarrhoea	7	34	49	9	1	2.63	98.6	10800
24		6	25	50	18	1	2.83	97.7	5200
25	Coryza	9	29	52	9	1	2.64	96.6	9000

	W.M.
Average of 10	2.65
Average of 5	2.74
Moving Average of 10	2.67
Moving Average of 5	2.74

External Temp. on Bridge 4 Hourly

	D	W
Av.	65	56
M.A	-	53

Average Humidity 55%

Date: 8.4.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		5	30	52	11	2	2.75	98.5	7400
17		6	26	43	23	2	2.89	98.6	9800
18	Coryza	8	23	56	11	2	2.76	97.0	8000
19		5	30	52	12	1	2.74	98.6	8000
20		10	34	44	12	0	2.58	97.1	7800
21		7	22	55	15	1	2.81	98.0	6800
22		8	32	43	15	2	2.71	98.4	5600
23	Hot bath 1 hour before	10	27	51	11	1	2.66	99.5	5800
24		11	29	49	10	1	2.61	98.2	2800
25	Coryza	6	31	52	9	2	2.70	96.1	12200

	W.M.
Average of 10	2.72
Average of 5	2.70
Moving Average of 10	2.69
Moving Average of 5	2.72

External Temp. on Bridge 4 Hourly

	D	W
Av.	65	58
M.A.	-	55

Average Humidity 63%

Date: 9.4.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		4	16	61	18	1	2.96	98.0	9600
17		2	28	43	25	2	2.97	97.8	8200
18		6	24	51	18	1	2.84	96.6	9200
19		7	31	54	6	2	2.65	98.6	7400
20		7	27	49	16	1	2.77	97.8	8800
21		5	31	56	8	0	2.67	98.2	6400
22		11	36	46	6	1	2.50	98.0	8400
23		21	36	38	5	0	2.27	99.3	9000
24		10	27	48	14	1	2.69	97.7	5400
25	Coryza	4	31	56	9	0	2.70	96.8	10400

	W.M.
Average of 10	2.70
Average of 5	2.69
Moving Average of 10	2.69
Moving Average of 5	2.71

External Temp. on Bridge 4 Hourly

	D	W
Av.	67	59
M.A.		58

Average Humidity 60%

Date: 10.4.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		4	32	46	17	1	2.79	98.4	7200
17	TAB*	6	30	50	13	1	2.73	98.0	10600
18	Coryza	2	13	63	20	2	3.07	97.0	6800
19		8	27	56	9	0	2.66	98.7	10800
20		5	35	45	13	2	2.72	98.0	9800
21		11	32	50	7	0	2.53	98.2	9000
22		4	33	54	9	0	2.68	98.0	10000
23		7	36	50	7	0	2.57	98.6	7000
24		7	28	55	10	0	2.68	97.7	4000
25	Coryza	3	28	53	14	2	2.84	97.0	12400

	W.M.		External Temp. on Bridge 4 Hourly D	W
Average of 10	2.73			
Average of 5	2.79		D	W
Moving Average of 10	2.72	Av.	67	61
Moving Average of 5	2.73	M.A.	-	59

Average Humidity 69%

* Typhoid, paratyphoid re vaccination.

Date: 11.4.47.*

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		10	19	56	14	1	2.77	98.4	7600
17	Slight diarrhoea	1	25	53	20	1	2.95	98.0	10200
18	S.	5	21	59	15	0	2.84	97.0	8800
19	S.	12	47	38	3	0	2.32	99.3	7000
20		4	28	50	14	4	2.86	97.0	10600
21	S.	7	36	51	6	0	2.56	97.4	5200
22		4	31	52	13	0	2.74	98.0	11600
23		14	46	35	5	0	2.31	98.7	7800
24		3	22	59	15	1	2.89	98.4	7600
25	Coryza	9	25	53	13	0	2.70	96.6	10600

	W.M.	External Temp. on Bridge 4 Hourly		
Average of 10	2.69			
Average of 5	2.70		D	W
Moving Average of 10	2.71	Av.	69	62
Moving Average of 5	2.73	M.A.		61

Average Humidity 64%

* Arrive and depart Port Said 12.4.47. Av. of 4 hrly. bridge temp on that day: D 71; W 64; Wet Bulb M.A. 62.

Date: 13.4.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		7	31	47	13	2	2.72	98.4	7600
17	S.	14	25	47	14	0	2.61	98.3	8200
18	S.	7	33	50	10	0	2.63	97.9	9200
19		31	51	16	2	0	1.89	98.5	7200
20	S.	6	34	48	11	1	2.67	98.3	10000
21		11	49	32	8	0	2.37	97.5	8600
22		9	44	40	7	0	2.45	98.0	7000
23		14	46	36	4	0	2.30	98.5	6800
24		7	14	48	31	0	3.03	98.3	4400
25	Coryza	15	37	35	11	2	2.48	96.8	10800

	W.M.
Average of 10	2.52
Average of 5	2.63
Moving Average of 10	2.65
Moving Average of 5	2.71

External Temp. on Bridge 4 Hourly

	D	W
Av.	74	66
M.A.	-	64

Average Humidity 62%

Date: 14.4.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		6	26	55	13	0	2.75	98.2	8200
17		8	35	48	8	1	2.59	98.4	7800
18	S.	6	31	48	13	2	2.74	98.1	9600
19		42	41	17	0	0	1.75	99.0	6400
20		7	30	54	9	0	2.65	98.4	13800
21		17	32	37	13	1	2.49	98.8	8000
22		8	35	44	13	0	2.62	97.5	8600
23		10	41	42	5	2	2.48	98.7	9200
24		2	25	44	27	2	3.02	99.3	6000
25	Coryza	5	31	49	15	0	2.74	96.7	10200

	W.M.
Average of 10	2.58
Average of 5	2.75
Moving Average of 10	2.60
Moving Average of 5	2.69

External Temp. on Bridge 4 Hourly

	D	W
Av.	75	69
M.A.		66

Average Humidity 70%

Date: 15.4.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		8	44	40	8	0	2.48	98.7	7800
17		7	32	47	14	0	2.68	98.4	8000
18	S.	4	43	46	7	0	2.56	97.3	7200
19	S.	47	40	12	1	0	1.67	99.4	7200
20		7	40	43	10	0	2.56	99.0	8400
21		10	41	42	7	0	2.46	98.0	7400
22	S.	11	39	41	8	1	2.49	98.1	9800
23		8	37	49	6	0	2.53	99.0	8000
24		4	27	52	16	1	2.83	98.4	6400
25	Coryza	9	41	44	6	0	2.47	98.4	10200

	W.M.
Average of 10	2.47
Average of 5	2.57
Moving Average of 10	2.52
Moving Average of 5	2.65

External Temp. on Bridge 4 Hourly

	D	W
Av.	80	75
M.A.	-	70

Average Humidity 77%

Date: 16.4.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		9	31	53	7	0	2.58	98.4	7600
17		3	44	44	9	0	2.59	98.6	12000
18	S.	3	36	51	9	1	2.69	97.7	7800
19	S.	26	50	24	0	0	1.98	99.3	6200
20	S.	5	40	39	15	1	2.67	98.2	12400
21		23	42	30	5	0	2.17	98.7	9800
22	S.	10	35	46	8	1	2.55	98.5	8600
23		9	34	47	9	1	2.59	98.7	11200
24		9	24	55	12	0	2.70	98.7	8400
25	Coryza	19	41	35	5	0	2.26	98.7	6600

	W.M.
Average of 10	2.48
Average of 5	2.56
Moving Average of 10	2.51
Moving Average of 5	2.63

External Temp. on Bridge 4 Hourly

	D	W
Av.	83	78
M.A.	-	74

Average Humidity 80%

Date: 17.4.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		14	47	34	5	0	2.30	98.6	10000
17	S.	7	32	53	8	0	2.62	98.8	9800
18	S.	9	35	48	8	0	2.55	98.2	6800
19		14	48	35	3	0	2.27	99.0	7200
20		9	44	40	7	0	2.45	98.5	13800
21	S.	14	35	43	6	2	2.47	98.6	10000
22	S.	14	42	38	5	1	2.37	98.3	12200
23		8	40	44	8	0	2.52	99.0	7000
24		4	32	57	6	1	2.68	98.6	4000
25	Coryza S.	9	47	38	6	0	2.41	98.8	11600

	W.M.
Average of 10	2.46
Average of 5	2.49
Moving Average of 10	2.47
Moving Average of 5	2.54

External Temp. on Bridge 4 Hourly

	D	W
Av.	85	78
M.A.		77

Average Humidity 72%

Date: 18.4.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		10	38	47	3	2	2.49	98.6	7400
17	S.	6	31	52	11	0	2.68	98.7	11000
18	S.	6	29	54	11	0	2.70	98.2	7000
19	S.	10	61	26	3	0	2.22	99.4	9800
20		12	47	35	6	0	2.35	98.2	12400
21		9	45	38	8	0	2.45	97.9	8200
22	S.	12	45	35	6	2	2.41	98.5	10800
23		6	41	45	8	0	2.55	99.0	7200
24		6	32	44	16	2	2.76	98.7	5400
25	S. Coryza	12	38	38	12	0	2.50	98.7	8400

	W.M.
Average of 10	2.51
Average of 5	2.60
Moving Average of 10	2.48
Moving Average of 5	2.55

External Temp. on Bridge 4 Hourly

	D	W
Av.	85	80
M.A.	-	79

Average Humidity 80%

Date: 19.4.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		9	41	42	8	0	2.49	98.7	6000
17		5	30	55	10	0	2.70	98.6	10800
18	S.	12	35	44	9	0	2.50	98.8	9800
19	S.	11	45	41	3	0	2.36	99.0	10400
20		9	46	38	7	0	2.43	98.6	10000
21		10	40	42	7	1	2.49	98.0	8800
22	S.	6	43	38	13	0	2.58	98.6	7200
23		11	36	42	11	0	2.53	98.4	6600
24		3	25	50	21	1	2.92	98.4	6200
25		10	44	37	8	1	2.46	98.7	8000

	W.M.
Average of 10	2.55
Average of 5	2.58
Moving Average of 10	2.51
Moving Average of 5	2.56

External Temp. on Bridge 4 Hourly

	D	W
Av.	86	80
M.A.		79

Average Humidity 76%

Date: 20.4.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		8	40	42	9	1	2.55	98.8	8800
17	Prickly heat	10	43	39	8	0	2.45	99.0	9600
18	S.	10	40	39	11	0	2.51	98.0	12000
19		24	36	34	6	0	2.22	99.0	10400
20	S.	19	39	38	4	0	2.27	98.6	9800
21		6	52	36	5	1	2.43	98.6	11200
22	S.	4	44	39	13	0	2.61	98.5	10400
23		11	44	43	2	0	2.36	99.1	10200
24		5	31	51	13	0	2.72	98.8	6400
25		15	39	39	7	0	2.38	98.6	9400

	W.M.
Average of 10	2.45
Average of 5	2.50
Moving Average of 10	2.50
Moving Average of 5	2.56

External Temp. on Bridge 4 Hourly

	D	W
Av.	84	77
M.A.	-	79

Average Humidity 72%

Date: 21.4.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5	Y.F.*	9	48	37	6	0	2.40	98.7	9000
17	Prickly heat	10	41	44	5	0	2.44	98.2	10400
18	S.	13	43	34	9	1	2.42	98.2	10000
19		16	40	35	8	1	2.38	98.9	10400
20		21	45	29	5	0	2.18	98.6	12600
21		13	45	39	3	0	2.32	98.2	9400
22		10	48	35	7	0	2.39	98.1	10600
23	Y.F.*	15	43	39	3	0	2.30	98.8	11200
24		1	27	59	12	1	2.85	98.6	5400
25		13	42	42	3	0	2.35	98.0	10200

	W.M.
Average of 10	2.40
Average of 5	2.46
Moving Average of 10	2.47
Moving Average of 5	2.51

Average Humidity 68%

External Temp. on Bridge 4 Hourly

	D	W
	83	72
	84	80
	84	78
	87	81
	81	76
	83	72
Av.	84	76
M.A.	-	78

* Yellow fever vaccination.

Date: 22.4.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		10	34	48	8	0	2.54	98.8	10200
17	Mercurial dermatitis	15	44	30	11	0	2.37	99.2	10200
18	S.	11	40	42	7	0	2.45	98.0	12000
19		14	46	34	6	0	2.32	99.4	9800
20		14	49	35	2	0	2.25	98.8	10000
21		12	41	38	9	0	2.44	98.2	7000
22		18	42	31	9	0	2.31	99.2	6800
23		13	36	44	7	0	2.45	99.0	6600
24		13	31	47	9	0	2.52	99.0	6400
25		11	40	42	6	1	2.46	97.7	10600

	W.M.
Average of 10	2.41
Average of 5	2.48
Moving Average of 10	2.42
Moving Average of 5	2.48

Average Humidity 73%

External Temp. on Bridge 4 Hourly

	D	W
	83	72
	84	80
	90	83
	90	80
	84	79
	84	79
Av.	86	79
M.A.	-	77

Date: 23.4.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		20	42	29	9	0	2.27	98.7	7000
17		12	43	41	4	0	2.37	98.8	13200
18	S.	5	38	48	9	0	2.61	99.0	9000
19		11	49	36	4	0	2.33	98.6	7600
20		11	55	31	3	0	2.26	98.6	11000
21		10	49	40	1	0	2.32	98.2	6400
22		10	43	40	7	0	2.44	98.2	12000
23		10	47	36	6	1	2.41	99.2	7400
24		12	18	52	17	1	2.77	98.7	6200
25		18	58	22	2	0	2.08	97.8	12000

	W.M.
Average of 10	2.39
Average of 5	2.43
Moving Average of 10	2.40
Moving Average of 5	2.46

Average Humidity 70%

External Temp. on Bridge 4 Hourly

	D	W
	85	79
	87	80
	89	79
	91	80
	84	78
	84	78
Av.	87	79
M.A.	-	78

Date: 24.4.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		17	45	35	3	0	2.24	98.3	8200
17	Mercurial dermatitis	16	39	40	5	0	2.34	99.0	10200
18	S.	15	42	33	10	0	2.38	98.2	7400
19		19	45	31	5	0	2.22	99.2	8800
20		9	46	41	4	0	2.40	98.4	13000
21		21	44	28	7	0	2.21	98.7	9800
22	S.	23	35	35	7	0	2.26	98.2	9200
23		22	40	32	6	0	2.22	98.6	8200
24		10	40	37	13	0	2.53	98.9	8200
25		14	40	45	1	0	2.33	98.3	13600

	W.M.
Average of 10	2.31
Average of 5	2.34
Moving Average of 10	2.37
Moving Average of 5	2.42

Average Humidity 76%

External Temp. on Bridge 4 Hourly

	D	W
	85	79
	86	80
	89	81
	88	80
	83	79
	83	78
Av.	86	80
M.A.	-	79

Date: 25.4.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		9	40	42	9	0	2.51	98.8	6200
17		17	35	41	7	0	2.38	99.0	8600
18		12	36	41	10	1	2.52	97.8	10200
19		20	40	35	5	0	2.25	99.0	10000
20		16	46	36	2	0	2.24	98.6	13800
21		18	40	32	10	0	2.34	98.6	10600
22		14	37	45	4	0	2.39	98.4	8600
23		13	54	29	3	1	2.25	98.6	8200
24		4	31	56	8	1	2.71	98.8	8600
25		14	49	32	5	0	2.28	98.2	10600

	W.M.
Average of 10	2.39
Average of 5	2.45
Moving Average of 10	2.36
Moving Average of 5	2.41

Average Humidity 76%

External Temp. on Bridge 4 Hourly

	D	W
	84	78
	87	80
	88	80
	87	80
	82	78
	82	79
Av.	85	79
M.A.	-	79

Date: 26.4.47. Arrive Mombasa.*

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		14	44	37	5	0	2.33	98.8	7400
17		15	42	39	4	0	2.32	98.7	8400
18		11	45	38	6	0	2.39	97.7	10600
19		23	43	33	1	0	2.12	98.9	7000
20		16	53	30	1	0	2.16	99.0	9800
21		17	57	21	5	0	2.14	98.4	8000
22		18	37	37	8	0	2.35	98.8	5600
23		16	52	30	2	0	2.18	98.6	8000
24		8	42	40	10	0	2.52	97.9	5400
25		10	42	45	3	0	2.41	97.7	10800

	W.M.
Average of 10	2.29
Average of 5	2.37
Moving Average of 10	2.33
Moving Average of 5	2.39

Average Humidity 90%

External Temp. on Bridge 4 Hourly

	D	W
	83	79
	75	75
	76	76
	81	79
	81	79
	80	77
Av.	79	77
M.A.	-	79

* Average of 4 hrly. bridge temp. readings on 27.4.47: D 77: W 75: M.A.; 77 (Wet Bulb)

Date: 30.4.47. Depart Mombasa

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		19	51	28	2	0	2.15	98.6	9000
18	S.	10	46	37	6	1	2.42	98.2	8200
23		16	49	32	3	0	2.22	98.6	8200
24		5	31	54	9	1	2.70	97.9	5600
25		12	38	47	3	0	2.41	98.8	9000

	W.M.
Average of 5	2.38
Moving Average of 5	2.40
Average Humidity 80%	

External Temp. on Bridge
4 Hourly

	D	W
	80	75
	80	76
	89	84
	88	82
	84	79
	83	78
Av.	84	79
M.A.	-	77

Date: 1.5.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		14	49	36	1	0	2.24	98.5	8200
18		7	37	48	8	0	2.57	98.0	8200
23	S.	18	48	33	1	0	2.17	98.8	6800
24	S. *	3	36	50	11	0	2.69	98.8	6600
25		25	45	25	5	0	2.10	98.8	8000

	W.M.
Average of 5	2.35
Moving Average of 5	2.37
Average Humidity 87%	

* Mild attack of appendicular colic

External Temp. on Bridge
4 Hourly

D	W
84	78
82	78
82	80
85	80
79	77
81	78

	D	W
Av.	82	79
M.A.	-	78

Date: 2.5.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		13	49	35	3	0	2.28	98.3	7800
18	S.	12	43	41	3	1	2.38	99.5*	6800
23		18	50	28	4	0	2.18	98.6	7200
24	S.	7	39	44	10	0	2.57	98.2	8600
25		25	46	26	3	0	2.07	98.1	7000

	W.M.
Average of 5	2.30
Moving Average of 5	2.34

Average Humidity 79%

* After a cup of tea.

