of the fingers, wrists, toes, ankles, and heels. They may break down and ulcerate, discharging a white chalky material which can be identified by the recognition of the typical needle-like crystals of monosodium biurate under the microscope.

Tophi can also be identified chemically by the murexide test, which is carried out as follows. Heat the removed contents of the tophus with five drops of dilute nitric acid until evaporation is complete; a reddish residue remains (alloxan); add a few drops of ammonia solution to the residue when cool; the result is a purplish red colour owing to the formation of ammonium murexide.

Other Tests

The sedimentation rate is raised during an attack of gout, but as this rate is raised in so many conditions it is of no particular help in diagnosis. There is a moderate leucocytosis during an attack, and unless this is recognized it may raise difficulties when a septic condition of the joint is suspected. Liver-function tests in gout have not shown any constant impairment and are of no value in diagnosis.

In conclusion, the history and clinical findings form the basis for a diagnosis of gout and are more important than any laboratory investigations. A raised level of uric acid in the blood or serum will support a diagnosis, but a normal result does not necessarily exclude it. The severity of an attack can be better judged by the physical appearance and the degree of pain than by chemical data.

Next article on Clinical Pathology.—"Blood Grouping," by Dr. A. E. Mourant.

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PHYSIOLOGICAL CHANGES IN BLOOD IN THE ANTARCTIC A PRELIMINARY REPORT

BY

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During the Norwegian-British-Swedish Expedition to the Antarctic in 1949-52 I spent two years in Queen Maud Land as medical officer of the wintering party. While there I made continuous physiological investigations on the expedition members, who numbered 15 men the first year and 14 the second. My investigations included basal metabolic rates and blood tests, the intention being to register the changes that occurred during acclimatization to the Antarctic climate and then back to temperate conditions. The blood tests were begun at home, and, with minor interruptions, were conducted monthly throughout the two-year stay, even on long sledge trips into the interior during several months of field work, and during the sea voyage south and back again.

Difficulties

I soon realized that the planning of physiological research on a polar expedition to an unknown country with an adverse climate is one thing, and the carrying out of it under extreme and unexpected conditions is quite another.

Cramped quarters, limited resources, primitive working conditions, the small restricted number of test subjects, and, above all, the human factor in these persons made large-scale investigations impossible, especially as all the other scientific programmes had priority when time and assistance mattered. Because of the extreme and primitive experimental environments even normally simple tests became time-consuming. During tests solutions and pipettes had to be kept at temperatures quite different from that of the surrounding air, which was often near freezing-point.

Owing to the fact that all scientists on the expedition had to do their part as handymen during the building of the base and afterwards, the tests planned could be done only when time permitted. Those that were thought most important were started first. This procedure was also of psychological importance, as the impact of all the blood tests begun at once would certainly have been to dismay some of the members and make them hesitate in giving "such quantities" of blood. In the way it happened they were coaxed into one series of tests after another with suitable intervals, and in the end they were all willing, though grumbling, guinea-pigs.

During sledging trips, to carry out only red-cell and white-cell counts, blood smears, and blood-sugar estimations on four persons usually took 10 to 12 hours. Consequently such tests had to be made when weather prevented sledging and outdoor work, which of course increased difficulties still more. The morning air temperatures in the tent varied from -5° to -30° C. (20° to -20° F.) before heating with the primus stove; this necessitated the thawing of frozen solutions, and in addition there was constant condensation in glass tubes and pipettes. The struggle to get from one tent to the other in drifting snow and subfreezing temperatures with half-full test-tubes to take blood samples in the early morning from shivering comrades who had just got out of their sleeping-bags in a cramped and poorly lighted tent is fun to tell about—afterwards!

Scope of the Tests

The blood investigations included: red-cell count, haemoglobin content, adrenaline in blood, blood sugar (fasting), white-cell count (morning and afternoon values), and white-cell differential count. The tests were made monthly, sometimes oftener, with three interruptions: (1) during landing operations and the month during which the base was established no tests could be done; (2) during the first summer's field work all tests at base were discontinued, as I went sledging inland for four months; however, while sledging I continued making regular blood tests on a small field group; and (3) during the second summer's field work tests were similarly discontinued for one month.

