is well lighted by one twenty-light electrolier in the centre, and two ten-light electroliers, one on each side.

In the engine room there is a complete set of measuring instruments, by which the engineer in charge may know how many lamps are lighted, and when to stop or start the second engine.

Sunstroke and Insanity. By THEO. B. HYSLOP, M.D.

The relationship of sunstroke and insanity has received only a comparatively small amount of attention at the hands of medico-psychologists in this and other countries, and our knowledge of the mental defects and aberrations of intellect, met with as sequelæ of an attack of sunstroke, is as yet ill-defined and unsystematized.

Authors resident in hot climates have concerned themselves largely with the study of the effects of a continued high degree of temperature upon the vital processes of man, and we are mostly indebted to them for our knowledge of acute sequelæ, such as ardent fever with acute delirium, remittent and intermittent fevers complicated with dysenteries, hepatic inflammations, congestions, etc.

All observers have experienced the same difficulty in estimating the exact effects of the solar rays, and this difficulty has arisen not only from the absence of a sufficient number of experiments, but by the common presence of other conditions, such as hot, rarefied, and, perhaps, impure air, heat of the body produced by exercise which is not attended by perspiration, and other conditions too numerous to mention.

It would be out of place here to dwell upon the varieties of sunstroke, which have been graphically described by Sir Joseph Fayrer, Duncan, Moore, and others, so for the present I propose to accept the convenient classification of Morache, who divides the forms of sunstroke into two classes, viz.:

(1) Coup de Soleil—due to direct heat of the sun.
(2) Coup de Chaleur—indirectly due to heat and other influences.

Some writers uphold the view that the direct influence of the sun has probably little or nothing to do with the hyperæmia discovered after death, which they consider to be venous in character, and a secondary phenomenon immediately dependent upon a diminished power of activity of

the heart. If this view be correct, the substitution of the term "heat stroke" for the generic term "sunstroke" would be advantageous, and would convey a more accurate notion as to the actual condition.

On the other hand, the assumption that the direct impingement of the sun's rays upon the head may be attended with an active congestion may possibly be true in some cases, but I do not think this is by any means proved apart from the presence of other important factors.

Dr. Handfield Jones, writing upon Functional Nervous Disorders, remarks that "any man of experience in the manifold disorders of jaded and exhausted nervous systems will recognize at once how close is the resemblance between the results of tropical heat and those produced by the ordinary causes in operation among the struggling multitude in our large towns," and it is with the factors which aid in producing such exhaustion of the nervous system that I have chiefly now to deal.

The relative values of the atmospheric influences, such as heat, humidity, winds, etc., as causes are interesting, but the bodily causes, such as fatigue, bodily habits, excesses—either alcoholic, dietetic, or sexual—and syphilis are the most important, and have an influence specially upon the general vigour of the constitution; and, in rendering a person more or less susceptible to heat, so far predispose him to suffer from it.

Solar heat as an immediate or exciting cause is said to act in two ways, causing (1) prostration of the nervous powers and syncope, with symptoms of debility, vertigo, weariness, nausea, and incontinence of urine; or (2) venalization of blood, with absence of perspiration, suppression of urine, and constipation. This latter state, however, is chiefly aided by fatigue, impure air, alcohol, disorders of viscera, and retained secretions; and, further, although the heat of the sun may possibly affect the vaso-motor centre in the medulla oblongata, especially by striking on the unguarded occiput and neck, yet the same symptoms arise when there is no direct influence of the sun upon the person attacked.

The recognition of this fact is important to us, as formerly many cases were not returned in India, but were overlooked owing to the fact that only those cases occurring after direct exposure to the sun were recorded; and, moreover, when we investigate the previous histories of our cases of insanity this source of error is always open to us.

Undoubtedly hot climates eventually sap the foundations of life amongst Europeans, and although the hypothesis of acclimatization, *i.e.*, "that an injurious effect is first produced and then accommodation of the body to the new condition within a limited time," is to a certain extent true, yet the rule does not extend in its application from the individual to the progeny.

It appears that acclimatization of Europeans in India depends largely upon intermixing by marriage with the natives, otherwise they are apt to degenerate into strumous or nervous types, and fail to reach beyond the third or fourth generation.