External Temp. on Bridge
4 Hourly

	D	W
	80	77
	83	76
	85	80
	83	76
	82	76
	81	74
Av.	82	77
M.A.	-	78

Date: 3.5.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		15	32	30	3	0	2.21	98.0	7400
18		12	37	41	10	0	2.49	97.8	10000
23		12	50	33	5	0	2.31	98.3	6600
24		14	30	48	8	0	2.50	98.3	6000
25		22	53	24	1	0	2.04	98.2	9800

	W.M.
Average of 5	2.31
Moving Average of 5	2.32

Average Humidity 77%

External Temp. on Bridge
4 Hourly

	D	W
	80	74
	82	75
	83	76
	82	77
	80	76
	80	76
Av.	81	76
M.A.	-	77

Date: 4.5.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		6	36	47	11	0	2.63	98.3	7000
18		11	36	43	10	0	2.52	97.8	9800
23		18	44	35	3	0	2.23	98.2	10600
24		6	34	44	15	1	2.71	98.3	7000
25		18	40	38	4	0	2.28	98.2	11400

	W.M.
Average of 5	2.47
Moving Average of 5	2.36

Average Humidity 73%

External Temp. on Bridge
4 Hourly

	D	W
	79	75
	81	75
	83	77
	82	75
	81	75
	78	74
Av.	81	75
M.A.	-	76

Date: 5.5.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C
5		10	37	46	7	0	2.50	98.4	9200
18		13	38	44	3	2	2.43	97.8	7400
23		12	47	40	1	0	2.30	98.6	8800
24		7	31	48	14	0	2.69	97.8	7000
25		15	46	31	8	0	2.32	97.8	10600

	W.M.
Average of 5	2.45
Moving Average of 5	2.41

Average Humidity 81%

External Temp. on Bridge
4 Hourly

	D	W
	78	74
	80	76
	85	78
	81	76
	80	76
	79	76
Av.	80	76
M.A.	-	76

Date: 6.5.47. Arrive Port Louis, Mauritius

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		7	47	41	5	0	2.44	98.2	9200
18	S.	15	36	43	6	0	2.40	97.1	7800
23	S.	15	42	39	4	0	2.32	98.2	9600
24	S.	11	31	46	12	0	2.59	98.2	6800
25	S.	11	54	29	6	0	2.30	98.0	8000

	W.M.
Average of 5	2.41
Moving Average of 5	2.44

Average Humidity 77%

External Temp. on Bridge
4 Hourly

	D	W
	79	75
	80	76
	82	76
	84	76
	78	73
	78	72
Av.	80	75
M.A.	-	75

Date: 8.5.47. **Depart Port Louis**

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		11	38	45	5	1	2.47	98.5	7600
18		6	37	50	7	0	2.58	97.3	8800
23		8	51	36	5	0	2.38	99.2	6200
24		4	39	45	11	1	2.66	98.1	6000
25		15	41	39	5	0	2.34	98.4	9800

	W.M.
Average of 5	2.49
Moving Average	2.45

Average Humidity 67%

External Temp. on Bridge
4 Hourly

	D	W
	77	70
	80	72
	84	75
	80	73
	78	71
	76	70
Av.	79	72
M.A.	-	74

Date: 9.5.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		6	38	47	8	1	2.60	98.0	6400
18	S.	5	34	53	8	0	2.64	97.7	11600
23		11	54	31	4	0	2.28	98.0	6800
24	S.	2	27	51	17	3	2.92	98.2	8000
25	S.	14	42	40	4	0	2.34	97.7	7600

	W.M.
Average of 5	2.56
Moving Average of 5	2.49

Average Humidity 67%

External Temp. on Bridge
4 Hourly

	D	W
	76	70
	76	71
	83	68
	73	71
	77	70
	75	67
Av.	77	70
M.A.	-	72

Date: 10.5.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C
5		11	32	50	7	0	2.53	98.4	6200
18		10	40	48	2	0	2.42	97.8	8600
23		19	35	39	7	0	2.34	97.8	9000
24		3	28	53	15	1	2.83	98.1	6200
25		12	44	39	5	0	2.37	98.2	8600

	W.M.
Average of 5	2.50
Moving Average of 5	2.52

Average Humidity 70%

External Temp. on Bridge
4 Hourly

	D	W
	74	67
	74	68
	77	69
	75	67
	73	67
	73	68
Av.	74	68
M.A.	-	70

Date: 11.5.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		16	46	31	7	0	2.29	98.2	*
18		6	46	42	6	0	2.48	98.0	*
23		4	39	51	6	0	2.59	98.4	*
24		4	38	47	10	1	2.66	97.8	*
25		18	38	33	10	1	2.38	98.3	*

	W.M.
Average of 5	2.48
Moving Average of 5	2.51

External Temp. on Bridge
4 Hourly

	D	W
	73	69
	73	68
	76	68
	73	67
	71	63
	71	63
Av.	73	66
M.A.	-	68

Average Humidity 66%

* White cell count impracticable because of heavy seas.

Date: 12.5.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		17	35	43	5	0	2.36	98.4	6000
18		8	41	45	5	1	2.50	97.6	8200
23		13	43	40	4	0	2.35	98.4	8000
24		5	33	52	9	1	2.68	97.9	6600
25		8	53	34	5	0	2.36	98.2	9800

	W.M.
Average of 5	2.45
Moving Average of 5	2.48

External Temp. on Bridge
4 Hourly

	D	W
	70	62
	72	69
	77	66
	76	66
	73	66
	72	66
Av.	73	66
M.A.	-	67

Average Humidity 66%

Date: 13.5.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		8	44	40	8	0	2.48	98.4	7800
18		2	38	51	8	1	2.68	97.6	13200
23		9	52	36	3	0	2.33	98.6	8600
24		3	32	56	9	0	2.71	97.8	4900
25		15	42	37	5	1	2.35	98.0	13800

	W.M.
Average of 5	2.51
Moving Average of 5	2.48

Average Humidity 65%

External Temp. on Bridge
4 Hourly

	D	W
	68	65
	74	64
	75	64
	71	67
	73	66
	72	64
Av.	72	65
M.A.	-	66

Date: 14.5.47. Arrive Durban.*

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		7	40	49	3	1	2.51	98.0	7800
18		8	37	46	9	0	2.56	96.6	13200
23		9	51	38	2	0	2.33	98.2	8800
24		6	33	47	13	1	2.70	97.5	6200
25		9	44	42	4	1	2.44	98.0	9200

	W.M.
Average of 5	2.51
Moving Average of 5	2.49

Average Humidity 61%

External Temp. on Bridge
4 Hourly

	D	W
	71	67
	72	64
	74	64
	73	64
	69	63
	71	65
Av.	72	64
M.A.	-	65

* Averages of 4 hrly. temp. readings in Durban: 15.5.47. D: 73 W: 65. 16.5.47. D: 73 W: 64. 17.5.47. D: 72 W: 64. 18.5.47. D73 W: 65. 19.5.47. D:74 W: 69. 20.5.47. D: 74 W: 70. Moving Averages of Wet Bulb Temps. in Durban: 65, 64, 64, 64, 66 and 68.

Date: 21.5.47. Sail Durban

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		7	32	47	13	1	2.69	98.3	8400
18		6	30	51	12	1	2.72	97.5	7200
23		10	48	33	8	1	2.42	98.3	9200
24		2	33	46	16	3	2.85	97.9	10600
25		8	42	42	8	0	2.50	98.3	10400

	W.M.
Average of 5	2.64
Moving Average of 5	2.55

Average Humidity 79%

External Temp. on Bridge
4 Hourly

	D	W
	74	70
	75	70
	77	69
	77	73
	76	72
	74	71
Av.	75	71
M.A.	-	70

Date: 22.5.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		4	39	45	12	0	2.65	98.1	8400
18		4	38	52	6	0	2.60	97.6	9200
23		7	44	47	2	0	2.44	98.0	10800
24		2	35	49	12	2	2.77	98.1	6400
25		13	32	42	12	1	2.56	98.4	8400

	W.M.
Average of 5	2.60
Moving Average of 5	2.58

Average Humidity 69%

External Temp. on Bridge
4 Hourly

	D	W
	73	68
	71	66
	73	66
	72	65
	70	65
	72	67
Av.	72	66
M.A.	-	69

Date: 23.5.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		4	31	56	8	1	2.71	98.5	5800
18		9	42	42	7	0	2.45	97.7	9200
23		10	40	44	6	0	2.46	98.0	12200
24		1	28	50	21	0	2.91	98.3	5400
25	S.	6	38	48	8	0	2.58	98.1	10000

	W.M.
Average of 5	2.62
Moving Average of 5	2.62

Average Humidity 84%

External Temp. on Bridge
4 Hourly

	D	W
	71	66
	74	68
	73	70
	73	71
	74	72
	75	72
Av.	73	70
M.A.	-	69

Date: 24.5.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5	V.*	6	36	49	9	0	2.61	98.1	10200
18		3	36	47	13	1	2.73	97.9	7000
23		9	44	40	6	1	2.46	98.4	6800
24	V.*	3	32	47	15	3	2.85	98.0	4000
25	V.*	7	40	46	6	1	2.54	98.2	10000

	W.M.
Average of 5	2.63
Moving Average of 5	2.62

Average Humidity 75%

External Temp. on Bridge
4 Hourly

	D	W
	74	72
	75	69
	76	72
	75	67
	74	67
	73	66
Av.	74	69
M.A.	-	68

* Smallpox vaccination; did not take.

Date: 25.5.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C
5		4	45	42	9	0	2.56	98.3	8000
18		6	29	53	12	0	2.71	97.4	8200
23		9	39	43	9	0	2.52	98.5	10000
24		3	22	60	13	2	2.89	97.8	5000
25		7	37	49	7	0	2.56	98.5	9200

	W.M.
Average of 5	2.65
Moving Average of 5	2.63

Average Humidity 67%

External Temp. on Bridge
4 Hourly

	D	W
	75	68
	74	68
	79	70
	77	70
	76	69
	75	71
Av.	76	69
M.A.	-	69

Date: 26.5.47. Arrive Mauritius (Port Louis)*

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		5	32	52	10	1	2.70	98.4	5400
18	S.	7	38	43	10	2	2.62	98.4	10400
23		7	43	41	9	0	2.52	98.5	8000
24	S.	3	22	47	26	2	3.02	98.0	6000
25	S.	13	33	49	5	0	2.46	98.0	9000

	W.M.
Average of 5	2.66
Moving Average of 5	2.65

Average Humidity 75%

External Temp. on Bridge
4 Hourly

	D	W
	75	71
	75	69
	80	72
	79	72
	77	73
	76	73
Av.	77	72
M.A.	-	70

* Bridge temp. 4 hrly. average on 27.5.47: D: 78 W: 72. M.A. of Wet Bulb Temp.: 71.

Date: 28.5.47. Sail Mauritius (Port Louis)

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		9	34	49	7	1	2.57	98.6	8400
18		5	33	50	11	1	2.70	98.6	13800
23		8	39	43	10	0	2.55	99.4	6200
24		4	28	59	9	0	2.73	98.4	6200
25		8	40	42	10	0	2.54	97.8	10000

	W.M.
Average of 5	2.62
Moving Average of 5	2.64

Average Humidity 71%

External Temp. on Bridge
4 Hourly

	D	W
	75	72
	76	70
	78	73
	79	70
	75	70
	75	68
Av.	76	70
M.A.	-	71

Date: 29.5.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		4	32	50	13	1	2.75	98.4	7400
18		2	30	52	16	0	2.82	98.6	9400
23		13	37	44	6	0	2.43	98.4	8600
24		7	24	51	16	2	2.82	98.4	9000
25	S.	7	31	47	14	1	2.71	98.6	8800

	W.M.
Average of 5	2.71
Moving Average of 5	2.66

Average Humidity 60%

External Temp. on Bridge
4 Hourly

	D	W
	76	58
	78	70
	81	72
	81	72
	79	70
	76	70
Av.	78	69
M.A.	-	70

Date: 30.5.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		6	34	49	10	1	2.66	98.4	9400
18	S.	5	26	55	14	0	2.78	98.6	8200
23		8	44	43	5	0	2.45	98.4	10800
24		5	29	48	16	2	2.81	98.4	8000
25		8	38	43	8	3	2.57	98.9	8200

	W.M.
Average of 5	2.65
Moving Average of 5	2.66

Average Humidity 67%

External Temp. on Bridge
4 Hourly

	D	W
	76	70
	79	72
	81	71
	83	74
	78	74
	77	72
Av.	79	72
M.A.	-	70

Date: 31.5.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		4	36	45	15	0	2.71	98.6	10600
18		1	34	53	12	0	2.76	97.8	8600
23		6	45	39	9	1	2.54	98.9	7400
24		1	22	48	24	5	3.10	98.7	5200
25		4	46	43	6	1	2.54	98.2	11600

	W.M.
Average of 5	2.73
Moving Average of 5	2.70

Average Humidity 72%

External Temp. on Bridge
4 Hourly

	D	W
	77	73
	84	77
	80	75
	81	73
	78	73
	78	73
Av.	80	74
M.A.	-	72

Date: 1.6.47. Arrive Mombasa*

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		6	31	44	18	1	2.77	98.6	7400
18	S.	6	40	49	5	0	2.53	98.0	10200
23		11	41	44	6	1	2.45	98.4	8200
24		4	20	53	22	1	2.96	97.8	6600
25		5	36	48	9	2	2.67	98.7	11600

	W.M.
Average of 5	2.68
Moving Average of 5	2.69

Average Humidity 73%

External Temp. on Bridge 4 Hourly

	D	W
	78	74
	83	76
	83	76
	85	76
	79	75
	78	74
Av.	81	75
M.A.	-	74

* Bridge temp. 4 hrly. average on 2.6.47: D: 84 W: 77.
M.A. (Wet Bulb) 75.

Date: 5.6.47. Sail Mombasa

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		5	23	57	14	1	2.83	97.7	6600
18		4	31	53	12	0	2.73	97.4	8600
23		8	33	49	9	1	2.62	96.6	6800
24		1	18	54	26	1	3.08	97.0	5600
25		9	45	36	9	1	2.48	96.8	12600

	W.M.
Average of 5	2.75
Moving Average of 5	2.72

Average Humidity 71%

External Temp. on Bridge 4 Hourly

	D	W
	82	74
	82	74
	83	76
	83	75
	80	75
	80	76
Av.	82	75
M.A.	-	76

Date: 6.6.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		5	39	42	12	2	2.67	98.3	7200
18	S.	2	26	49	21	2	2.95	96.9	7200
23		9	39	49	3	0	2.46	96.6	8000
24		1	26	51	18	4	2.98	97.2	6200
25		15	46	31	7	1	2.33	96.5	9200

	W.M.
Average of 5	2.68
Moving Average of 5	2.70

Average Humidity 90%

External Temp. on Bridge
4 Hourly

	D	W
	79	77
	81	77
	82	77
	79	78
	77	77
	79	76
Av.	79	77
M.A.	-	76

Date: 7.6.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		14	29	42	15	0	2.58	98.3	10000
18	S.	4	37	47	12	0	2.67	98.1	10400
23		3	31	49	14	1	2.77	98.7	9400
24		1	19	55	19	6	3.10	98.2	5000
25		11	33	48	7	1	2.54	98.1	10800

	W.M.
Average of 5	2.73
Moving Average of 5	2.72

Average Humidity 90%

External Temp. on Bridge
4 Hourly

	D	W
	77	76
	77	77
	83	78
	82	79
	80	78
	80	78
Av.	80	78
M.A.	-	77

Date: 8.6.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		4	32	50	13	1	2.75	98.6	6800
18	S.	7	22	61	10	0	2.74	98.0	9200
23		7	32	48	12	1	2.68	98.8	8600
24		2	23	45	24	6	3.09	98.3	4000
25		10	45	38	6	1	2.43	97.3	9600
26		5	26	49	19	1	2.85	98.8	11400

	W.M.	External Temp. on Bridge 4 Hourly	D	W
Average of 5 (excluding 6)	2.74		80	77
			80	77
Moving Average of 5 (excluding 26)	2.72		81	78
			79	76
			79	75
			77	75
Average Humidity 85%		Av.	79	76
		M.A.	-	77

Date: 9.6.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		6	19	53	17	5	2.96	98.8	7400
18		5	31	52	12	0	2.71	98.6	11200
23		1	32	52	15	0	2.81	98.9	8400
24		4	15	50	29	2	3.10	98.8	8200
25		12	38	42	7	1	2.47	99.0	8800
26		9	42	38	11	0	2.51	98.9	13800

	W.M.	External Temp. on Bridge 4 Hourly	D	W
Average of 5 (excluding 26)	2.81		79	77
			87	83
Moving Average of 5 (excluding 26)	2.76		90	83
			90	84
			88	84
			89	82
Average Humidity 81%		Av.	87	82
		M.A.	-	79

Date: 10.6.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		7	35	38	17	3	2.74	99.1	6800
18	S.	7	35	45	13	0	2.64	98.8	10600
23		5	36	50	9	0	2.63	99.0	8600
24		4	22	51	20	3	2.96	98.7	6200
25		8	44	39	9	0	2.49	98.2	9600
26		8	23	54	12	3	2.79	98.5	8200

	W.M.
Average of 5 (excluding 26)	2.69
Moving Average of 5 (excluding 26)	2.75

Average Humidity 65%

External Temp. on Bridge
4 Hourly

	D	W
	90	81
	92	77
	92	83
	93	83
	90	82
	90	82
Av.	91	81
M.A.	-	80

Date: 11.6.47. At Berbera

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		8	36	42	12	2	2.64	99.1	8000
18		10	38	39	12	1	2.56	98.9	13600
23		8	40	41	11	0	2.55	98.8	10600
24		6	24	52	15	3	2.85	99.2	10400
25		7	38	44	11	0	2.59	98.4	9400
26		17	40	38	4	1	2.32	98.6	8000

	W.M.
Average of 5 (exclüding 26)	2.64
Moving Average of 5 (excluding 26)	2.71

Average Humidity 44%

External Temp. on Bridge
4 Hourly

	D	W
	90	81
	95	74
	101	76
	97	76
	96	78
	90	75
Av.	95	77
M.A.	-	80

Date: 12.6.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		5	29	49	14	3	2.81	98.7	9000
18		8	37	43	12	0	2.59	98.9	10000
23		7	46	40	6	1	2.48	98.2	10600
24		2	22	56	19	1	2.95	99.2	8600
25		9	41	42	7	1	2.50	99.2	9400
26		7	40	40	13	0	2.59	98.5	11400

	W.M.
Average of 5 (excluding 26)	2.67
Moving Average of 5 "	2.67

Average Humidity 74%

External Temp. on Bridge
4 Hourly

	D	W
	89	79
	89	83
	90	83
	90	83
	90	84
	88	82
Av.	89	82
M.A.	-	80

Date: 13.6.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		10	40	39	10	1	2.52	98.1	7400
18		8	56	42	14	0	2.62	98.0	10000
23		14	39	48	8	1	2.43	98.0	11000
24		5	30	45	20	0	2.80	98.2	6000
25		10	51	33	6	0	2.35	98.6	9000
26		6	47	34	13	0	2.54	98.6	10000

	W.M.
Average of 5 (excluding 26)	2.54
Moving Average of 5 "	2.62

Average Humidity 80%

External Temp. on Bridge
4 Hourly

	D	W
	86	81
	87	82
	89	81
	88	80
	85	80
	84	80
Av.	86	81
M.A.	-	80

Date: 14.6.47. At Port Sudan

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		6	38	49	6	1	2.58	98.0	
18		7	35	46	12	0	2.63	98.7	
23		11	37	45	6	1	2.49	98.6	
24	*	3	31	54	9	3	2.78	99.8	
25		20	34	37	9	0	2.35	98.5	
26		6	40	37	17	0	2.65	98.2	

	W.M.
Average of 5 (excluding 26)	2.57
Moving Average of 5 "	2.59

Average Humidity 70%

External Temp. on Bridge 4 Hourly

	D	W
	85	79
	86	79
	87	78
	89	78
	86	79
	84	78
Av.	86	78
M.A.	-	80

* Acute appendicitis; appendicectomy during night. Pathologically acute purulent appendicitis.