To avoid the influence of the prevailing extreme working conditions much trouble was taken to standardize the tests in every detail. As the same person did the tests all the time, the personal bias in colorimetric readings and laboratory operations can be disregarded. The morning tests were taken between 7.30 and 10 o'clock, and the afternoon tests between 4 and 6 o'clock. To avoid the influence of the daily variations in blood cells the tests on each particular individual were taken approximately the same hour every time, the procedure being made easier by the divergent times of getting up in the morning owing to the different personal jobs.

Samples were always taken from the ear-lobes, alternating between left and right, because wounds in finger-tips healed slowly and became painful. It was also more difficult to get blood from the finger-tips, which more often were cold and ischaemic because of the climate. For psychological reasons I did not take the blood samples on myself, but let them be done by any of my comrades who liked to try their skill. In this way some of them took a "cruel revenge" on their torturer, often inspired by the spectators' delighted remarks. Most of my comrades attained considerable skill in blood-letting during those two years.

Red-cell Count

The counts were made according to Ellerman's method. The number of red cells remained unchanged throughout the two and a half years. Only during summer field work inland in high altitudes did red cells react with a normal physiological increase, which showed that the method used was reliable. The men at the base at sea-level did not, of course, show this increase during summer.

Isachsen (1911) demonstrated in Norway a seasonal change in red cells with a maximum in the summer and a minimum in the winter. No such seasonal change was found by me in the Antarctic. The irregular red-cell changes shown by Frazier (1945), during Byrd's Antarctic Expedition, 1939-41, do not contradict my findings, as there is reason to believe that the red-cell variations shown in his curve are within the limits of experimental error.

Haemoglobin Content

Determination was made with a Zeiss haematometer. In spite of the red cells remaining unchanged in number, the Hb curve showed characteristic seasonal fluctuations. During both polar winters the Hb stayed at a high level, but when spring set in (September-October) the curve of both years declined steeply owing to increased outdoor activity. With greater muscular strain the Hb was used to form myohaemoglobin as musculation increased. This was also illustrated by the weight curve. Fat was first lost when outdoor activity started; the weight then went up as muscles increased during summer, and more fat was added during the second polar winter. Thus both Hb and weight curves became indicators of outdoor temperatures. This drop in Hb in the second spring could not be prevented by continuous prophylactic administration of iron, but it seems that Hb regeneration was accomplished quicker and to a higher degree because of this medication.

Finsen (1894), Isachsen (1911), and Odin (1937) have demonstrated a seasonal fluctuation of Hb with a minimum in the winter (December-January) and a maximum in the summer (June-August). The rise in Hb is regarded as being due to the influence of ultra-violet rays on the formation of Hb (Odin) as well as to the diet. The seasonal variations were found to be greater in North Sweden (Luleå) than in the south (Lund), attributed to the long winter nights in the north. Grimsgaard (1910), in northern Norway, showed

a decrease in Hb during the dark winter months. Contrary to this, Høygaard (1937, 1940) found the average winter values (December-April) of primitive-living Eskimos in Greenland to be higher than the summer values (June-July), although these were taken when summer food conditions were extraordinarily good. The winter values (men) were 4.5% above those of the summer. In accordance with this, Gyllencreuz (1884), of the Swedish Spitzbergen Expedition, 1882-3, found no decrease of Hb during winter (September-February); and Ekelöf (1904) of the Swedish Antarctic Expedition, 1901-4, found an increase of Hb during the second winter. MacLean (1919), of Mawson's Antarctic Expedition, 1911-14, showed a rise in Hb during midwinter and reported that several Arctic expeditions had found no diminution in Hb during the dark months. Howe, in Alaska (Mikkelsen, 1910), and Koettlitz (Scott, 1905), of Scott's Expedition, 1901-4, had reported similar observations.

My investigations show the same increase in winter values, with a marked drop on the arrival of spring, in spite of the increased influence of exceptionally strong ultra-violet light. The diet can be regarded as unchanged, but with additional fresh seal meat and liver in the spring. Thus it seems that the seasonal decrease in Hb during winter found by Scandinavian workers has no correspondence in polar regions. On the contrary, winter values are high, with a marked decrease towards summer.