The effects of a tropical climate are, so to speak, relative; and beyond the influences of fatigue, over-exertion, overcrowding, bad ventilation, unsuitable dress, retained excretions, defective secretions, unsuitable diets, etc., we have to consider malaria, syphilis, and alcohol, all of which tend to debilitate or contaminate the system, and predispose the individual to the occurrence of sunstroke. From literature, and a limited experience gained by an analysis of 55 cases of insanity following sunstroke, I have been led to the belief that India is, perhaps, the country most productive of that affection amongst Europeans, for no less than 23 of the cases were said to have occurred there. In eight cases there was a history of malaria, and in five of syphilis, whilst any tendency to alcoholism could only be traced in seven of the 55 cases. What the relationship of malaria and syphilis is to sunstroke I am not prepared to say. Undoubtedly syphilis (as first pointed out by Mr. Hutchinson) precedes attacks of sunstroke. Possibly the special and primary syphilitic brain lesions affecting the meninges or vessels, or encephalic nervous substance, may predispose to heat-stroke by weakening the resistive power of the organism and brain, particularly to the effects of heat; but this is mere supposition on my part, and much information is yet wanted before we can assign to syphilis a definite part in the etiology.

Alcohol especially predisposes to the indirect form of heat-stroke, and, as before stated, is a powerfully co-operating aid to the external and bodily causes, but possibly some observers tend to give this agent too great a prominence as a factor.

With these brief general considerations as to the etiology, I will now pass on to what is to us the more important part

of the subject. The most abiding results of sunstroke are all referable to impaired functional energy of the cerebro-spinal system, and this impairment shows itself either in motor paralysis, sensory paralysis of common or special sensation, hyper- and dysæsthesiæ of the nerves of common and special sensation, in debility, and undue excitability of the emotional centres, and in similar states of the cerebral hemispheres and spinal cord; or more commonly in some nervous defect or perversion consisting in a functional paralysis of one or more of the great nerve centres. In addition to these, the extreme sensitiveness of a patient to the rays of the sun, or to excessive heat ever afterwards, and the effect exercised upon them by alcohol all point, according to Sir Joseph Fayrer, to an unstable condition of the great vaso-motor centre in the medulla oblongata.

The same author states that undoubtedly an attack of insolation is often attended with meningitis, or cerebral changes, which may destroy life or intellect sooner or later, or permanently compromise the whole health or that of some important function.

The mental sequelæ are interesting, and of the syncopal, asphyxial, and hyperpyrexial forms of sunstroke, the two latter appear to be the most important and dangerous.

In many cases the sequelæ may be attributed to the injury which the brain has received during the primary attack, and in the case of the syncopal variety, the temporary loss of nutrition of the brain may result in mental or even physical weakness, which may continue through life.

In infancy heatstroke is certainly a cause of accidental idiocy or imbecility. Dr. Langdon Down states that he has seen a notable number of feeble-minded children, who owe their disaster to sunstroke, while making the passage of the Red Sea and Suez Canal *en route* from India; or from exposure in that country, and he attributes the mental decadence as originating without doubt from the actual exposure to heat. Dr. Shuttleworth has kindly allowed me to copy the records of six cases of imbecility following sunstroke admitted to the Royal Albert Asylum at Lancaster. The parents of idiots and imbeciles are extremely ready to attribute the mental affections of their children to accidental causes; but in these cases the non-existence of hereditary neuroses, the absence of fits and other diseases or accidents likely to have been the cause, as well as the nature, extent, and immediate consequence of the attack of sunstroke, aided

me in a great measure in coming to the conclusion that the damage to the mental power was undoubtedly dependent upon sunstroke.

The amount of injury to the mental powers was variable, but all the patients were simple-minded or imbecile, rather than belonging to the lower grades of idiocy.

Sometimes the mental symptoms are found intercurrent with the sopor and coma following the shock, and they may then take the form of delirium or excitement with hallucinations, passing into a condition somewhat similar to that of primary dementia. As a general rule, however, although there may be some trace left of the primary injury to the brain, the progress of the case is more favourable than when the psychosis develops some months, or even years, after the injury. In children, as in adults, the neuroses following sunstroke are somewhat similar to, and have much in common with, the traumatic neuroses. In none of the six cases was there any hereditary, neurotic, or strumous taint, and, moreover, until the period of the actual attacks of sunstroke nothing abnormal or defective had been detected by the parents.