Date: 15.6.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		10	33	46	11	0	2.58	98.6	
18	S.	8	24	58	9	1	2.71	97.8	
23		7	44	42	7	0	2.49	98.4	
24		0	26	60	12	2	2.90	100.2	
25	S.	9	40	46	5	0	2.47	99.0	
26		7	35	48	10	0	2.61	98.2	

	W.M.
Average of 5 (excluding 26)	2.63
Moving Average of 5 "	2.58

Average Humidity 76%

External Temp. on Bridge 4 Hourly

	D	W
	83	79
	86	72
	85	79
	84	79
	82	78
	81	76
Av.	83	77
M.A.	-	79

Date: 16.6.47. Arrive Port Suez

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.
5		8	35	46	10	1	2.61	98.2	
18		6	37	47	9	1	2.62	98.4	
23		7	36	43	14	0	2.64	98.1	
24		3	19	56	22	0	2.97	99.6	
25		6	47	38	8	1	2.51	98.2	
26		10	35	47	8	0	2.53	98.0	

	W.M.
Average of 5 (excluding 26)	2.67
Moving Average of 5 "	2.62

Average Humidity 71%

External Temp. on Bridge
4 Hourly

	D	W
	80	77
	83	75
	83	74
	82	74
	81	74
	80	75
Av.	82	75
M.A.	-	77

Voyage III "CHESHIRE" A

Liverpool, Malta, Port Said, Malta, Liverpool.

SUBJECTS

Name	Age	Smoking	Previous History	Present Voyage
5. R.L.	26	S.	Many trips	Round trip
27. A.J.S.	39	N.S.	Many trips	" "
28. J.W.	21	N.S.	1st trip	" "
29. J.A.	33	S.	Many trips	" "
30. L.W.	21	S.	Many trips	" "

Date: 3.8.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		8	42	42	7	1	2.51	98.6	5000	64	3200
27		6	42	42	9	1	2.57	97.2	9400	60	5640
28		10	22	50	17	1	2.77	98.2	3800	60	2280
29		3	30	58	7	2	2.75	98.0	8200	56	4592
30		18	39	40	3	0	2.28	98.4	9800	69	6762

	W.M.
Average of 5 W.M.'s	2.58
Average of 4 subjects present on all three Cheshire trips, i.e. 5, 27, 29, 30.	2.53
Moving Average of 5 W.M.'s	-

External Temp. on Bridge
6 Hourly

	D	W
Midnight	60	58
6 a.m.	60	58
Midday	62	61
6 p.m.	61	59
Average	61	59
Moving Av.		-

%N = Percentage of neutrophils in a differential count.
A.N. = Absolute number of neutrophils per cu. mm.

Date: 4.8.47.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		4	35	47	14	0	2.71	98.6	8800	52	5104
27		5	34	46	15	0	2.71	97.2	7400	63	4662
28		5	31	52	9	3	2.74	97.5	4600	58	2668
29		10	26	47	15	2	2.73	97.6	9000	60	5400
30		12	39	39	10	0	2.47	98.5	8200	66	5412

	W.M.
Average of 5	2.67
Average of 4	2.65
Moving Average of 5	-

External Temp. on Bridge
6 Hourly

	D	W
Midnight*	60	59
6 a.m.	60	58
Midday	62	60
6 p.m.	60	59
Average	61	59
Moving Av.		-

* The same order of recording temperatures will be preserved throughout the Cheshire voyages.

Date: 5.8.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		4	25	53	18	0	2.85	98.6	7600	59	4484
27	S.	5	23	57	14	1	2.83	98.0	8400	64	5376
28		3	23	52	20	2	2.95	98.1	6200	67	4154
29	S.	4	18	61	16	1	2.92	98.4	10800	62	6696
30		11	37	45	6	1	2.49	98.2	8800	65	5720

	W.M.
Average of 5	2.81
Average of 4	2.77
Moving Average of 5	2.69

External Temp. on Bridge
6 Hourly

	D	W
	62	59
	63	60
	67	64
	72	66
Av.	66	62
M.A.*		60

* M.A. = Moving Average

Date: 6.8.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		1	28	47	20	4	2.98	98.8	6200	54	3348
27		4	23	55	15	3	2.90	97.4	9400	58	5452
28		4	23	50	22	1	2.93	97.9	6400	66	4224
29	S.	1	25	56	18	0	2.91	98.0	9000	59	5310
30		9	33	47	10	1	2.61	98.4	7200	68	4896

	W.M.
Average of 5	2.87
Average of 4	2.85
Moving Average of 5	2.78

External Temp. on Bridge
6 Hourly

	D	W
	66	64
	65	63
	72	68
	75	71
Av.	70	67
M.A.		63

Date: 7.8.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		2	20	50	25	3	3.07	98.5	7800	63	4914
27	S.	2	23	59	14	2	2.91	97.5	6400	50	3200
28		3	22	53	21	1	2.95	98.1	4200	65	2730
29	S.	1	16	48	26	9	3.26	98.2	8600	55	4730
30		6	31	47	15	1	2.74	98.5	7800	63	4914

	W.M.
Average of 5	2.99
Average of 4	3.00
Moving Average of 5	2.89

External Temp. on Bridge
6 Hourly

	D	W
	73	73
	77	74
	80	76
	79	76
Av.	77	75
M.A.		68

Date: 8.8.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		5	35	38	19	3	2.82	98.7	6000	51	3060
27		1	24	49	25	1	3.01	98.0	5400	54	2916
28		3	19	62	13	3	2.94	98.6	4200	58	2436
29		3	25	50	18	4	2.95	98.7	6400	56	3584
30		7	32	43	16	2	2.74	98.4	13800	68	9384

	W.M.
Average of 5	2.89
Average of 4	2.88
Moving Average of 5	2.92

External Temp. on Bridge
6 Hourly

	D	W
	79	76
	74	73
	77	75
	80	77
Av.	78	75
M.A.		72

Date: 9.8.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		6	29	53	10	2	2.73	98.9	6200	59	3658
27		5	26	53	16	0	2.80	98.1	5600	53	2968
28		3	20	52	22	3	2.99	98.0	5000	52	2600
29		2	34	46	16	2	2.78	98.8	8200	63	5166
30		8	30	48	14	0	2.68	98.5	8600	69	5934

	W.M.
Average of 5	2.80
Average of 4	2.75
Moving Average of 5	2.89

External Temp. on Bridge
6 Hourly

	D	W
	79	76
	80	74
	84	77
	82	79
Av.	81	77
M.A.	-	76

Date: 10.8.47. At Malta

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		13	34	44	9	0	2.49	99.0	7000	64	4480
27		6	21	52	18	0	2.91	98.7	7200	54	3888
28	Slight Gastro-enteritis	3	32	42	20	3	2.88	98.7	5400	51	2754
29		6	34	42	15	3	2.71	98.9	7400	55	4070
30		10	25	47	16	0	2.75	98.6	9400	67	6298

	W.M.
Average of 5	2.75
Average of 4	2.72
Moving Average of 5	2.81

External Temp. on Bridge
6 Hourly

	D	W
	79	78
	83	78
	88	79
	82	77
Av.	83	78
M.A.	-	77

Date: 11.8.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		7	41	39	13	0	2.58	98.8	4400	66	2904
27		5	22	62	8	3	2.82	98.5	5800	56	3248
28		7	33	44	12	4	2.73	98.4	4800	54	2592
29		3	35	43	16	3	2.81	99.1	9600	68	6528
30		12	41	42	5	0	2.40	98.5	10200	64	6528

	W.M.
Average of 5	2.67
Average of 4	2.65
Moving Average of 5	2.74

External Temp. on Bridge
6 Hourly

	D	W
	80	77
	80	78
	90	82
	80	78
Av.	83	79
M.A.	-	78

Date: 12.8.47. Arrive Port Said

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		8	43	40	9	0	2.50	98.6	3800	56	2128
27		7	28	43	20	2	2.82	97.9	4800	60	2880
28		6	32	48	12	2	2.72	97.8	6200	58	3596
29		7	33	45	12	3	2.71	98.2	9000	58	5220
30		13	47	33	7	0	2.34	98.0	7000	67	4690

	W.M.
Average of 5	2.62
Average of 4	2.59
Moving Average of 5	2.68

External Temp. on Bridge
6 Hourly

	D	W
	78	76
	80	76
	84	77
	79	77
Av.	80	77
M.A.	-	78

Date: 15.8.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		5	41	41	13	0	2.62	98.8	8600	64	5504
27		4	28	53	14	1	2.80	98.6	8200	58	4756
28		3	33	43	18	1	2.77	98.8	6200	67	4154
29		8	30	49	11	2	2.69	98.8	10200	64	6528
30		12	41	41	6	0	2.41	98.4	10000	77	7700

	W.M.
Average of 5	2.66
Average of 4	2.63
Moving Average of 5	2.65

External Temp. on Bridge
6 Hourly

	D	W
	78	76
	82	78
	82	76
	79	77
Av.	80	77
M.A.	-	78

Date: 16.8.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		5	34	46	13	2	2.73	98.6	9600	61	5856
27		5	35	52	8	0	2.63	98.4	5400	69	3726
28		2	26	51	19	2	2.93	98.6	6600	70	4620
29		2	35	44	19	0	2.80	98.4	9400	65	6110
30		11	28	47	14	0	2.64	98.5	10000	66	6600

	W.M.
Average of 5	2.75
Average of 4	2.70
Moving Average of 5	2.68

External Temp. on Bridge
6 Hourly

	D	W
	78	76
	78	74
	78	75
	78	74
Av.	78	75
M.A.	-	76

Date: 17.8.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		5	36	47	11	1	2.67	98.8	5800	60	3480
27		6	30	50	14	0	2.72	99.4	8200	57	4674
28		5	18	47	28	2	3.04	98.4	3400	61	2074
29		4	29	48	19	0	2.82	99.1	12200	66	8052
30		17	32	38	12	1	2.48	99.1	8000	69	5520

	W.M.
Average of 5	2.75
Average of 4	2.67
Moving Average of 5	2.72

External Temp. on Bridge
6 Hourly

	D	W
	78	72
	79	75
	84	78
	81	75
Av.	81	75
M.A.	-	76

Date: 18.8.47. At Malta

SUBJECT.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		8	28	45	18	1	2.76	98.7	4400	60	2640
27		4	30	50	16	0	2.78	98.9	7400	52	3848
28		6	27	47	20	0	2.81	98.6	3800	67	2546
29		5	23	57	13	2	2.82	99.1	9200	64	5888
30		12	35	41	11	1	2.54	98.6	10200	73	7446

	W.M.
Average of 5	2.75
Average of 4	2.73
Moving Average of 5	2.75

External Temp. on Bridge
6 Hourly

	D	W
	80	75
	80	76
	84	77
	77	76
Av.	80	76
M.A.	-	75

Date: 19.8.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		10	33	42	13	2	2.64	98.8	8200	66	4412
27		6	27	55	11	1	2.74	99.2	5800	62	3596
28		5	24	58	12	1	2.80	97.3	4800	66	3168
29		10	32	44	12	2	2.64	98.6	11400	71	8094
30		15	37	40	7	1	2.42	98.5	13200	70	9240

	W.M.
Average of 5	2.65
Average of 4	2.61
Moving Average of 5	2.72

External Temp. on Bridge
6 Hourly

	D	W
	77	73
	80	75
	84	77
	80	76
Av.	80	75
M.A.	-	75

Date: 20.8.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		6	28	49	15	2	2.79	98.8	5600	72	4032
27		7	33	51	9	0	2.62	98.7	8200	59	4838
28		6	24	50	19	1	2.85	99.1	4000	62	2480
29		8	28	42	20	2	2.80	99.2	8000	55	4400
30		10	39	42	9	0	2.50	98.7	9000	73	6570

	W.M.
Average of 5	2.71
Average of 4	2.68
Moving Average of 5	2.70

External Temp. on Bridge
6 Hourly

	D	W
	78	76
	77	76
	88	81
	81	79
Av.	81	78
M.A.		76

Date: 21.8.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		3	31	52	12	2	2.79	98.6	9600	60	5760
27		5	33	48	14	0	2.71	97.6	9000	66	5940
28		10	27	48	13	2	2.70	97.4	6200	68	4216
29		6	25	50	17	2	2.84	98.2	10000	58	5800
30		14	38	40	8	0	2.42	98.1	9000	72	6480

	W.M.
Average of 5	2.69
Average of 4	2.69
Moving Average of 5	2.68

External Temp. on Bridge
6 Hourly

	D.	W
	78	76
	75	70
	75	71
	71	68
Av.	75	71
M.A.	-	75

Date: 22.8.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		4	34	51	10	1	2.70	96.6	5800	54	3132
27		5	27	56	12	0	2.75	98.0	10200	55	5610
28		4	20	56	17	3	2.95	98.0	5200	62	3224
29		7	37	45	10	1	2.61	97.8	6400	66	4224
30		12	32	43	12	1	2.58	98.1	9600	63	6048

	W.M.
Average of 5	2.72
Average of 4	2.66
Moving Average of 5	2.71

External Temp. on Bridge
6 Hourly

	D	W
	69	65
	67	66
	74	69
	70	67
Av.	70	67
M.A.	-	72

Date: 23.8.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		7	33	45	14	1	2.69	98.8	7000	63	4410
27		6	23	51	18	2	2.87	97.4	7600	57	4332
28		6	28	49	16	1	2.78	98.2	4000	63	2520
29		6	25	36	30	3	2.99	97.6	9000	63	5670
30		13	29	51	7	0	2.52	99.1	11200	64	7168

	W.M.
Average of 5	2.77
Average of 4	2.77
Moving Average of 5	2.73

External Temp. on Bridge
6 Hourly

	D	W
	67	66
	67	65
	70	66
	66	64
Av.	68	65
M.A.	-	68

Voyage IV "CHESHIRE" B.

Liverpool, Malta, Port Said, Tobruk, Malta, Liverpool

SUBJECTS

Name	Age	Smoking	Previous History	Present Voyage
5, 27, 29, 30	As Voyage III			Round trip
31 D.W.	23	S.	Many trips	Round trip

Date: 3.9.47.*

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		9	30	50	9	2	2.65	98.6	10400	64	6656
27		8	32	45	14	1	2.68	97.2	7800	56	4368
29		7	30	49	13	1	2.71	98.4	9000	57	5130
30	Slight coryza	10	34	43	11	2	2.61	96.8	6200	64	3968
31		3	27	54	13	2	2.81	98.2	6200	62	3844

	W.M.
Average of 5	2.69
Average of 4 (i.e. Nos. 5, 27, 29 30)	2.66
Moving Average of 5	-

External Temp. on Bridge
6 Hourly

	D	W
	64	63
	67	64
	71	67
	68	66
Av.	67	65
Moving Average	-	-

* Bridge Temp. 6 hrly. average for 2.9.47. = D: 67 W: 64.