Adrenaline in Blood

It has been stated by many that the blood adrenaline increases in the polar climate. The raised blood-sugar level should indicate this. Frazier noted an increased liability to adrenaline shock following injections of local anaesthetics with small amounts of adrenaline. He claims this to be due to an increased amount of adrenaline in the blood stream. Butson (1949) investigated this possibility by injecting 1 ml. of 1/150,000 adrenaline intravenously over a period of 90 seconds. A slight increase in sensitivity was noted.

To investigate this further, attempts were made to determine the blood adrenaline by fluorescence according to Pekkarinen's (1948) absorption method. Less than 0.5 mg. of adrenaline per 100 ml. cannot be demonstrated in blood with this method. Tests were done during several periods of our stay: when arriving in Antarctic climate; after mid-

Blood-sugar and white-cell curves showing changes due to acclimatization. The blood-sugar and morning white-cell curves are smoothed by applying the formula $\frac{a+2b+c}{4}$ (from April, 1950, to January, 1952). A=Inverted temperature. B=Fasting blood sugar. C=Afternoon white-cell count. D=Morning white-cell count.

winter, when blood sugar was at its peak ; and just before leaving. No measurable amount of adrenaline in the blood could be shown.

Blood Sugar

Fasting blood sugar in the morning was determined according to the Crecelius-Seifert method. As a result of acclimatization the fasting blood-sugar level was increased on an average 9% compared with home values, with incidental peaks averaging 17% increase. This confirms the usual assumption that fasting blood sugar is increased in Antarctic climate.

Frazier (1945) reports that Lockhart, of the U.S. Antarctic Service, 1939-41, found a blood-sugar increase above normal in 13% of the group tested. Butson (1949), of the Falkland Islands Dependencies Survey, found an average increase of 10 mg. per 100 ml. in fasting blood sugar in his subjects (Hagedorn-Jensen method). Heinbecker (1928), by means of the Shaffer-Hartmann method, found the average fasting blood sugar of Eskimos to be 120 mg. per 100 ml. Rabinowitch and Smith (1936) found 137 mg. per 100 ml. by means of the picric-acid method, which is considered to give values 10 to 15% higher than the Shaffer-Hartmann method. They therefore came to the conclusion that Eskimos have a higher fasting blood-sugar level than people living elsewhere. This was not confirmed by Høygaard (1937, 1940), who found an average fasting blood sugar of 88 mg. per 100 ml. (Hagedorn-Jensen) in Greenland Eskimos.

The most interesting result of my blood-sugar investigations, however, is the demonstration of a characteristic curve during adaptation to a different climate. The peculiar feature of this curve is the first great dip in the blood-sugar level (see Chart—compare with the morning white-cell curve). This dip seems to be characteristic for acclimatization. An obvious tendency towards a similar dip is found in the last part of the curve during reacclimatization to temperate conditions. This second dip is well developed in the morning white-cell curve, but would probably have shown equally well in the blood-sugar curve had not tests been discontinued on arriving home, as blood-sugar changes seem to lag one to two months behind white-cell changes. Later tests at home showed that blood-sugar values have returned to normal—the same as before leaving for the Antarctic—thus marking the completion of the second “dip of acclimatization.” To illustrate this the assumed continuation of the blood-sugar curve has been drawn (dotted line in Chart).

White-cell Count

The counts were made according to Ellerman's method. Blood was taken while fasting, in the morning, as well as later in the afternoon. The morning white-cell curve shows the same characteristic “dip of acclimatization” as the blood-sugar curve (see Chart). In the first part of Frazier's white-cell curve the corresponding “dip of acclimatization” can be seen. He attributes this to the isolation of the group and the absence of infections and colds. However, the rest of his curve showed a marked difference from mine, because his values were not fasting morning values, but were made from blood taken two hours after meals, and therefore were influenced by activity and prevailing weather. Temperatures at the American base were also quite different from those at ours. A similar but less accentuated “dip of acclimatization” can also be seen in the white-cell counts done by MacLean (1919), of Mawson's Antarctic Expedition.

After acclimatization, morning white-cell values stayed at an even level 25% below normal with only slight variations. There were no pronounced tendencies towards seasonal changes. Ekelöf (1904) found a marked decrease in the number of white cells during a stay in the Antarctic. Isachsen (1911) showed that no seasonal fluctuations are normally found in white-cell counts.