The chief clinical features noted were:—

(1) The ordinary aspect of the child, with absence of bodily deformities.

(2) The full development and comparatively normal dimension of the muscular and osseous systems (including the shape of the head, jaws, and teeth, &c.)

(3) The absence of any physical defects or affections of the nervous system, such as paralysis or chorea.

(4) The good use of all the special organs of sense, and absence of illusions or hallucinations.

(5) The special affections of speech, either of a temporary character immediately following the attack, or as a continued impairment or failure in development of the faculty.

(6) The frequency of the occurrence of fits immediately after the attacks, lasting for a short period but not continued through life.

(7) The limited or perverted moral state as seen in various grades, from mere disobedience to propensities peculiar, dangerous, or even homicidal, and sometimes, though rarely, habits of a degraded nature.

(8) The small mental capacity, with failure to improve much by the ordinary educational methods.

(9) The attachments, antipathies, and peculiarities which were in most cases retained through life; their absolute inability to compete with their fellow beings, and their mental unfitness to aid in their own survival.

EPILEPSY is one of the most common of the sequelæ of sunstroke, and occurs in various degrees of severity, from slight epileptiform convulsions to the severest forms of the disease. Maclean, writing upon diseases of tropical climates, states that immense numbers of soldiers were invalided home from India for this affection following sunstroke, but in a large proportion of cases the attacks disappeared before arrival at Netley, particularly in the long voyage round the Cape of Good Hope.

As a rule the disease appeared to be amenable to treatment. The same author also noted a few examples of chorea-like movements of the muscles of the forearm and hands, probably due to nerve irritation.

Dr. Mickle is inclined to the belief that the apoplectiform seizure or the epileptiform *petit mal* of general paralysis has been mistaken for sunstroke. While acknowledging that such an error may possibly occur, my limited experience has taught me that it is more common for the sequelæ of sunstroke to be mistaken for general paralysis.

The frequent occurrence of epilepsy is suggestive, and as in the cases of the periodical psychoses, the disorder seems to be a manifestation of an unstable vaso-motor state.

Both idiocy and imbecility may be dependent upon early epilepsy, but the absence of spastic contractures, oculo-motor anomalies, deformities and other conditions, together with the absence of progressive mental deterioration associated with the occurrence of the convulsions, is suggestive rather of an acquired psychosis; and further, in cases of epilepsy following upon sunstroke, the mental defect and convulsions appear to be collateral phenomena, both depending upon a common cause, whilst the positive signs of alienism, such as anomalies of character and moral perversions with defective or one-sided development of special faculties, appear to be, in a large measure, different from the progressive deterioration of ordinary idiopathic or hereditary epilepsy.

In adults I have seen the occurrence of episodical attacks somewhat analogous to epilepsy in which there was a periodical attack of depression or excitement, or even conditions closely resembling the epileptiform and apoplectiform attacks of paretic dementia.

Insanity arising from sunstroke is much like that due to traumatism, but as a rule progressive deterioration terminating in dementia is far more common in the latter than in the former. An attack of sunstroke seems to form an acquired predisposition to insanity, and, as in the case of traumatism, the most serious psychoses are developed months or even years after the injury.

Dr. Clouston believes that few Englishmen become insane in hot climates in whom sunstroke is not assigned as the cause, and that that cause gets the credit of far more insanity than it produces. At the Morningside Royal Asylum only 12 cases were admitted in nine years which could be said to have been due to traumatism or sunstroke, being only one-third per cent. of the admissions.

In the case of Bethlem the percentage is much higher, for of 1,947 admissions no less than 49 (or 2·6 per cent.) were attributed to sunstroke. Possibly this high percentage may have been due to the admission of large numbers of officers and others who have seen foreign service.