Date: 4.9.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		4	22	58	16	0	2.86	98.6	8600	54	4644
27		2	31	48	16	3	2.87	98.2	7000	60	4200
29	Slight coryza	7	29	46	13	5	2.80	98.3	9200	62	5704
30		10	46	41	3	0	2.37	97.8	9400	67	6298
31		5	32	52	9	2	2.71	98.3	6000	58	3480

	W.M.
Average of 5	2.72
Average of 4	2.72
Moving Average of 5	-

External Temp. on Bridge
6 Hourly

	D	W
	66	65
	67	65
	76	70
	73	68
Av.	70	67
M.A.*		65

* Moving Average

Date: 5.9.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		5	26	52	16	1	2.82	98.5	5600	56	3136
27		7	21	50	20	2	2.89	98.0	7600	50	3800
29	Coryza improving	6	34	41	16	3	2.76	99.1	9000	63	5670
30		13	37	43	7	0	2.44	98.0	9400	60	5640
31		6	29	56	9	0	2.68	98.4	5800	70	3860

	W.M.
Average of 5	2.72
Average of 4	2.73
Moving Average of 5	2.71

External Temp. on Bridge
6 Hourly

	D	W
	66	65
	68	66
	75	70
	75	70
Av.	71	68
M.A.	-	67

Date: 6.9.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		2	25	53	18	3	2.98	98.6	4600	58	2668
27		7	29	46	13	5	2.80	97.6	7800	47	3666
29	S. *	5	31	45	16	3	2.81	98.3	9000	62	5580
30		14	46	32	8	0	2.34	97.7	10200	69	7038
31		4	30	54	11	1	2.75	98.4	6000	55	3300

	W.M.
Average of 5	2.74
Average of 4	2.73
Moving Average of 5	2.73

External Temp. on Bridge
6 Hourly

	D	W
	74	70
	73	69
	79	72
	77	73
Av.	76	71
M.A.	-	69

* Coryza improving

Date: 7.9.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		5	22	53	20	0	2.88	98.6	7000	55	3850
27		4	29	48	16	3	2.85	98.4	6400	51	3264
29	Coryza improving	4	25	51	18	2	2.89	98.8	8400	62	5208
30		10	40	41	9	0	2.49	98.7	8000	64	5120
31		5	25	57	13	0	2.78	98.4	6800	56	3808

	W.M.
Average of 5	2.78
Average of 4	2.78
Moving Average of 5	2.75

External Temp. on Bridge
6 Hourly

	D	W
	75	70
	76	75
	80	72
	76	70
Av.	77	72
M.A.	-	70

Date: 8.9.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		4	24	50	18	4	2.94	98.6	7600	58	4408
27		4	29	41	24	2	2.91	98.4	6000	54	3240
29	Coryza improving	4	23	52	18	3	2.93	99.0	10200	59	6018
30		15	43	35	6	1	2.35	98.2	11200	72	8064
31		6	33	47	13	1	2.70	98.2	6600	64	4224

	W.M.
Average of 5	2.77
Average of 4	2.78
Moving Average of 5	2.76

External Temp. on Bridge
6 Hourly

	D	W
	76	72
	76	73
	78	74
	77	72
Av.	77	73
M.A.	-	72

Date: 9.9.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		1	29	46	22	2	2.95	99.0	9400	63	5922
27		7	24	49	18	2	2.84	97.7	8000	51	4080
29	S.	9	27	49	13	2	2.72	98.6	10000	62	6200
30		15	38	40	6	1	2.40	98.2	10000	62	6200
31		3	38	39	18	2	2.78	98.6	8600	59	5074

	W.M.
Average of 5	2.74
Average of 4	2.73
Moving Average of 5	2.76

External Temp. on Bridge
6 Hourly

	D	W
	77	72
	78	75
	83	73
	75	70
Av.	78	73
M.A.	-	73

Date: 10.9.47. Arrive Port Said

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		3	25	50	20	2	2.93	98.6	4600	52	2392
27		4	27	50	17	2	2.86	98.2	5400	63	3402
29	S.	7	29	43	20	1	2.79	98.6	6800	50	3400
30		15	48	32	4	0	2.23	97.3	8200	65	5330
31		3	37	50	10	0	2.67	98.0	6200	63	3906

	W.M.
Average of 5	2.70
Average of 4	2.70
Moving Average of 5	2.74

External Temp. on Bridge
6 Hourly

	D	W
	79	76
	78	76
	81	71
	75	70
Av.	78	73
M.A.	-	73

Date: 13.9.47.* At Port Said

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		3	19	54	23	1	3.00	98.7			
27		6	27	49	17	1	2.80	98.9			
29											
30											
31											

* Temp. readings on bridge for 12.9.47. are as follows:

Av. D: 79 W: 73 M.A.: 73

Date: 14.9.47. Sail Port Said

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		7	25	42	24	2	2.89	98.1	8000	48	3840
27		5	29	54	12	1	2.78	98.4	7000	54	3780
29		8	31	44	16	1	2.71	98.4	11200	61	6832
30		15	38	41	4	1	2.35	97.5	8800	67	5896
31		4	36	47	11	2	2.71	98.2	8000	61	4880

	W.M.
Average of 5	2.69
Average of 4	2.68
Moving Average of 5	2.71

External Temp. on Bridge
6 Hourly

	D	W
	77	72
	75	71
	79	73
	77	72
Av.	77	72
M.A.	-	73

Date: 15.9.47.   At Tobruk

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		3	24	47	26	1	3.01	98.7	5800	53	3074
27		5	22	49	21	3	2.95	98.8	6000	68	4080
29		4	26	44	23	3	2.95	99.0	9000	68	6120
30		14	42	37	6	1	2.38	98.4	9000	63	5670
31		6	32	54	8	0	2.64	98.4	9200	64	5888

	W.M.
Average of 5	2.79
Average of 4	2.82
Moving Average of 5	2.73

External Temp. on Bridge
6 Hourly

	D	W
	76	71
	76	71
	78	72
	75	70
Av.	76	71
M.A.	-	72

Date: 16.9.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		5	28	52	12	4	2.85	98.5	10200	63	6426
27		5	28	55	12	0	2.74	98.6	7000	60	4200
29		7	36	44	12	1	2.64	98.6	10000	58	5800
30		15	41	36	7	1	2.38	98.6	9200	63	5796
31		2	29	47	19	3	2.92	98.4	7400	64	4736

	W.M.
Average of 5	2.71
Average of 4	2.65
Moving Average of 5	2.73

External Temp. on Bridge
6 Hourly

	D	W
	74	73
	77	71
	85	74
	77	69
Av.	78	72
M.A.	-	72

Date: 17.9.47. At Malta

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		5	22	51	20	2	2.92	98.8	6600	61	4026
27		5	27	45	19	4	2.90	98.8	6000	62	3720
29		7	28	54	11	0	2.69	99.1	12600	67	8442
30		17	41	37	5	0	2.30	97.9	6600	64	4224
31		4	36	44	15	1	2.73	98.6	6800	64	4352

	W.M.
Average of 5	2.71
Average of 4	2.70
Moving Average of 5	2.74

External Temp. on Bridge
6 Hourly

	D	W
	75	69
	79	73
	79	74
	77	72
Av.	78	72
M.A.	-	72

Date: 18.9.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		8	25	51	14	2	2.77	98.7	7400	51	3774
27		6	21	51	22	1	2.94	98.6	6600	63	4158
29		4	21	53	17	5	2.88	99.1	10400	68	7072
30		13	42	40	5	0	2.37	98.0	7200	64	4608
31		9	25	55	11	0	2.68	98.8	7000	75	5250

	W.M.
Average of 5	2.75
Average of 4	2.76
Moving Average of 5	2.72

External Temp. on Bridge
6 Hourly

	D	W
	77	73
	75	73
	85	76
	76	73
Av.	78	74
M.A.	-	73

Date: 19.9.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		2	16	54	24	4	3.12	99.0	10200	67	6834
27		4	25	55	16	1	2.88	97.9	6400	59	3648
29		9	24	39	27	1	2.87	98.8	13600	60	8160
30		15	41	38	8	1	2.42	97.8	11400	62	7068
31		5	28	50	17	1	2.84	98.4	6600	65	4290

	W.M.
Average of 5	2.83
Average of 4	2.82
Moving Average of 5	2.76

External Temp. on Bridge 6 Hourly

	D	W
	73	72
	77	74
	80	77
	77	74
Av.	77	74
M.A.	-	73

Date: 20.9.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		1	22	60	14	3	2.96	98.7	9800	53	5194
27		2	30	51	17	1	2.88	97.5	7200	62	4464
29		3	23	56	17	1	2.90	98.4	10000	68	6800
30		3	40	52	4	0	2.55	98.0	9600	59	5664
31		8	26	45	18	2	2.77	99.0	8000	61	4880

	W.M.
Average of 5	2.81
Average of 4	2.82
Moving Average of 5	2.80

External Temp. on Bridge 6 Hourly

	D	W
	73	70
	69	65
	73	68
	71	66
Av.	72	67
M.A.	-	72

Date: 21.9.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		2	24	57	15	2	2.91	98.6	8400	47	3948
27		4	29	56	11	0	2.74	98.0	7200	60	4320
29		12	31	42	14	2	2.72	98.4	11800	59	6962
30		15	44	35	6	1	2.37	97.8	10200	71	7242
31		3	37	48	11	0	2.65	98.1	8400	74	6216

	W.M.
Average of 5	2.68
Average of 4	2.69
Moving Average of 5	2.77

External Temp. on Bridge
6 Hourly

	D	W
	66	62
	66	62
	70	63
	69	66
Av.	68	63
M.A.	-	68

Date: 22.9.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		4	36	49	11	1	2.72	97.7	12200	62	7564
27		5	24	50	21	0	2.87	97.4	6600	68	4488
29		12	31	46	10	1	2.57	97.6	12200	65	7930
30		20	41	36	4	0	2.26	97.8	11800	77	9086
31		6	37	42	14	2	2.72	98.4	7600	54	4104

	W.M.
Average of 5	2.63
Average of 4	2.61
Moving Average of 5	2.71

External Temp. on Bridge
6 Hourly

	D	W
	65	63
	65	63
	66	60
	64	59
Av.	65	61
M.A.	-	64

Date: 23.9.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W:M.	BODY TEMP.	W.B.C.	%N	A.N.
5		2	31	50	15	2	2.84	98.2	6400	59	3776
27		15	43	37	5	1	2.37	97.3	8800	55	4840
29		12	40	37	11	0	2.47	98.2	9600	57	5472
30	Diarrhoea	33	44	20	3	0	1.93	98.8	9800	83	8134
31		4	35	46	14	0	2.68	98.0	8600	61	5240

	W.M.
Average of 5	2.46
Average of 4	2.40
Moving Average of 5	2.59

External Temp. on Bridge
6 Hourly

	D	W
	62	62
	58	54
	58	53
	56	50
Av.	58	55
M.A.	-	60

Voyage V "CHESHIRE" C

Liverpool, Malta, Port Said, Tobruk, Malta, Liverpool

SUBJECTS

Name	Age	Smoking	Previous History	Present Voyage
5, 27, 29, 30		As Voyages III, and IV		
32 R.W.J.	19	S.	2nd trip to semi-tropical climate	Round trip

Date: 2.10.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5	Coryza	1	44	50	5	0	2.59	98.6	4800	52	2496
27		7	34	42	17	0	2.69	97.8	5600	54	3024
29	Coryza	6	36	44	13	1	2.67	98.4	7200	60	4320
30	Coryza	24	46	26	4	0	2.10	97.2	9600	67	6432
32		7	30	48	13	2	2.73	98.2	6600	52	3432

	W.M.
Average of 5	2.56
Average of 4 (i.e. Nos. 5,27,29,30 common to all three Cheshire trips)	2.51
Moving Average of W.M.'s of all 5 subjects, taken in 3 day groups	-

External Temp. on Bridge
6 Hourly

	D	W
	63	61
	61	59
	60	56
	61	59
Av.	61	59
M.A.		-

Date: 3.10.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5	Coryza	5	39	48	8	0	2.59	98.4	6600	55	3630
27		7	37	47	8	1	2.59	98.7	8600	72	6192
29	Coryza	3	37	51	8	1	2.67	98.6	10000	52	5200
30	Coryza Otitis externa.	21	49	30	0	0	2.09	97.9	8000	71	5680
32		5	31	53	8	3	2.73	98.0	5800	57	3306

	W.M.
Average of 5	2.53
Average of 4	2.49
Moving Average of 5	-

External Temp. on Bridge
6 Hourly

	D	W
	61	60
	62	60
	66	64
	64	62
Av.	63	61
M.A.		-

Date: 4.10.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5	Coryza	4	32	53	9	2	2.69	98.4	7400	57	4218
27		7	47	37	7	2	2.50	97.8	7000	60	4200
29	Coryza	8	38	43	11	0	2.57	98.6	14200	78	11076
30	Coryza Otitis ext.	21	47	27	5	0	2.16	98.2	12400	74	9176
32		8	32	49	9	2	2.65	98.6	5000	58	2900

	W.M.
Average of 5	2.51
Average of 4	2.48
Moving Average of 5	2.53

External Temp. on Bridge
6 Hourly

	D	W
	63	62
	61	61
	67	64
	66	64
Av.	64	63
M.A.	-	61

Date: 5.10.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5	Coryza	8	31	48	12	1	2.67	98.4	3600	51	1836
27		3	29	57	11	0	2.76	97.8	7400	66	4884
29	Coryza	7	30	48	15	1	2.76	99.1	12600	51	6426
30	Coryza Otitis ext.	17	44	35	4	0	2.26	98.5	11200	66	7392
32		6	32	46	12	4	2.76	98.6	8600	57	4902

	W.M.
Average of 5	2.64
Average of 4	2.61
Moving Average of 5	2.56

External Temp. on Bridge
6 Hourly

	D	W
	68	67
	69	66
	73	67
	70	68
Av.	70	67
M.A.		64

Date: 6.10.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5	Coryza	3	28	51	18	0	2.84	99.0	6800	57	3876
27		7	31	51	11	0	2.66	98.1	7600	52	3952
29	S.Coryza	5	26	46	21	2	2.89	99.0	8200	57	4674
30	Coryza	20	40	34	6	0	2.26	98.7	6000	64	3840
32		6	33	55	5	1	2.62	98.6	4000	58	2320

	W.M.
Average of 5	2.65
Average of 4	2.66
Moving Average of 5	2.60

External Temp. On Bridge
6 Hourly

	D	W
	71	69
	72	69
	77	74
	75	71
Av.	74	71
M.A.		67

Date: 7.10.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5	Coryza	4	24	59	13	0	2.81	98.7	5200	64	3328
27		5	24	47	22	2	2.92	98.0	8000	60	4800
29	Coryza	5	26	52	16	1	2.82	98.6	9000	67	6030
30	Coryza	11	41	41	6	1	2.45	98.4	14200	75	10650
32		3	36	45	15	1	2.75	98.5	7600	60	4560

	W.M.
Average of 5	2.75
Average of 4	2.75
Moving Average of 5	2.68

External Temp. on Bridge
6 Hourly

	D	W
	74	73
	73	71
	80	75
	76	73
Av.	76	73
M.A.		70

Date: 8.10.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5	Coryza	3	27	49	20	1	2.89	99.0	6400	46	2944
27		5	33	43	18	1	2.77	98.0	8200	61	5002
29	Coryza	7	28	53	10	2	2.72	98.3	9800	60	5880
30	Coryza	9	50	33	7	1	2.41	97.7	8800	67	5896
32		8	25	51	15	1	2.76	98.4	5800	65	3770

	W.M.
Average of 5	2.71
Average of 4	2.70
Moving Average of 5	2.70

External Temp. on Bridge
6 Hourly

	D	W
	75	72
	73	68
	74	72
	74	71
Av.	74	71
M.A.	-	72

Date: 9.10.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5	Coryza	4	23	57	14	2	2.87	98.4	7000	57	3990
27		5	32	45	16	2	2.78	97.4	7600	47	3572
29	S. Coryza	8	24	53	13	2	2.77	99.0	9600	59	5664
30	Coryza	12	45	34	8	1	2.41	97.8	13000	78	10140
32		3	40	41	15	1	2.71	98.6	7200	64	4608

	W.M.
Average of 5	2.71
Average of 4	2.71
Moving Average of 5	2.72

External Temp. on Bridge
6 Hourly

	D	W
	73	70
	73	65
	81	69
	71	65
Av.	74	67
M.A.		70

Date: 10.10.47. Arrive Port Said

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N
5	Coryza	2	25	49	20	4	2.99	98.4	7600	57	4332
27	*	2	33	49	15	1	2.80	96.9	11000	67	7370
29	Coryza *	7	28	52	12	1	2.72	98.6	8600	67	5762
30	Coryza	15	46	33	6	0	2.30	97.6	13000	81	10530
32		4	32	49	14	1	2.76	97.9	6600	56	3696

	W.M.
Average of 5	2.71
Average of 4	2.70
Moving Average of 5	2.71

External Temp. on Bridge
6 Hourly

	D	W
	71	66
	78	66
	76	69
	73	67
Av.	74	67
M.A.	-	68

* Mild diarrhoea

Date: 12.10.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N
5	Coryza	5	30	48	17	0	2.77	99.0	9600	58	5568
27		6	31	50	11	2	2.72	97.7	7200	58	4176
29	Coryza	4	27	48	18	3	2.89	99.0	8000	53	4240
30	Coryza	16	43	31	9	1	2.36	99.0	10400	64	6656
32		12	31	49	8	0	2.53	98.2	7600	59	4484

	W.M.
Average of 5	2.65
Average of 4	2.69
Moving Average of 5	2.69

External Temp. on Bridge
6 Hourly

	D	W
	72	69
	77	72
	81	75
	80	72
Av.	78	72
M.A.	-	69

Date: 14.10.47. Sail Port Said

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		4	33	54	9	0	2.68	99.0	4800	58	2784
27		9	29	52	10	0	2.63	97.6	6600	63	4158
29	Coryza	5	31	42	20	2	2.83	99.4	9000	61	5490
30	Coryza	9	50	37	4	0	2.36	98.1	10800	63	6804
32		6	34	46	13	1	2.69	98.4	5000	51	2550

	W.M.
Average of 5	2.64
Average of 4	2.63
Moving Average of 5	2.67

External Temp. on Bridge
6 Hourly

	D	W
	73	68
	73	66
	77	68
	73	66
Av.	74	67
M.A.		69

Date: 15.10.47. At Tobruk

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		6	32	56	5	1	2.63	98.8	9400	55	5170
27		3	26	52	16	3	2.90	98.0	5800	59	3422
29	Coryza	4	35	46	14	1	2.73	98.6	7200	52	3744
30		16	47	29	6	2	2.31	98.6	7800	65	5070
32		2	42	46	10	0	2.64	98.6	8200	62	5084

	W.M.
Average of 5	2.64
Average of 4	2.64
Moving Average of 5	2.64

External Temp. on Bridge
6 Hourly

	D	W
	73	67
	73	69
	83	70
	71	69
Av.	75	69
M.A.		69

Date: 16.10.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		6	34	45	13	2	2.71	98.4	6200	62	3844
27		3	34	50	13	0	2.73	97.6	6400	60	3840
29	Coryza	6	33	49	11	1	2.68	99.2	5000	48	2400
30		21	45	31	2	1	2.19	97.7	10800	64	6912
32		10	34	46	9	1	2.57	98.5	7000	64	4480

	W.M.
Average of 5	2.58
Average of 4	2.58
Moving Average of 5	2.62

External Temp. on Bridge
6 Hourly

	D	W
	70	67
	71	64
	78	66
	70	66
Av.	72	66
M.A.	-	67

Date: 17.10.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N
5		5	38	46	9	2	2.65	98.3	7000	57	3990
27		5	25	58	12	0	2.77	97.7	7400	61	4516
29		8	33	48	11	0	2.62	99.0	10600	54	5724
30		20	42	32	5	1	2.25	97.5	6600	65	4290
32		12	41	41	5	1	2.42	98.6	7200	57	4104