After our return from the Antarctic the values were still 25% below normal (after the reacclimatization dip), prob-

ably owing to the long period with absence of infections. These low values may explain the wide susceptibility to all kinds of infection which most members showed for a long time after coming home. It is curious that the values have remained low also after the men had had a series of infections.

Afternoon white-cell values followed the same trend as the morning values, but were obviously more influenced by the incidental fluctuations of climate and activity at the time of the tests. Thus the morning values were more stable and showed the general trend, while afternoon values were more sensitive indicators of temporary conditions. In fact, if afternoon values are divided by morning values and the

curve is smoothed by applying the formula $\frac{a + 2b + c}{4}$ the curve (after acclimatization) almost accurately, but with a slight drag, follows the inverted temperature curve, and thus reflects the influence of weather (temperature) and the correspondingly varying strain (activity). After we returned from the Antarctic the afternoon values did not remain at the correspondingly low level, as the morning values did, but increased somewhat.

By making a two-way breakdown of the white-cell values, the reliability of the method used with such a small number of subjects can be demonstrated. An arbitrary but convenient division is into *smokers* (8) and *non-smokers* (7). This breakdown is interesting, because the smokers seem to represent the high white-cell values, while non-smokers have constantly low values. The morning white-cell curve for smokers (high values), as well as the curve for non-smokers (low values), follows the “normal mean curve” (total values) amazingly well, which goes to show that even with only half the number of test subjects a characteristic and applicable curve could have been obtained. The same applies to the afternoon values. Another interesting fact is that at home the mean morning values for smokers and non-smokers were about the same. When landing in the Antarctic both groups still differed very little, but from then on there was an appreciable difference. The white cells of the smokers seemed to react considerably more to acclimatization and showed a more accentuated “curve of acclimatization.” Perhaps smoking makes white-cell values less stable and more liable to react to other stimuli, as the uneven swinging individual curves of the “great smokers” tend to show.

Differential Count.—Blood smears were mostly taken each time white-cell counts were made. The results of these differential counts have not yet been worked out, but there is reason to believe that the counts will show a decrease in eosinophil cells. Stein *et al.* (1949) report that the eosinophil count is significantly depressed on exposure to cold. This was not confirmed by Sapin-Jaloustre, of the French Adelie Land Expedition, 1949-51 (verbal communication, 1945).

Other Tests

Additional blood tests (mainly blood-sugar levels and white-cell counts) were taken on individual members each time they had been away from base any number of days, and therefore had been more exposed to the cold. During the first half-year these tests almost invariably showed a temporary increase in the blood-sugar levels and white-cell counts. In exposing fasting men to cold in a refrigerator Swift (1932) determined the blood sugar just before and immediately after exposure. The blood-sugar level remained unchanged. When exposing cold-adapted men to low temperatures for brief periods of time, Miller and Miller (1948) could not find any significant variation in blood-sugar levels and white-cell counts.

The basal metabolic rates taken in conjunction with the blood tests have not yet been worked out.

I should like to add that after two and a half years of almost continuous blood-letting under trying conditions my comrades are worth all the appreciation that can be given to them.

Summary

Continuous monthly blood tests were made on 15 (14) members of the N.-B.-S. Expedition to the Antarctic, 1949-52, during the two-year stay and the trip there and back.

Red-cell counts showed no changes or seasonal fluctuations. Haemoglobin values showed a typical seasonal fluctuation as a function of outdoor activity, not related to the usual summer maximum and winter minimum shown in Scandinavia. No measurable increase of adrenaline in the blood was found. During acclimatization to Antarctic climate and back again to normal climate fasting blood-sugar values as well as morning white-cell counts showed a characteristic dip of acclimatization in their curves. After acclimatization the fasting blood sugar showed an increased level of 9%, while morning white-cell counts stayed 25% below normal. Morning white-cell values were more stable and showed the general trend of acclimatization, while afternoon values were more sensitive indicators of temporary conditions. The white cells of smokers seemed to be more sensitive to reactions in the Antarctic and stayed at a considerably higher level.