Dr. Mickle believes that sunstroke is not uncommonly a cause of general paralysis among British soldiers in India, and he quotes the authority of Meyer, Victor, Berstens, and others. On careful analysis of the aforesaid 49 cases, I have only been able to find one case in which general paralysis really existed, whereas the number that simulated that disease was remarkable. The symptoms in fourteen cases consisted in associated mental and physical defects, which rendered the differential diagnosis one of extreme difficulty. The physical symptoms consisted in tongue tremors, thickness or slurring of speech, pupillar anomalies, altered reflexes (chiefly exaggerated), shaky and interrupted handwriting, tottering or weak gait, loss of control over bladder and rectum, hallucinations, or perversion of all or some of the senses (that of smell least commonly), and mental conditions, such as melancholia or hypochondriasis, but more commonly exaltation, extravagance, excitement, or even acute mania. With such a combination of symptoms the diagnosis of general paralysis appeared to be warrantable, but the cases proved deceptive, for after a time the physical signs disappeared, and the patient recovered mentally; or the mental health remained in a weak or permanently impaired condition, as shown by some irrelevancy or inattentiveness; or more commonly by some trace of exaltation or fixed delusions, with a smiling, self-satisfied manner.

Such patients become docile, cheerful, tractable, and industrious, and are perhaps in a condition to resume work, and so they may go on for years, with no motor or special sensory disturbances, and no marked change mentally from year to year.

A very common symptom is cephalalgia, which may occur periodically or persistently, and is probably dependent upon chronic meningitis, with some thickening or opacity of the membranes. Such patients cannot tolerate heat, and a close or heated atmosphere will cause an exacerbation of the sensory symptoms, or even recurrence of the mental disturbance. Alcohol is apt to aggravate the symptoms, and although possibly in some cases it has played a considerable part in the production of the insanity, yet I believe it is far more effective as a cause in cases where the brain has been previously rendered weak by sunstroke, for in many cases the primary affection or attack of sunstroke has not been preceded by alcoholic excesses, and, moreover, has not been followed by any immediate mental or motor defect, but it has formed, nevertheless, a predisposition to the disastrous effects of other exciting causes, such as alcohol.

The symptoms arising from locomotor ataxia, various paralyses (either general or circumscribed), epilepsy, senile dementia, and many other conditions may, in some particulars, render the diagnosis difficult, but the greatest difficulty is experienced with such affections as (1) General paralysis; (2) Syphilitic disease of the brain and membranes; (3) Alcoholic insanity; (4) Dementia, with paralysis from local lesions, or circumscribed brain lesions, with dementia and paralysis (from softening, hæmorrhage, embolism, and thrombosis).

It is not my intention to discuss the differential diagnosis of these affections, for there are few motor, sensory, or psychical elements which can be said to be symptomological of sunstroke.

It is rather by the history, the combination and character of the symptoms, and the subsequent course of the case, that we are able to define a group within which the cases have some common characteristics; and, moreover, the possession of this knowledge may materially guard us in giving our prognosis, and aid in the course of treatment pursued.

The pathology of the affection is somewhat indefinite. Many writers uphold the view that exposure of the uncovered head to the scorching rays of the sun may give rise to puru-

lent meningitis; but the question may be asked, "Why, when so many people are exposed to the injurious influences, so few suffer from it?" The difficulty in answering this question is increased by the want of a satisfactory physical explanation of the fact.

Obernier has endeavoured to show, by both clinical and experimental observations, that the causes and nature of sunstroke are to be sought in the abnormal increase of temperature in the body; and Liebermeister has further shown that the cerebral symptoms associated with high temperatures are only to a limited degree, if at all, dependent upon cerebral hyperæmia. Sufficient facts are not yet established to justify any decided opinion as to the pathology. Experiments have shown that moderate heat directed upon the cranium causes dilatation of the vessels, and we must conclude that the initial congestion of sunstroke is due in part to heat, and—with due regard to the authority of Liebermeister—there is some probability that at the onset of the symptoms there is some hyperæmia of the pia and brain, or, more accurately speaking, a distension of the whole venous system, and the changes found after death may further assume the existence of a cerebral congestion similar to the congestion found in other organs. Buck is of opinion that a tendency to capillary stasis is induced—the heart labours to overcome the obstruction, and, failing, gives us the syncopal or cardiac variety; or the nervous system, resenting the increased abnormity of the circulation, develops convulsions and coma, as the cerebro-spinal variety of the disease.

The post-mortem appearances vary in the different forms of the disease. In ardent fever, serous effusions in the ventricles and between the membranes of the brain have been noted, with turgescence of vessels, and congestion of the pulmonary system. The cause of death is said to be most commonly asphyxia, and not apoplexy, and the most important changes are found in connection with the thoracic viscera.