	W.M.
Average of 5	2.54
Average of 4	2.57
Moving Average of 5	2.59

External Temp. on Bridge
6 Hourly

	D	W
	69	64
	70	64
	73	67
	71	65
Av.	71	65
M.A.	-	67

Date: 18.10.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N
5	Nausea	7	39	39	13	2	2.64	98.5	5000	51	2550
27		8	29	52	10	1	2.67	97.4	7600	59	4484
29		7	29	44	19	1	2.78	99.2	8200	57	4674
30		20	41	33	5	1	2.26	98.5	7400	65	4810
32		10	39	39	10	2	2.55	98.3	8800	57	5016

	W.M.
Average of 5	2.58
Average of 4	2.59
Moving Average of 5	2.57

External Temp. on Bridge
6 Hourly

	D	W
	69	63
	66	64
	73	66
	69	63
Av.	69	64
M.A.		65

Date: 19.10.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		4	29	50	14	3	2.83	98.3	6000	58	3480
27		7	31	41	18	3	2.76	98.7	8800	61	5368
29		2	37	48	15	0	2.72	99.4	9400	47	4418
30		15	51	28	6	0	2.25	98.0	8400	73	6132
32	Coryza	8	43	40	8	1	2.51	98.6	5600	58	3248

	W.M.
Average of 5	2.61
Average of 4	2.64
Moving Average of 5	2.58

External Temp. on Bridge
6 Hourly

	D	W
	68	64
	68	65
	78	70
	70	66
Av.	71	66
M.A.	-	65

Date: 20.10.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		6	22	57	13	2	2.83	98.4	4800	52	2496
27		3	29	56	12	0	2.77	98.6	6000	60	3600
29		4	27	54	14	1	2.81	98.0	8400	44	3696
30		13	42	39	6	0	2.38	98.7	8000	63	5040
32	Coryza	13	42	39	6	0	2.38	98.2	10000	61	6100

	W.M.
Average of 5	2.63
Average of 4	2.70
Moving Average of 5	2.61

External Temp. on Bridge
6 Hourly

	D	W
	68	65
	69	66
	78	70
	69	66
Av.	71	67
M.A.	-	66

Date: 21.10.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N
5		4	30	55	11	0	2.73	98.4	6800	57	3876
27		7	31	48	13	1	2.70	98.3	5400	60	3240
29		5	29	48	15	3	2.82	98.8	7000	56	3920
30		12	46	38	4	0	2.34	98.4	8200	69	5658
32		4	37	52	6	1	2.63	98.7	6800	62	4216

	W.M.
Average of 5	2.64
Average of 4	2.65
Moving Average of 5	2.63

External Temp. on Bridge
6 Hourly

	D	W
	66	63
	59	59
	68	64
	66	63
Av.	65	62
M.A.	-	65

Date: 22.10.47.

SUBJ.	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.	W.B.C.	%N	A.N.
5		8	35	47	10	0	2.59	98.1	8200	58	4756
27	*	11	37	43	8	1	2.51	97.2	7000	58	4060
29	*	8	41	37	13	1	2.58	97.8	8000	60	4800
30		13	48	37	2	0	2.28	98.1	8600	63	5418
32		13	48	32	5	2	2.35	97.0	6200	56	3472

	W.M.
Average of 5	2.46
Average of 4	2.49
Moving Average of 5	2.58

External Temp. on Bridge
6 Hourly

	D	W
	59	58
	61	54
	62	56
	60	54
Av.	60	55
M.A.		61

* Seasick

GLASGOW

SUBJECTS

Name	Age	Smoking	Previous History
5. R.L.	25 etc. as on all voyages		
33. M.H.	22	S.	Never abroad
34. E.W.	22	N.S.	Never abroad. Suffers from functional dyspepsia.
35. J.McF.	22	S.	Never abroad
36. M.Y.	23	S.	Never abroad

Date: 12.1.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		6	32	48	13	1	2.71	98.3
33		8	38	44	9	1	2.57	97.6
34		11	35	43	8	3	2.47	97.5
35		8	29	53	9	1	2.66	97.9
36		7	22	55	15	1	2.81	96.6

W.M.

Average of 5 W.M.'s 2.64

6 Hourly Temp.

	D	W
6 a.m.	37	35
Midday	37	36
6 p.m.	38	36
Midnight*	39	37
Av.	38	36

* The same order of temperature recordings will be preserved throughout the Glasgow observations.

Date: 13.1.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		4	28	51	13	4	2.85	98.2
33		8	26	55	10	1	2.70	97.1
34		10	28	44	15	3	2.73	97.6
35		8	23	50	17	2	2.82	97.3
36		3	28	53	14	2	2.84	98.1

W.M.

Average of 5 2.79

6 Hourly Temp.

	D	W
	39	37
	40	38
	40	39
	39	38
Av.	40	38

Date: 14.1.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		7	22	46	19	6	2.95	97.7
33		6	24	65	4	1	2.70	97.6
34		14	36	40	9	1	2.47	97.7
35		9	32	43	14	2	2.68	97.1
36		11	21	44	24	0	2.81	97.8

	W.M.		6 Hourly Temp. D	W
Average of 5	2.72		39	38
			39	38
			40	39
			40	38
		Av.	39	38

Date: 15.1.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		7	23	48	21	1	2.86	98.1
33		12	36	40	10	2	2.54	97.6
34		17	36	35	13	1	2.48	97.7
35		8	25	47	16	4	2.79	97.0
36		7	22	58	13	0	2.77	96.4

	W.M.		6 Hourly Temp. D	W
Average of 5	2.69		38	36
			38	36
			34	32
			33	31
		Av.	36	34

Date: 16.1.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		9	28	49	12	2	2.70	98.0
33		16	27	45	10	2	2.55	97.0
34		20	36	38	6	0	2.30	97.6
35		3	36	43	16	2	2.78	97.2
36		5	35	44	15	1	2.72	98.2

	W.M.		6 Hourly Temp. D	6 Hourly Temp. W
Average of 5	2.61		30	29
			30	29
			30	29
			32	31
		Av.	31	30

Date: 17.1.48. *

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		7	26	52	15	0	2.75	98.8
33		9	36	46	9	0	2.55	97.4
34		22	31	41	6	0	2.53	98.0
35		13	30	45	12	0	2.56	98.1
36		5	31	50	13	1	2.74	98.8

	W.M.		6 Hourly Temp. D	6 Hourly Temp. W
Average of 5	2.63		35	34
			39	38
			40	39
			36	35
		Av.	37	36

* 18.1.48. Average of 6 hrly. temps. D: 35. W: 34.

Date: 19.1.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		6	28	52	11	3	2.77	98.2
33		11	33	48	6	2	2.55	97.3
34		15	32	44	8	1	2.48	97.6
35		5	30	47	17	1	2.79	97.7
36		3	29	59	9	0	2.74	97.4

	W.M.		6 Hourly Temp. D	6 Hourly Temp. W
Average of 5	2.67		32	31
			35	34
			35	34
			34	33
		Av.	34	33

Date: 20.1.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		3	36	50	9	2	2.71	98.4
33		8	38	48	5	1	2.53	97.4
34		16	35	40	9	0	2.42	98.4
35		12	29	50	9	0	2.56	97.0
36		5	19	55	20	1	2.93	98.8

	W.M.		6 Hourly Temp. D	6 Hourly Temp. W
Average of 5	2.63		35	34
			39	38
			39	38
			36	35
		Av.	37	36

Date: 21.1.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		2	32	47	17	2	2.85	98.6
33		6	37	43	14	0	2.65	97.6
34		13	41	34	9	3	2.48	97.6
35		11	31	50	8	0	2.55	98.4
36		7	11	50	27	5	3.12	97.7

	W.M.		6 Hourly Temp. D	6 Hourly Temp. W
Average of 5	2.73		33	32
			35	34
			36	35
			34	33
		Av.	34	33

Date: 22.1.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		4	35	42	18	1	2.77	98.6
33		7	37	45	11	0	2.60	97.4
34		12	41	40	5	2	2.44	98.2
35		11	38	38	12	1	2.54	97.6
36		5	29	50	15	1	2.78	97.6

	W.M.		6 Hourly Temp. D	6 Hourly Temp. W
Average of 5	2.63		34	33
			34	33
			35	34
			34	33
		Av.	34	33

Date: 23.1.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		8	24	48	18	2	2.84	98.6
33		5	42	48	5	0	2.51	97.8
34		10	39	43	8	0	2.49	97.7
35		8	31	49	12	0	2.65	97.0
36		5	31	48	16	0	2.75	98.9

	W.M.		6 Hourly Temp. D	6 Hourly Temp. W
Average of 5	2.65		32	31
			34	33
			32	31
			31	30
		Av.	32	31

Date: 24.1.48.*

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		9	30	45	16	0	2.68	98.2

	6 Hourly Temp. D	6 Hourly Temp. W
Av.	32	31

* 25.1.48. Average of 6 hrly. temps. D: 35. W: 34.

Date: 26.1.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		7	28	56	9	0	2.67	98.0
33		9	40	36	15	0	2.57	97.0
34		14	23	43	18	2	2.71	97.6
35		6	23	54	13	4	2.86	98.0
36		11	25	45	17	2	2.74	97.4

	W.M.	6 Hourly Temp. D	W
Average of 5	2.71	38	37
		41	39
		39	38
		38	37
	Av.	39	38

Date: 27.1.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		16	20	52	9	3	2.63	98.2
33		5	33	55	7	0	2.64	96.8
34		7	29	55	8	1	2.67	97.8
35		12	30	48	10	0	2.56	97.4
36		6	24	53	15	2	2.83	97.8

	W.M.	6 Hourly Temp. D	W
Average of 5	2.67	33	32
		37	36
		37	36
		38	37
	Av.	36	35

Date: 28.1.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		3	33	42	2	1	2.84	98.2
33	Coryza	6	31	49	12	2	2.73	97.4
34		14	33	41	11	1	2.52	97.4
35		8	29	44	18	1	2.75	97.2
36	Coryza	8	27	44	18	3	2.81	97.8

	W.M.		6 Hourly Temp. D	W
Average of 5	2.73		39	38
			39	38
			40	39
			38	37
		Av.	39	38

Date: 29.1.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		11	25	49	14	1	2.69	98.2
33	Coryza	8	34	48	9	1	2.61	97.2
34		11	35	45	8	1	2.53	97.8
35		10	20	54	15	1	2.77	97.4
36	Coryza	12	22	43	20	3	2.80	98.4

	W.M.		6 Hourly Temp. D	W
Average of 5	2.68		37	36
			41	39
			39	38
			37	35
		Av.	38	37

Date: 30.1.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		6	28	53	13	0	2.73	98.1
33	Coryza	10	29	51	10	0	2.61	96.4
34		11	39	39	11	0	2.50	97.8
35		9	38	45	8	0	2.52	98.5
36	Coryza	4	20	60	15	1	2.89	98.7

	W.M.		6 Hourly Temp. D	6 Hourly Temp. W
Average of 5	2.65		38	37
			39	38
			43	42
			42	40
		Av.	41	39

Date: 31.1.48. *

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		8	26	50	14	2	2.76	98.4
33	Coryza	4	32	54	10	0	2.70	97.4
34		12	38	37	13	0	2.51	97.8
35		5	33	48	13	1	2.72	97.2
36	Coryza	7	14	65	11	3	2.89	99.2

	W.M.		6 Hourly Temp. D	6 Hourly Temp. W
Average of 5	2.72		43	42
			47	45
			44	43
			43	42
		Av.	44	43

* Average of 6 hrly. temps. on 1.2.48. D: 46. W: 44.

Date: 2.2.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5	Coryza	4	26	56	13	1	2.81	98.5
33		12	37	39	11	1	2.52	98.0
34		9	34	44	11	2	2.63	97.9
35		9	33	44	13	1	2.64	98.9
36	Coryza	6	30	46	15	3	2.79	97.8

	W.M.		6 Hourly Temp. D	6 Hourly Temp. W
Average of 5	2.68		47	45
			47	45
			46	44
			45	43
		Av.	46	44

Date: 3.2.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		7	32	46	14	1	2.70	98.0
33		9	44	36	9	2	2.51	97.2
34		11	29	50	9	1	2.60	97.6
35		11	38	43	8	0	2.48	97.3
36		3	25	41	27	4	3.04	97.8

	W.M.		6 Hourly Temp. D	6 Hourly Temp. W
Average of 5	2.67		40	39
			41	39
			41	39
			40	38
		Av.	41	39

Date: 4.2.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		7	38	41	13	1	2.63	98.0
33		7	32	51	8	2	2.66	96.6
34		9	30	49	12	0	2.64	97.6
35		8	30	44	15	3	2.75	97.2
36	M.*	5	33	45	14	3	2.77	99.2

	W.M.		6 Hourly Temp.	
			D	W
Average of 5	2.69		42	41
			44	41
			41	39
			42	41
		Av.	42	40

* M = menstruating.

Date: 5.2.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		6	30	52	12	0	2.70	98.0
33		4	38	43	14	1	2.70	96.6
34		7	35	47	11	0	2.62	97.8
35		7	33	45	13	1	2.65	97.4
36	M.	6	29	47	16	2	2.79	98.0

	W.M.		6 Hourly Temp.	
			D	W
Average of 5	2.69		41	39
			42	40
			43	42
			41	39
		Av.	42	40

Date: 6.2.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		1	31	49	18	1	2.87	97.7
33		3	44	48	5	0	2.55	97.0
34		12	28	48	10	2	2.62	97.8
35		8	31	49	8	4	2.69	97.3
36	M.	11	21	43	22	3	2.85	98.9

	W.M.		6 Hourly Temp. D	W
Average of 5	2.72		36	35
			35	34
			34	33
			35	34
		Av.	35	34

Date: 7.2.48.*

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		8	25	46	20	1	2.81	98.1
33		5	35	49	11	0	2.66	97.4
34	Dyspepsia	7	31	49	10	3	2.71	97.8
35		3	27	50	18	2	2.89	97.3
36	M.	7	16	49	26	2	3.00	97.8

	W.M.		6 Hourly Temp. D	W
Average of 5	2.81		42	41
			47	44
			41	40
			40	38
		Av.	43	41

* Average of 6 hrly. temp readings: 8.2.48. D: 43. W: 41.

Date: 9.2.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5	Slight coryza	9	23	53	14	1	2.75	98.3
33		5	31	59	5	0	2.64	97.7
34		13	30	47	8	2	2.56	98.1
35		12	22	52	14	0	2.68	97.2
36		5	31	44	18	2	2.81	98.4

	W.M.		6 Hourly Temp. D	W
Average of 5	2.69		43	41
			44	43
			42	40
			42	40
		Av.	43	41

Date: 10.2.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5	Slight coryza	7	37	47	9	0	2.58	98.2
33		4	36	51	8	1	2.66	97.3
34		11	30	49	8	2	2.60	98.1
35		5	26	52	14	3	2.84	97.4
36		7	21	55	13	4	2.86	98.8

	W.M.		6 Hourly Temp. D	W
Average of 5	2.71		46	45
			48	47
			45	43
			41	39
		Av.	45	43

Date: 11.2.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		8	35	46	11	0	2.60	98.3
33		5	35	54	6	0	2.61	97.0
34		12	32	40	13	3	2.63	98.1
35		5	27	53	15	0	2.78	97.2
36		8	26	53	10	0	2.74	98.7

	W.M.		6 Hourly Temp. D	6 Hourly Temp. W
Average of 5	2.67		41	40
			44	43
			46	44
			38	37
		Av.	42	41

Date: 12.2.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		4	33	52	11	0	2.70	98.4
33		9	32	52	7	0	2.57	96.6
34	M.	14	33	44	9	0	2.48	98.2
35		9	33	45	13	0	2.62	97.5
36		8	23	44	20	5	2.91	97.6

	W.M.		6 Hourly Temp. D	6 Hourly Temp. W
Average of 5	2.66		37	36
			39	38
			38	36
			34	33
		Av.	37	36

M = Menstruating.

Date: 13.2.48.*

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		5	35	50	10	0	2.65	97.5
33		4	35	52	9	0	2.66	97.2
34	M.	8	25	52	15	0	2.74	98.1
35		3	22	57	16	2	2.92	97.6
36		6	21	46	20	7	3.01	99.0

	W.M.		6 Hourly Temp. D	W
Average of 5	2.80		37	36
			40	39
			44	42
			40	38
		Av.	40	39

* Average of 6 hrly. temp. readings:-

14.2.48.	D: 45	W: 43
15.2.48.	D: 44	W: 42
16.2.48.	D: 39	W: 38
17.2.48.	D: 37	W: 36

Date: 18.2.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5	Coryza	9	26	54	11	0	2.67	98.0
33		14	32	46	8	0	2.48	97.4
34		8	34	46	12	0	2.62	98.1
35		8	29	43	16	4	2.79	97.3
36		4	25	52	17	2	2.78	99.2

	W.M.		6 Hourly Temp. D	W
Average of 5	2.67		27	26
			34	32
			29	28
			29	28
		Av.	30	28

Date: 19.2.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5	Coryza	4	41	44	11	0	2.62	97.9
33		6	33	50	10	1	2.67	97.4
34		14	34	41	11	0	2.49	98.0
35		10	31	47	10	2	2.63	97.4
36		1	15	55	26	3	3.15	99.3

	W.M.	6 Hourly Temp.		
			D	W
Average of 5	2.71		32	30
			36	34
			36	34
			34	33
		Av.	35	33

Date: 20.2.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5	Coryza	8	32	54	5	1	2.59	98.6
33		6	30	58	5	1	2.65	98.1
34		5	35	48	11	1	2.68	97.9
35		9	32	50	9	0	2.59	98.4
36		4	25	49	18	4	2.89	99.3

	W.M.	6 Hourly Temp.		
			D	W
Average of 5	2.68		34	32
			36	35
			35	34
			34	32
		Av.	35	33

Date: 21.2.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5	Coryza	5	30	54	10	1	2.72	97.0
33		5	28	56	11	0	2.73	97.4
34				Absent				
35		8	33	50	8	1	2.61	97.9
36				Absent				

	W.M.		6 Hourly Temp. D	6 Hourly Temp. W
Average of 5	-		32	31
			34	33
			34	33
			34	33
		Av.	34	33

Date: 23.2.48.*

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5	Coryza	6	27	48	17	2	2.82	98.0
33		7	28	54	9	2	2.78	96.9
34		13	36	45	6	0	2.44	98.0
35		7	21	51	19	0	2.88	97.4
36		6	26	47	19	2	2.85	98.7

	W.M.		6 Hourly Temp. D	6 Hourly Temp. W
Average of 5	2.75		37	35
			42	39
			42	40
			40	38
		Av.	40	38

* Average of 6 hrly. temp. readings: 22.2.48. D:37 W: 35.