I would welcome any criticism or helpful information about the problems mentioned here.

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* In the Scandinavian languages.

Reports of Societies

PSYCHOTHERAPY IN PRISONS

At a meeting of the Section of Psychiatry of the Royal Society of Medicine on December 8, with Dr. E. B. Strauss, president of the Section, in the chair, the subject of discussion was "Psychotherapy in Prisons and Corrective Institutions."

Group Treatment

Dr. J. C. MACKWOOD, for many years psychotherapist to H.M. Prison, Wormwood Scrubs, said that in 1946 a ward for psychotherapy was set apart in the prison hospital grounds. Here the selected prisoners were given the status of sick persons. The ward enabled group treatment to be undertaken, it constituted a kind of family setting, and it sheltered the prisoner from the additional punishments which he might be liable to incur when housed amongst those not getting this treatment. This social group was a potent stimulus for starting respect for the majority verdict. All kinds of offenders responded to this approach and became readjusted, including those with associated psychopathological (functional) disturbances that required analytical psychotherapy which could be provided within this group framework. When the offenders were first seen in prison it was not always easy to determine the cases which

would not respond to treatment, and the acceptance or rejection of a particular individual by the group was often a very useful guide.

Several ex-prisoners had written of the struggle within themselves they had encountered after discharge; a well-organized psychiatric social service for helping the prisoners after leaving prison was essential. In the final analysis this was more a sociological problem than an individual one.

Dr. W. F. ROPER, principal medical officer, Wakefield Prison, said that institutional life was often considered a barrier to successful psychotherapy, but it could be made of assistance. For many years there had been a movement towards enlightened man-management, the object being to liberalize the regime to the greatest extent possible. This was predominantly a lay achievement, but it had provided a background against which useful psychological work had been done. In 1947 a psychiatric unit was set up at Wakefield. At the moment there were two full-time visiting psychiatrists, a psychologist, and a psychiatric social worker. Prisoners were subject to a periodical review by the whole-time medical officers, and, when considered desirable, were referred to the psychotherapist for treatment. The prisoner was given an opportunity to work out new and more successful attitudes in his personal relationships.

The difficulties attending psychotherapy in prison were those of selection and timing, those associated with after-care, with relatives and the domestic environment, with occupation, and with the attitude of the group. Aftercare was a great problem, not made easier by the fact that in many cases the prisoner wanted, after his discharge, to have no reminder of his prison experience. The psychiatric social worker could do something to mitigate the difficulties following discharge. Relatives might be a great help or a great hindrance. They could help if they remained loyal or reverted to loyalty, and a great hindrance if they fostered ideas of innocence and injustice. Group treatment had worked very well in the hands of medical officers. It was no hardship to work with and through the existing prison staff, who were good colleagues, but the psychiatrist must "fit in." The results of psychological treatment at Wakefield were difficult to assess, but not unpromising.

Approved Schools

Dr. CHRISTOPHER LACK, visiting psychiatrist to the Magdalen Hospital Classifying School, introduced the subject of psychotherapy in approved schools. Girls, committed by a juvenile court in the southern half of England and who were between the ages of 14 and 17 years, were admitted to the classifying school for observation and investigation, before being sent on to the training school best suited to their needs. In selecting girls for psychotherapy, it was important to bear in mind not only their need for treatment but whether they were capable of adjusting to the life of a small community in an open school. A few approved-school girls were so violent as to disrupt the community in which they lived. Special provision was needed for the management and treatment of the aggressive, unstable adolescent, some of whom were psychopaths.

A greater number of girls would be amenable to training and to psychotherapy if they were committed earlier. The approved school should not be used as a last resort. Many of the girls had a history of disturbed behaviour and emotional difficulties dating back over several years, and the problem was intensified if they were not committed until the approach of their 17th birthday. Only a small percentage of girls were recommended for psychotherapy. The latter was only one weapon in the war against juvenile delinquency. Nowhere in the field of psychiatric endeavour was it more necessary to be modest in their claims than when they intruded upon the domains of the Law.

Discussion

Dr. PETER SCOTT, physician at the Maudsley Hospital, spoke of the value of the visiting psychiatrist who was able to link the prison with the mental health service. He mentioned the similarities between offenders referred