When the medulla is affected accumulation of blood takes place in the right side of the heart and lungs, with secondarily (as a consequence) a want of that fluid duly arterialized in the brain. Roth and Lex state that death in the majority of cases occurs from cardiac paralysis, and only occasionally from cerebral disturbance. Arndt speaks vaguely of a "diffuse encephalitis," as explaining the

cerebral symptoms, which often remain after the acute attack; and he points out that during an attack of sunstroke the blood is acid, very rich in urea and white globules, and shows very little tendency to coagulation. Köster and Fox have called attention to the occurrence of hæmorrhages, separation and destruction of the nerve fibres, and extravasation in both vagi and phrenic nerves.

In children, Dr. Shuttleworth has found meningitis, with effusion and traces of old-standing disease of the membranes in one case, and in another the membranes were thickened and somewhat opaque, especially at the vertex.

In the adult I found in one case marked opacity of the arachnoid, with an excess of serous fluid between the convolutions and in the ventricles. The dura mater was apparently normal, and not adherent to the skull cap. The inner membranes stripped readily, and in one coherent film, leaving the surface of the convolutions intact. The vessels at the base were healthy, and normal in arrangement. There was no marked congestion of the venous system. The convolutions themselves were well formed, and the cortex was of good depth and colour. Striation, however, was ill defined, and there was a considerable amount of œdema of the white substance. On microscopic examination of the cortex cerebri I found a considerable number of spider cells and other evidences of degeneration.

In another case, reported to the Medico-Psychological Association by Dr. R. Percy Smith, the dura mater was found normal, but there was great excess of sub-arachnoid fluid over the surface of the brain, especially at the upper ends of the ascending frontal and parietal convolutions. The pia mater was soft, but peeled readily from the upper surface of the brain, leaving the convolutions intact. The convolutions were somewhat wasted, and the arteries at the base were slightly atheromatous. On section, the grey matter was pale and ill-defined, especially over the whole of the frontal region, and the left lateral ventricle was dilated. The condition of the spinal cord was interesting—the dura mater being distended by fluid in its lower parts, whilst along the cervical and dorsal regions there were numerous hæmorrhagic patches on its outer surface, consisting principally of clotted blood lying in the meshes of thin gelatinous material.

In the lower cervical region the anterior surface of the dura mater was adherent to the posterior surface of the

bodies of three cervical vertebræ by old firm adhesions. No compression of the cord or caries of bone could be detected, and the spinal cord itself was firm and healthy, and did not show any signs of degeneration. Köster has described a hyperæmic condition of the brain, and the occurrence of several small ecchymoses under the peri- and sub-cardium of the left ventricle in a case of death from sunstroke; but he has also described similar results found in the case of a syphilitic woman where excessive increase of temperature could not have been the cause of death; and he further calls attention to the possible occurrence of disturbances of the vaso-motor and respiratory nerve-centres, which must take place in a pronounced form in patients suffering from sunstroke. In the only other case which I have to report the dura mater was found normal, but the veins of the pia mater were deeply congested and full of dark coloured blood. The inner membranes peeled readily, and left the convolutions intact. There was slight excess of sub-arachnoid fluid, and the white substance of the brain was œdematous; otherwise, beyond considerable injection of the choroid plexus, the brain appeared to be fairly healthy. Both lungs were deeply congested.

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*An Inquiry into the Blood and Urine of the Insane.** By W. Johnson Smyth, M.D., Senior Assistant Medical Officer, Kent County Asylum, Barming Heath.

The brain is, in man, the material substratum of mind. Professor Huxley teaches that mind is as much a function of matter as motion is. However this may be, certain it is that mental processes can be altered or even arrested by artificially altering the physical condition of the brain.

We can arrest cerebration by a number of drugs too numerous to enumerate. We can slow cerebration, or we can pervert it: Alcohol, cannabine, and absinthe may produce actual delusions with or without excitement.

The man of vigour is rarely anæmic; the anæmic are invariably not those of intellectual vigour.

Considerations such as these suggest the question, "What is the condition of the blood of the insane?" To supply the answer is a matter of no little difficulty, since a vast amount of work must be undertaken.

* Two essays, those of Dr. Johnson Smyth and of Dr. Mackenzie, were adjudged equal and deserving of the medal and prize of the Association. Not having space for both, we print that of Dr. Johnson Smyth, which came first to hand.—Eds.