Date: 24.2.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5	Coryza	4	35	42	17	2	2.78	98.0
33		6	46	38	9	1	2.53	97.2
34		7	39	37	15	2	2.66	98.0
35		7	31	49	13	0	2.68	97.7
36		7	29	43	19	2	2.80	98.6

	W.M.		6 Hourly Temp. D	W
Average of 5	2.69		35	33
			40	38
			39	37
			38	36
		Av.	38	36

Date: 25.2.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5	Coryza	4	32	44	17	3	2.83	98.2
33		11	32	52	5	0	2.51	97.0
34		6	39	46	8	1	2.59	97.8
35		8	35	48	7	2	2.60	97.3
36		7	27	51	10	5	2.79	99.4*

	W.M.		6 Hourly Temp. D	W
Average of 5	2.66		32	31
			41	38
			40	38
			36	34
		Av.	37	35

* After a cup of tea.

Date: 26.2.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5	Coryza	3	27	52	17	1	2.86	98.8
33		5	34	49	10	2	2.70	97.5
34		10	33	44	13	0	2.60	98.0
35		5	36	49	10	0	2.64	98.7
36		2	21	58	14	5	2.99	99.5

	W.M.	6 Hourly Temp. D	6 Hourly Temp. W
Average of 5	2.76	29	27
		38	35
		36	34
		33	31
	Av.	34	32

Date: 27.2.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5	Coryza	7	28	52	12	1	2.72	98.4
33		4	30	53	13	0	2.79	97.6
34		7	26	59	8	0	2.68	98.3
35		4	33	53	10	0	2.69	98.5
36		5	32	46	14	3	2.78	99.7

	W.M.	6 Hourly Temp. D	6 Hourly Temp. W
Average of 5	2.73	33	31
		39	36
		38	36
		36	34
	Av.	37	34

Date: 1.3.48.*

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		3	30	53	14	0	2.78	98.4
33		10	29	55	6	0	2.57	97.5
34	Coryza	8	39	48	4	1	2.51	97.8
35		3	28	54	14	1	2.82	97.6
36	M.	3	31	46	18	2	2.85	98.1

	W.M.	6 Hourly Temp. D	W
Average of 5	2.71	38	36
		43	41
		43	42
		40	38
		Av. 41	39

* Average of 6 hrly. temp. readings: 28.2.48. D: 37 W: 35.
29.2.48. D: 37 W: 35

Date: 2.3.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		4	36	48	12	0	2.68	98.4
33		5	31	51	13	0	2.72	97.8
34	Coryza	9	32	53	6	0	2.56	98.5
35		12	27	46	11	4	2.68	97.3
36	M.	6	25	50	18	1	2.83	98.2

	W.M.	6 Hourly Temp. D	W
Average of 5	2.69	38	37
		44	42
		46	44
		45	43
		Av. 43	41

Date: 3.3.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		3	34	46	12	5	2.82	98.4
33		5	39	50	6	0	2.57	97.2
34	Coryza	10	37	43	10	0	2.53	98.4
35		9	35	42	14	0	2.61	97.7
36	M.	2	33	51	10	4	2.81	98.9

	W.M.		6 Hourly Temp. D	6 Hourly Temp. W
Average of 5	2.67		44	42
			45	44
			49	47
			43	41
		Av.	45	43

Date: 4.3.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		4	32	46	18	0	2.78	98.1
33		7	41	41	9	2	2.58	97.5
34	Coryza	13	33	42	12	1	2.57	97.8
35		6	35	47	11	1	2.66	97.3
36	M.	4	28	44	22	2	2.90	98.2

	W.M.		6 Hourly Temp. D	6 Hourly Temp. W
Average of 5	2.70		36	34
			44	42
			42	40
			40	38
		Av.	41	39

Date: 5.3.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		4	33	47	16	0	2.75	98.4
33		8	31	48	13	0	2.66	97.1
34	Coryza	11	32	49	8	0	2.54	97.7
35		6	26	58	9	1	2.73	97.4
36		4	30	45	17	1	2.75	98.1

	W.M.	6 Hourly Temp. D	W
Average of 5	2.69	38	36
		41	39
		41	39
		36	35
		Av. 39	37

Date: 6.3.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		2	32	45	19	2	2.87	98.5
33		13	29	44	13	1	2.60	97.4
34	Coryza	9	35	45	11	0	2.58	97.8
35		6	29	47	16	2	2.79	97.6
36		11	24	42	19	4	2.81	98.2

	W.M.	6 Hourly Temp. D	W
Average of 5	2.73	33	31
		37	35
		35	34
		35	33
		Av. 35	33

Date: 8.3.48.*

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5	Coryza	5	29	48	16	2	2.81	98.4
33		8	33	49	10	0	2.61	97.6
34	Coryza	6	28	52	14	0	2.74	98.0
35		2	26	60	12	0	2.82	98.0
36		1	19	52	24	4	3.11	98.0

	W.M.	6 Hourly Temp. D	6 Hourly Temp. W
Average of 5	2.82	51	49
		54	52
		52	50
		52	50
		Av. 52	50

* Average of 6 hrly. temp. readings: 7.3.48. D: 48. W:46

Date: 9.3.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		4	27	52	16	1	2.83	98.2
33		8	30	51	10	1	2.66	97.5
34		7	32	51	9	1	2.65	97.9
35		0	25	57	15	3	2.96	97.8
36		3	18	49	25	5	3.11	99.4

	W.M.	6 Hourly Temp. D	6 Hourly Temp. W
Average of 5	2.84	50	48
		58	54
		55	52
		48	44
		Av. 53	49

Date: 10.3.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5	Coryza	8	27	44	18	3	2.81	98.4
33		7	30	51	9	3	2.71	96.9
34		7	37	40	16	0	2.65	98.1
35		6	33	44	16	1	2.73	97.4
36		2	24	43	24	7	3.10	99.0

	W.M.		6 Hourly Temp. D	6 Hourly Temp. W
Average of 5	2.80		45	43
			50	46
			49	47
			47	45
		Av.	48	45

Date: 11.3.48.

SUBJECT	MISCELL.	I	II	III	IV	V	W.M.	BODY TEMP.
5		6	30	43	21	0	2.79	98.1
33		2	30	52	15	1	2.83	97.3
34		5	44	40	11	0	2.57	98.4
35		9	32	54	5	0	2.55	97.4
36		3	24	46	21	6	3.03	98.4

	W.M.		6 Hourly Temp. D	6 Hourly Temp. W
Average of 5	2.75		47	45
			51	48
			49	46
			42	40
		Av.	47	45

CAMBRIDGE

S U B J E C T S

Name	Age	Smoking	Previous History
5. R.L.	27	S.	See previous investigations.
37. J.H.D.	33	N.S.	In tropical or subtropical climate some years ago.
38. M.K.A.	27	S.	do.
39. B.M.H.	27	S.	do.
40. D.B.	27	N.S.	Never abroad
41. G.B.	27	S.	do.
42. A.G.S.	23	S.	do.

W I N T E R   S E R I E S

DATE	W.M.'s of Polynuclear Counts of Subjects							External Temp. Average of 5 readings daily	
	5	37	38	39	40	41	42	D	W
31.1.49.	2.71	2.45	2.70	2.73	2.56			41	40
1.2.49.	2.76	2.48	2.81	3.08	2.55			38	37
2.2.49.	2.88	2.65	2.83	2.99	2.62			36	35
3.2.49.	2.87	2.60	2.75	2.81	2.57			31	30
4.2.49.	2.70	2.54	2.65	2.77	2.53			32	Frozen
7.2.49.	2.78	2.41	2.75	2.62				43	42
8.2.49.	2.79	2.46	2.72	2.73	2.55			42	40
9.2.49.	2.85	2.50	2.83	2.74	2.69	2.60	2.76	42	41
10.2.49.	2.60	2.43	2.77	2.81	2.60	2.62	2.85	39	38
11.2.49.	2.68	2.40	2.77	2.69	2.57	2.70	2.82	41	40
12.2.49.					2.54			40	39
Average	2.762	2.492	2.758	2.797	2.578	2.64	2.81	39	38

SPRING SERIES

Date	W.M.'s of Polynuclear Counts of Subjects							External Temp. Average of 5 readings daily	
	5	37	38*	39	40	41	42	D	W
17.5.49.	2.73	2.65		2.72	2.70			61	59
18.5.49.	3.03	2.63		2.67	2.79			60	56
19.5.49.	2.70	2.57		2.73	2.72	2.88		64	60
20.5.49.	3.07	2.59		2.90	2.67	2.99		61	58
23.5.49.	3.01	2.67		2.79	2.76	2.89		62	58
24.5.49.	2.86	2.50		2.77	2.58	2.84		58	54
25.5.49.	2.81C			3.01	2.65C	2.92	2.95	60	55
26.5.49.	2.78C	2.66		3.10C	2.60C	2.80	2.96	53	52
27.5.49.	2.82C	2.54			2.64C	2.90	2.91	58	53
28.5.49.	3.02	2.73		3.00C				58	54
30.5.49.		2.60		2.99C	2.69	3.00		59	53
31.5.49.						3.03		57	53
1.6.49.						3.00		56	52
Average	2.883	2.614		2.868	2.680	2.925	2.94	59	55

* Blood films from Subject No.38 showed a persistent left shift, accompanied by an increase in mononuclears, some of which were abnormal, and suggestive of Infectious Mononucleosis. He also had a sore throat, pyrexia and splenomegaly, so that his counts are not included.

C. Mild Coryza

APPENDIX B

Graphical Representation of the Results

FIGURE 1 Polynuclear Counts and External Temperature Voyage I
"EMPRESS OF AUSTRALIA"

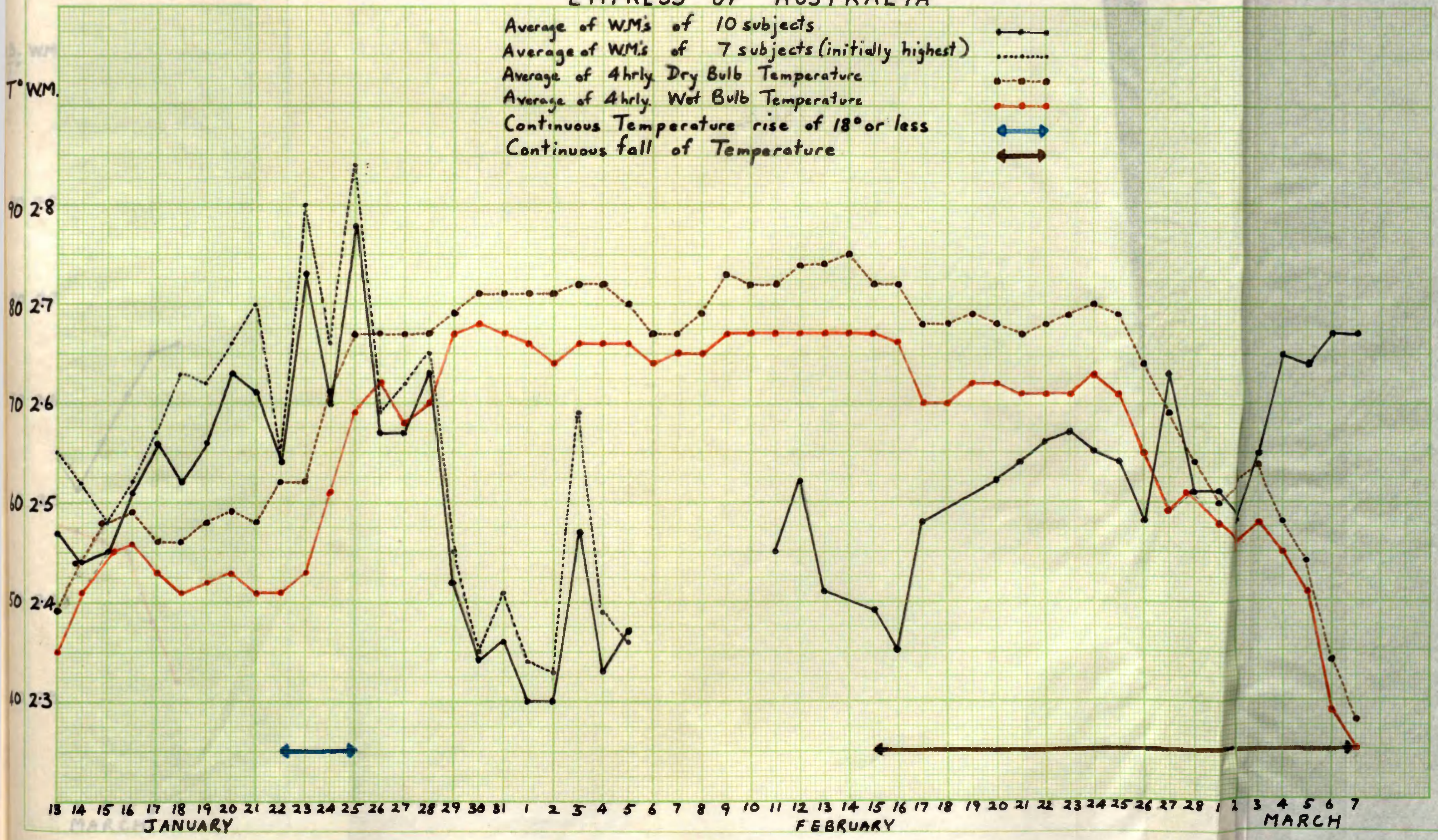


FIGURE 2 Polynuclear Counts and External Temperature Voyage I
"EMPRESS OF AUSTRALIA"

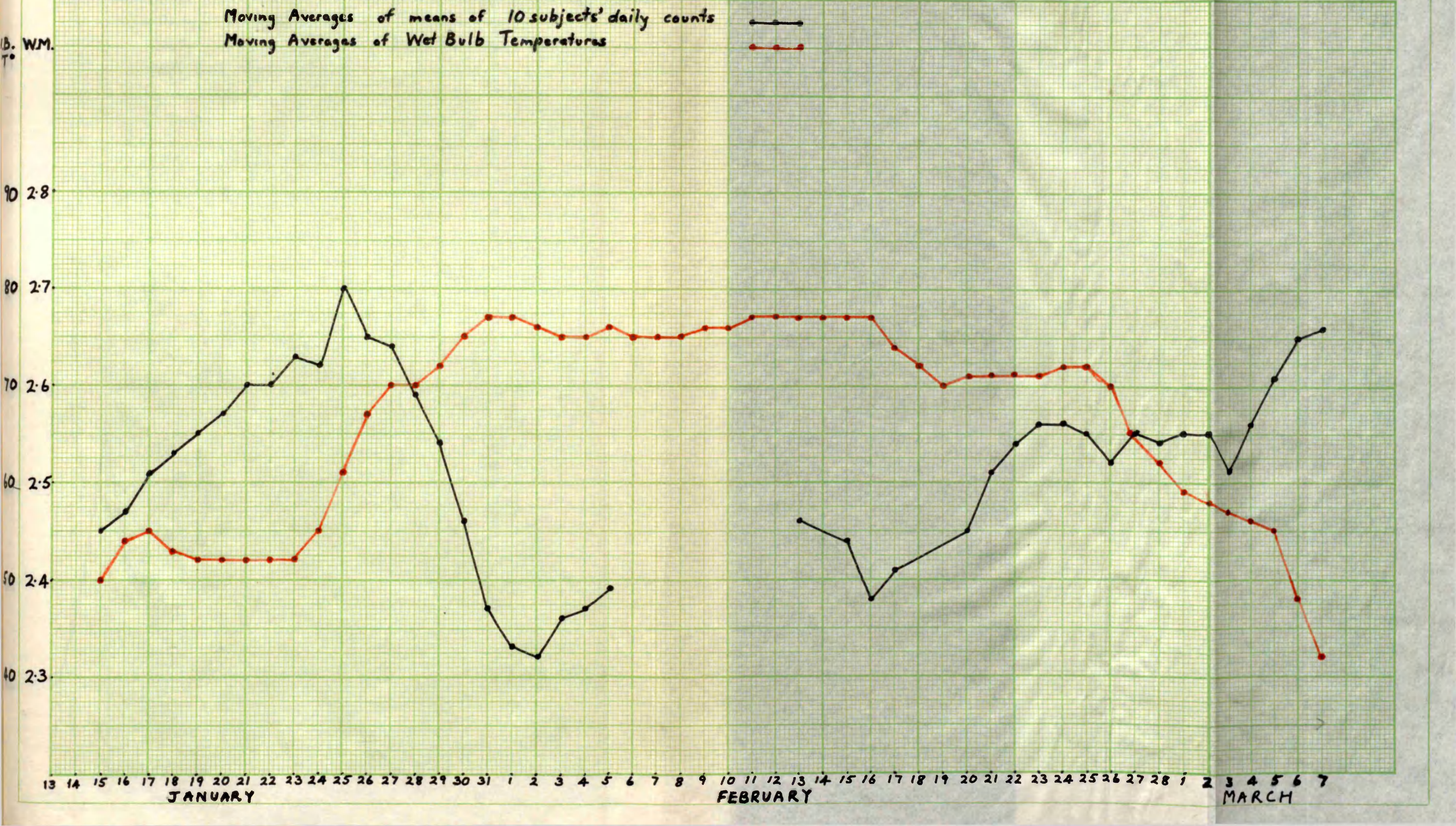


FIGURE 3 Polynuclear Counts Voyage I Second Part.

To show divergence between 6 passengers and 4 permanent staff.

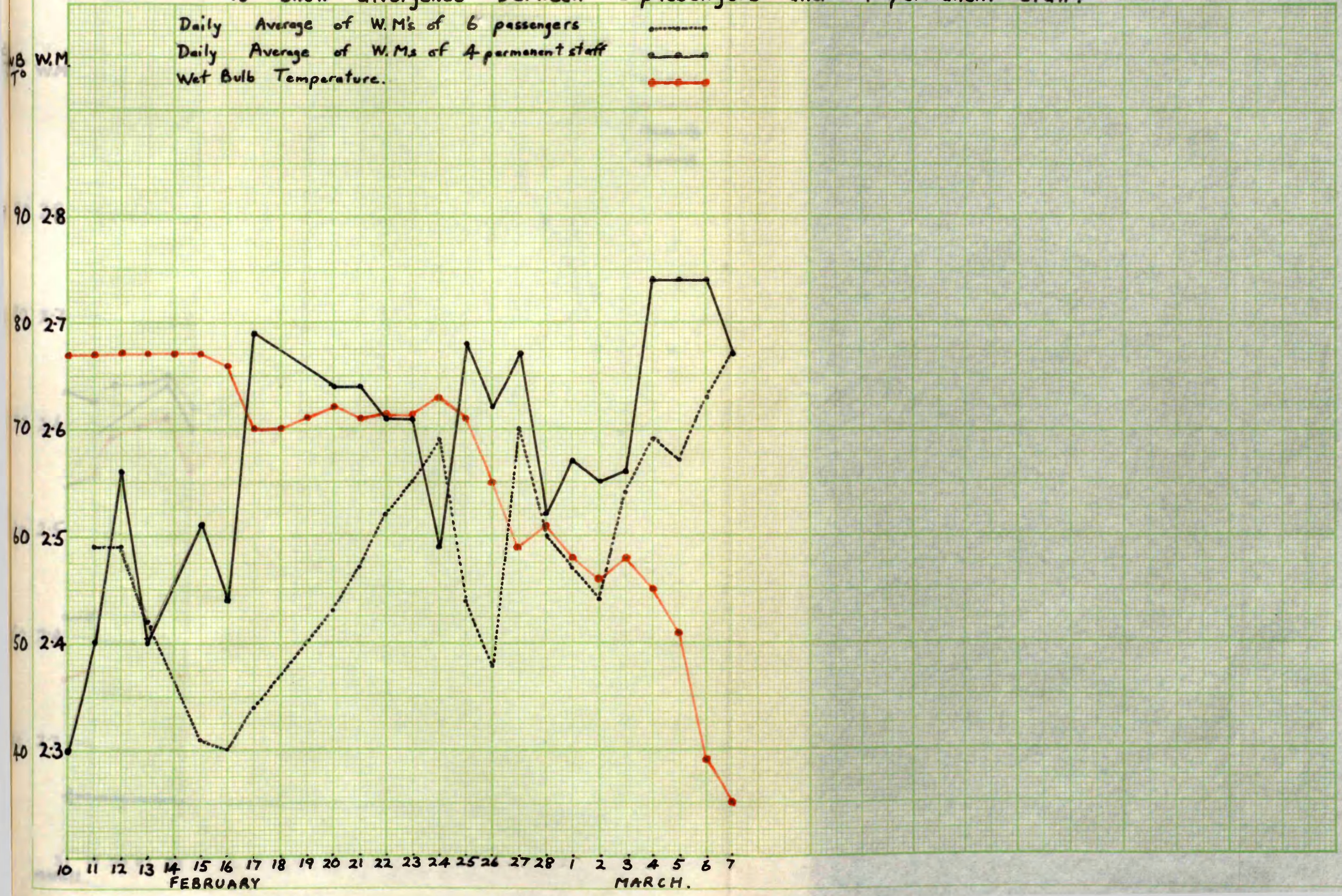


FIGURE 4 Polynuclear Counts and External Temperature Voyage II
"ASCANIUS"

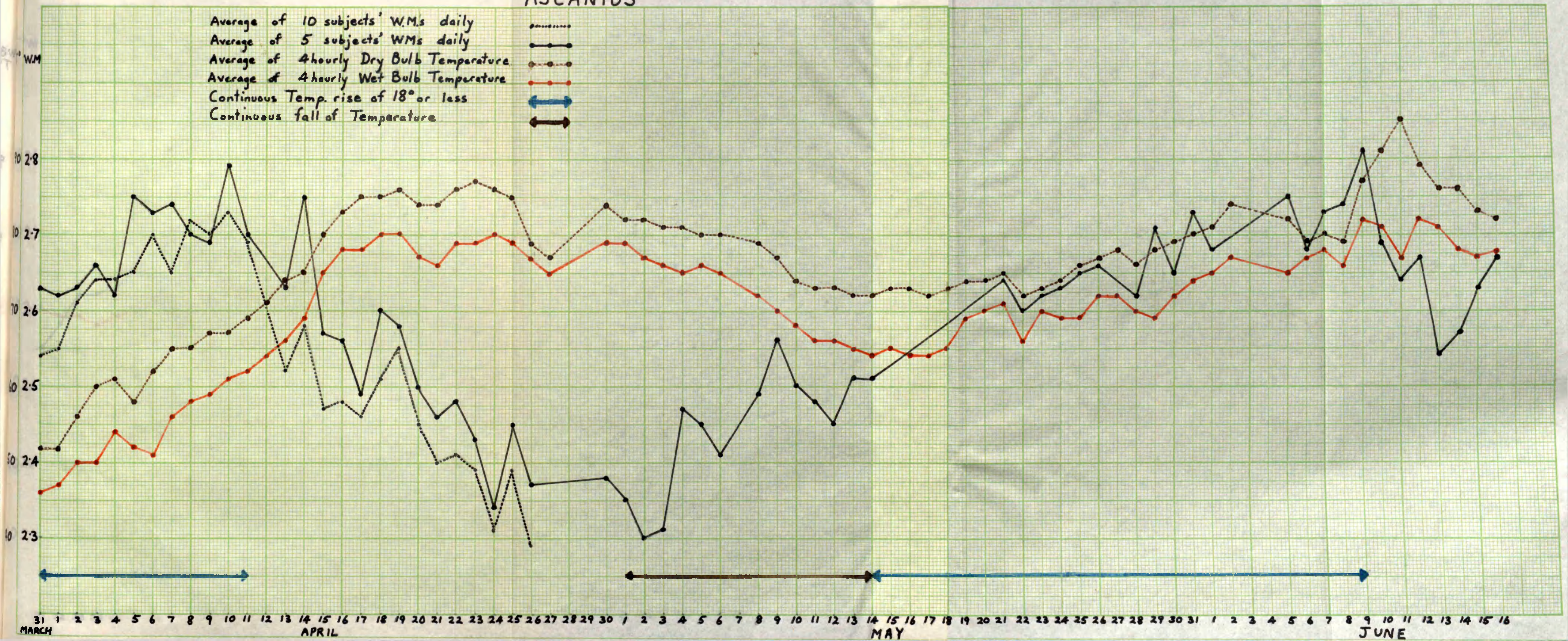


FIGURE 5 Polynuclear Counts and External Temperature Voyage II "ASCANIUS"

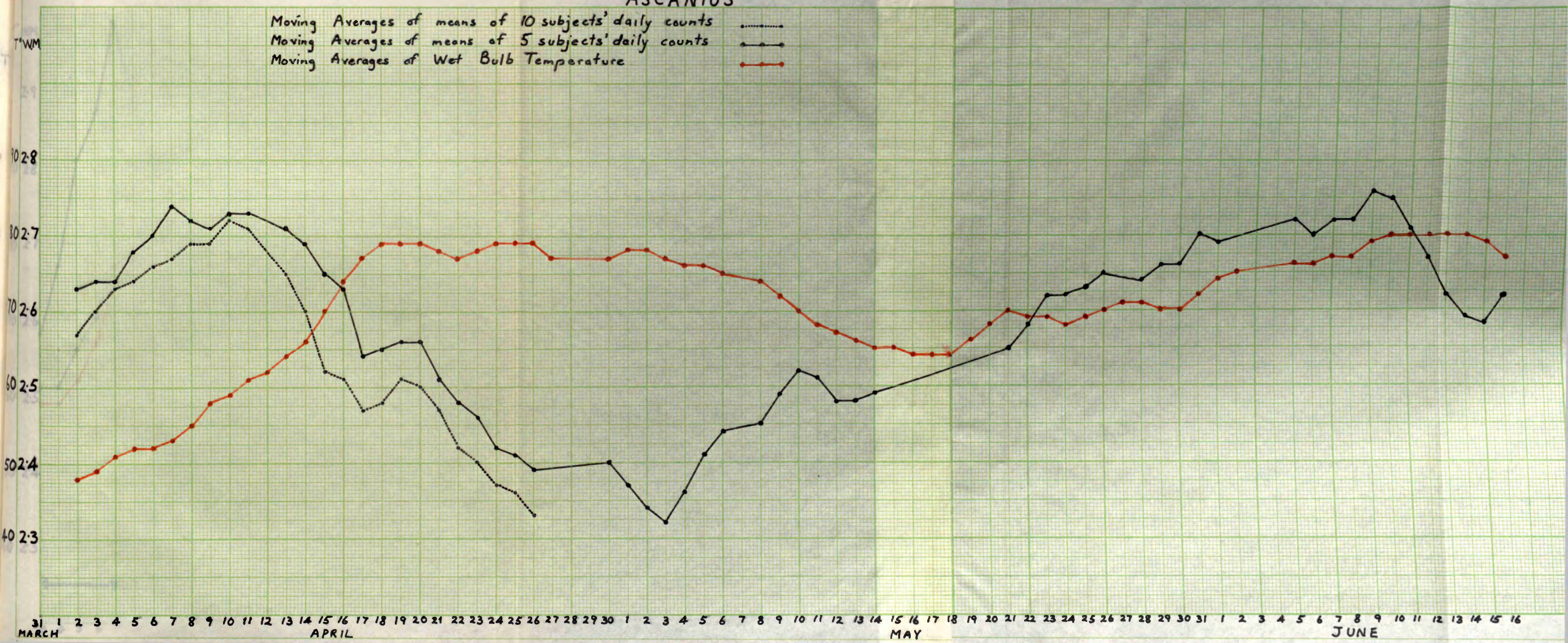


FIGURE 6 Polynuclear Counts and External Temperature Voyage III

"CHESHIRE" A

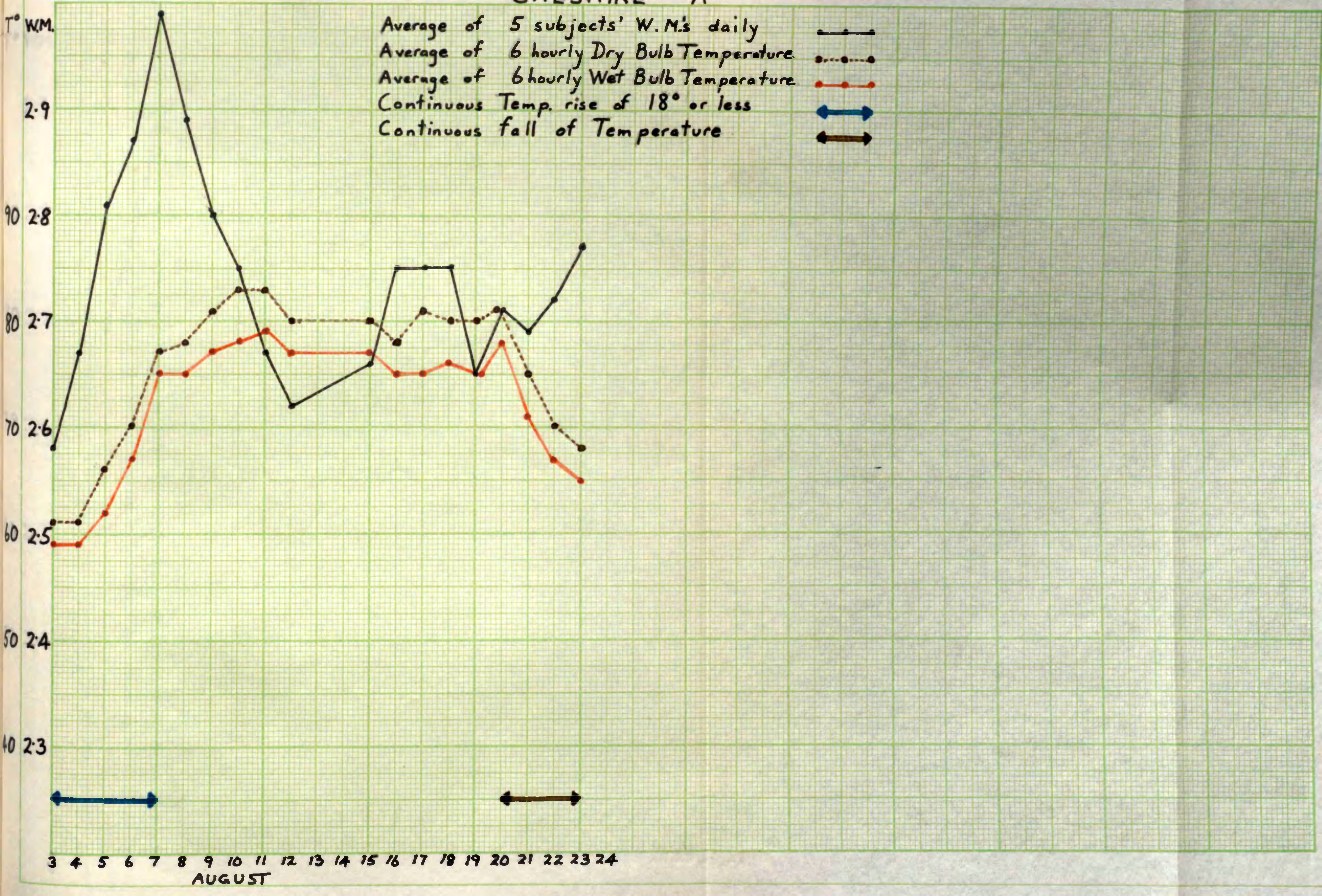


FIGURE 7 Polynuclear Counts and External Temperature Voyage III
"CHESHIRE" A

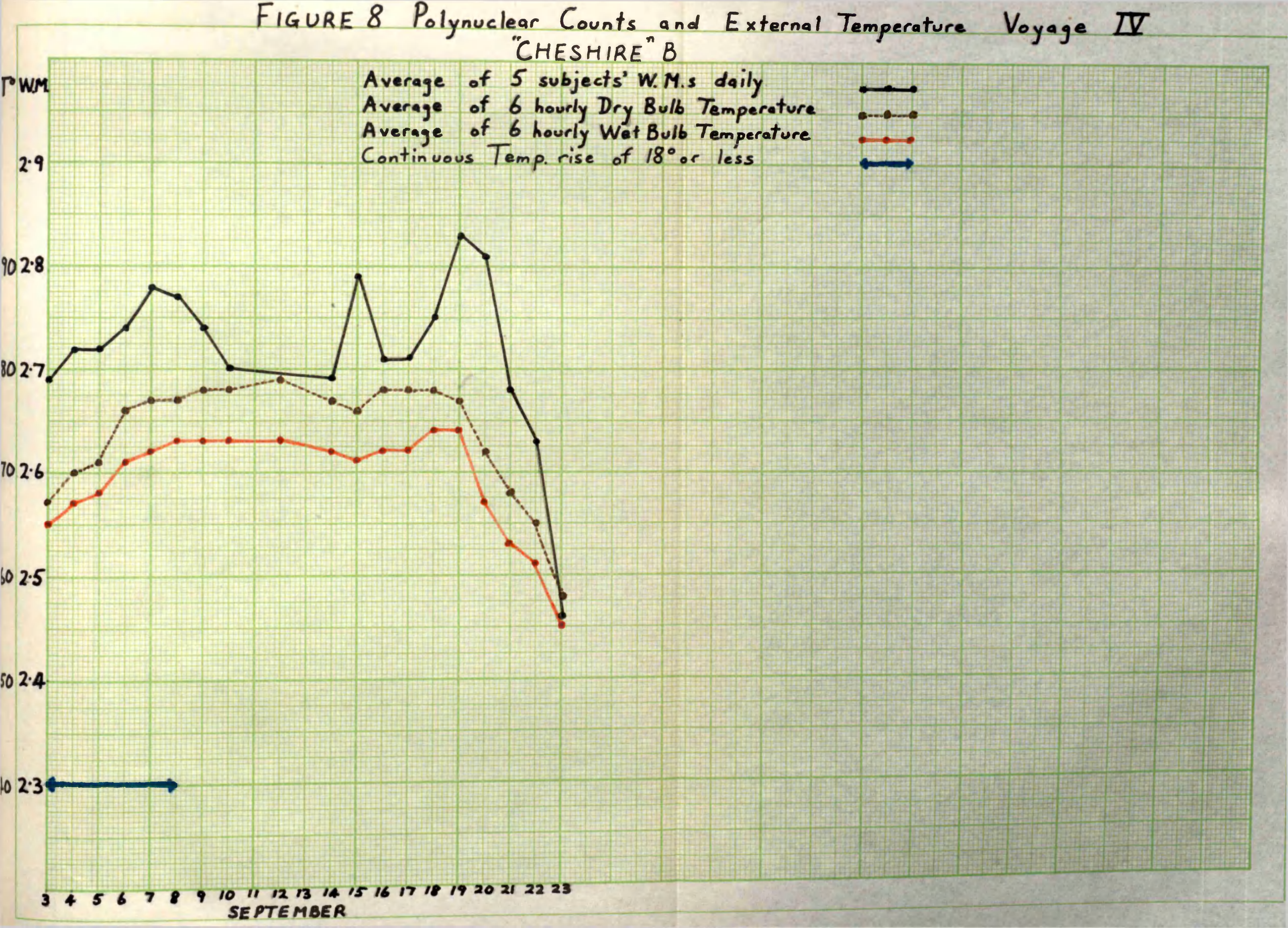


FIGURE 8 Polynuclear Counts and External Temperature Voyage IV
"CHESHIRE" B
Average of 5 subjects' W.M.s daily
Average of 6 hourly Dry Bulb Temperature
Average of 6 hourly Wet Bulb Temperature
Continuous Temp. rise of 18° or less
T° W.M.
2·9
90 2·8
80 2·7
70 2·6
60 2·5
50 2·4
40 2·3
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
SEPTEMBER

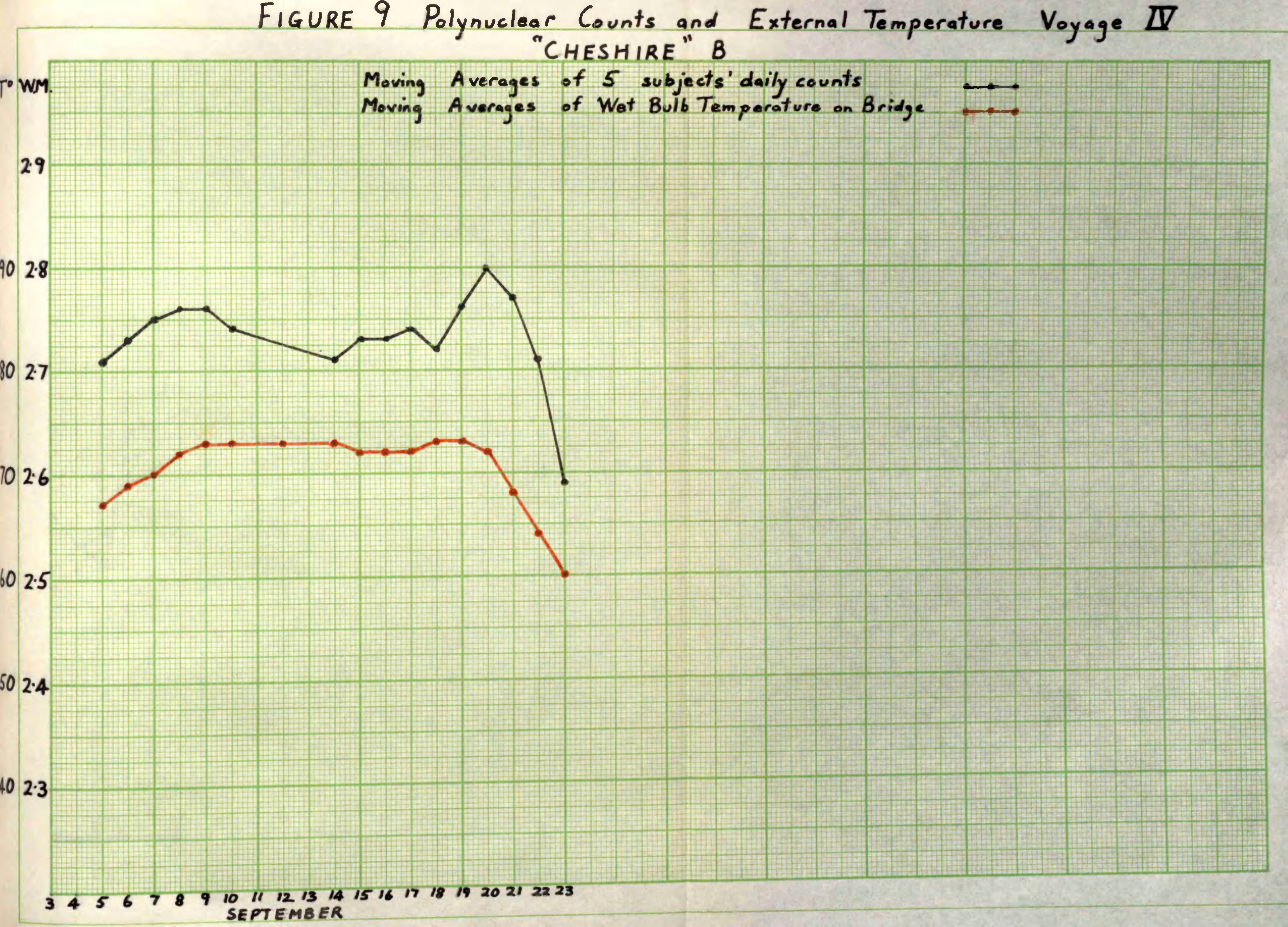
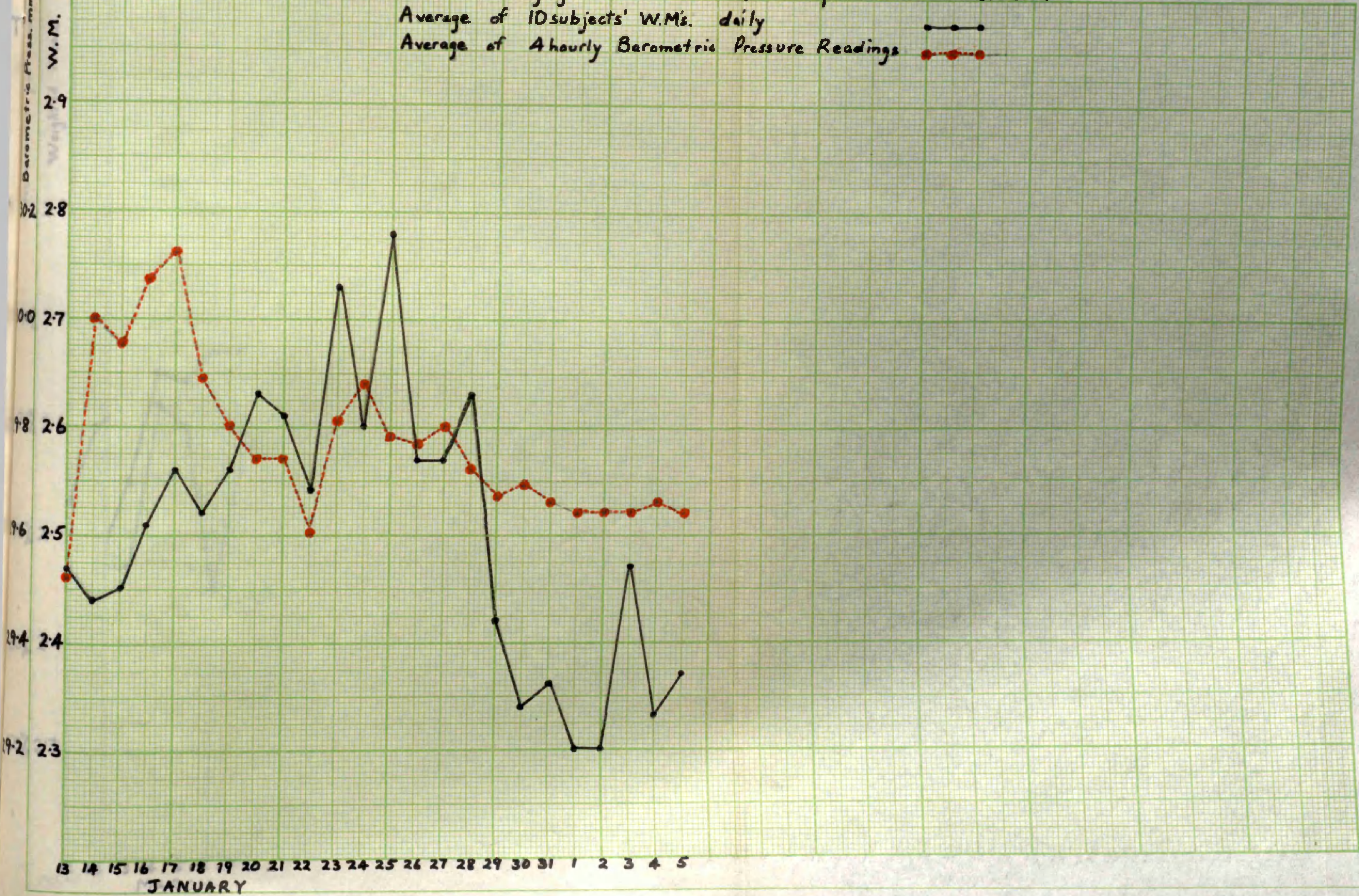


FIGURE 9 Polynuclear Counts and External Temperature Voyage IV
"CHESHIRE" B
Moving Averages of 5 subjects' daily counts
Moving Averages of Wet Bulb Temperature on Bridge
T° WM.
2·9
90 2·8
80 2·7
70 2·6
60 2·5
50 2·4
40 2·3
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
SEPTEMBER

FIGURE 10 Polynuclear Counts and External Temperature Voyage V
"CHESHIRE" C

FIGURE 11 Polynuclear Counts and External Temperature Voyage V
"CHESHIRE" C

FIGURE 12 Polynuclear Counts and Barometric Pressure Readings.
Voyage I (First half) "Empress of Australia"



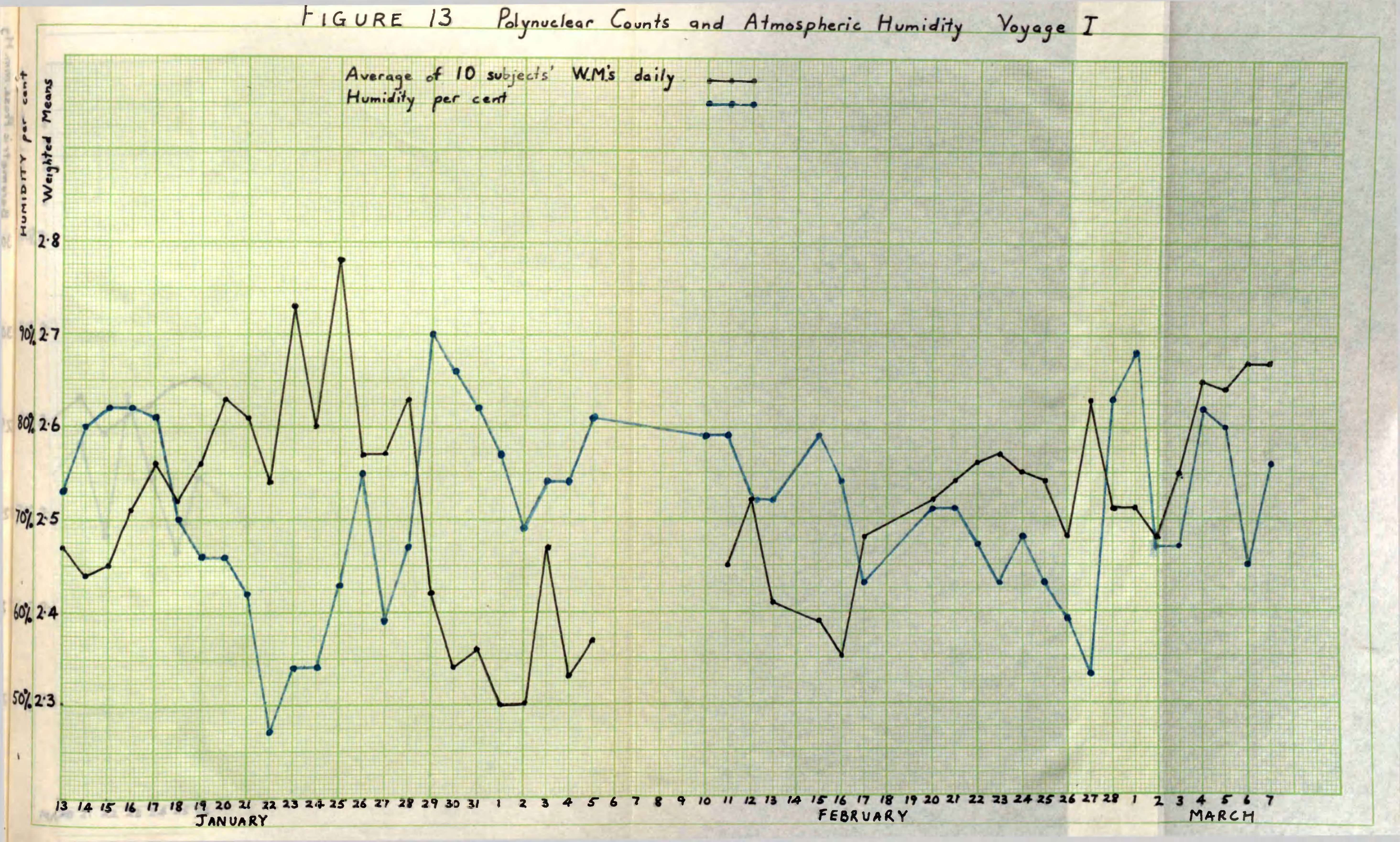


FIGURE 13 Polynuclear Counts and Atmospheric Humidity Voyage I
Average of 10 subjects' W.M.'s daily
Humidity per cent
HUMIDITY per cent
Weighted Means
2·8
90% 2·7
80% 2·6
70% 2·5
60% 2·4
50% 2·3
13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 1 2 3 4 5 6 7
JANUARY
FEBRUARY
MARCH

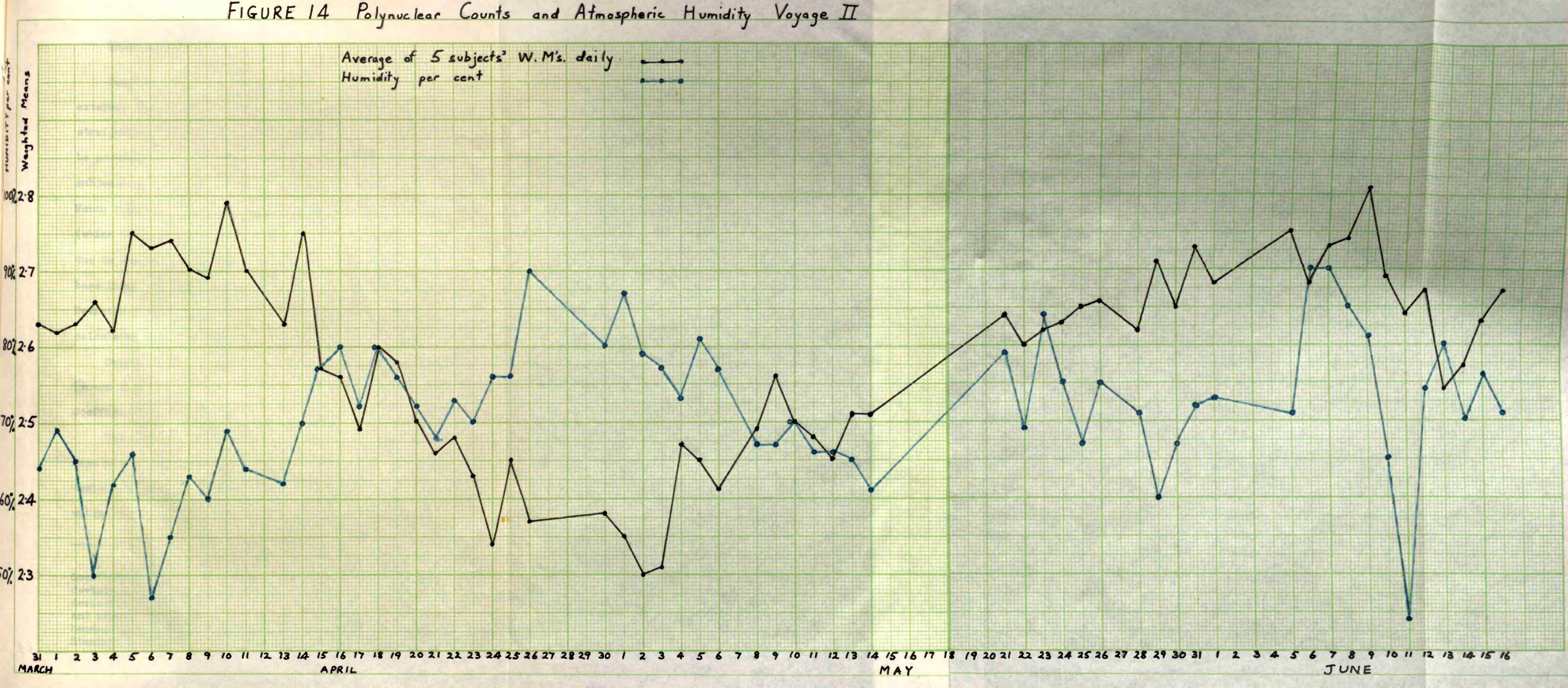


FIGURE 14 Polynuclear Counts and Atmospheric Humidity Voyage II
Average of 5 subjects' W. M's. daily
Humidity per cent
HUMIDITY per cent
Weighted Means
100% 2·8
90% 2·7
80% 2·6
70% 2·5
60% 2·4
50% 2·3
MARCH
APRIL
MAY
JUNE

APPENDIX C

Notes on the Calculation of the Coefficients of Correlation.

Despite the apparently consistent relationship between external temperature and the Polynuclear Count, calculation of straightforward Correlation Coefficients did not seem likely to be productive. In an ordinary scatter diagram in which the subjects are considered separately the deviations of the Weighted Means from the mean are partly due to variations from day to day (which it is desired to correlate with temperature) and partly due to the fact that the subjects themselves each have a different base line. The result is an artificial increase in the Standard Deviation; and hence as the Coefficient of Correlation is calculated from the formula:-

$$\text{Coeff. of Correlation} = r = \frac{\text{mean } xy - \text{mean } x \times \text{mean } y}{\sigma x \times \sigma y}$$

(where σ = the Standard Deviation) a corresponding decrease in the Coefficient results.[1]

This difficulty was overcome by using the average Weighted Mean of the four or five subjects on each day, so that the deviations from the mean are entirely the day to day variations which it is desired to correlate with the temperature.

---

1. At first sight the numerator of the formula for the Coefficient of Correlation is also affected by the artificial deviations; in fact this is not so because the superimposed deviations cancel each other out, because some are positive and others, negative. They do not cancel out in the denominator because they are squared before addition, in the calculation of the Standard Deviations.

All the Coefficients of Correlation between the Polynuclear Count and external temperature are calculated in this way (including the Glasgow observations) and are therefore comparable.

As the results of the straightforward calculation of the Coefficients of Correlation were significant in the other cases, it was considered unnecessary to introduce the above refinement. An ordinary scatter diagram was used, in which the subjects were considered separately, and the Coefficient of Correlation was calculated from the usual formula $r = \frac{\text{mean } xy - \text{mean } x \times \text{mean } y}{\sigma y \times \sigma y}$

The Coefficients of Correlation between the Polynuclear Count and rise of temperature, absolute number of neutrophils and total white cells were calculated in this fashion.

The Standard Errors of the Correlation Coefficients were calculated throughout from the formula:-

Standard Error $= \frac{1 - r^2}{\sqrt{n}}$ where n = the total number of observations, and r = the Coefficient of Correlation.

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