

BRAIN.

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Original Articles.

SUNSTROKE AND SOME OF ITS SEQUELÆ.

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UNDER the designations of sunstroke, coup-de-soleil, heat apoplexy, heat asphyxia, thermic fever, ardent fever, insolation, and others, are included certain pathological states, which though differing from each other materially are not unfrequently confounded.

1st. There is simple syncope from exhaustion caused by heat.

2nd. A condition analogous to shock, due to the action of the direct rays of a powerful sun on the brain and cord; the nerve-centres, especially the respiratory, are affected; respiration and circulation rapidly fail, and death may result; recovery is frequent, though not always perfect.

3rd. Overheating of the whole body, blood, and nerve centres, either from direct exposure to the sun's rays, or more frequently, to a high temperature out of them; causing vasomotor paralysis and intense pyrexia; respiration and circulation fail, and asphyxia follows. Recovery frequently occurs, but is often incomplete, owing to structural changes in the centres, giving origin to a variety of symptoms indicative of lesions of a grave character, some of which are well illustrated in the cases subsequently cited.

The cases of simple exhaustion and syncope may occur during great fatigue or over-exertion, or when there is depression of vital power from any cause during exposure to a high temperature, as in the case of the stokers and engine-room men of steamers in the Red Sea or the tropics, when the temperature rises to 120° and upwards, in the vicinity of the furnaces where they are employed; or in the case of men, especially Europeans, in the tropics who are exposed to the intense heat and light of the sun's rays, which taking effect on the head, neck, and body, produce a condition like shock acting through the vagus and vaso-motor system. There is depression of nerve force and of muscular power; the skin is pale, cold, and moist, the pulse feeble. Death may occur in this state from failure of the heart; but complete recovery more frequently occurs. Asphyxia and apnoea may come on after premonitory symptoms of depression and weakness, during exposure of the head and spine to the direct rays of a powerful sun, when the atmosphere is much heated, and the nervous energy is depressed by over fatigue, illness, or dissipation. The brain and respiratory nerve-centres are overwhelmed by the sudden rise of their temperature, respiration and circulation fail, the latter probably owing to inhibitory action of the vagus. When death takes place very suddenly during great excitement or exertion, and exposure to heat, it has been ascribed to rapid coagulation of cardiac-myosin.

This, however, though it *may* occur occasionally, is generally a post-mortem change; the heart's action being really brought to a close by heat, in the same manner as it has been shown by Claude Bernard and Lauder Brunton, that the effect of a very high temperature on animals is first to accelerate, and finally to stop the heart, and especially the ventricles, in a state of tetanic contraction.

Recovery, though frequently complete, is sometimes tedious, and occasionally imperfect, ending in serious impairment of health or intellect.

The symptoms of this form of sunstroke are those of sudden and violent lesion of the nerve-centres, unconsciousness, cold shivers, feeble pulse; all the signs of depression, terminating in death by shock; or fatal reaction may result, with a

variety of conditions pointing to injury to the cerebro-spinal system. In another class of cases there is ardent fever, the body generally, including the nerve centres, is heated intensely; this may occur quite independently of the direct action of the sun's rays. It comes on frequently at night, or in the shade, in a building or tent, especially in persons who are depressed by fatigue, bad air, over feeding, alcoholic stimulants and the consequent depression, want of rest, illness, and notably when the air is impure from overcrowding, or from insufficiency of cubic space.

The temperature of the body may rise to 108° – 110° ; respiration and circulation fail; there is dyspnœa, hurried gasping respiration, great restlessness; pungently hot skin, sometimes dry, occasionally moist. The pulse varies; in some it is full and labouring, in others quick and jerking; the head, face, and neck are livid and congested, the carotid pulsation very perceptible; pupils, at first contracted, dilate widely before death. Coma, stertor, delirium, convulsions, frequently epileptiform in character, with relaxation of sphincter, and suppression of urine, these are the precursors of death by asphyxia, and it may be that there is cerebral hæmorrhage.

Such are the cases to which the term heat apoplexy is given; and a large proportion of the fatal cases among Europeans in India is so caused. Recovery may partially occur, to be followed by relapse and death, or secondary consequences, the result of tissue change, may destroy life or impair health and intellect at a later period. The premonitory symptoms of this form of the disease may appear some hours or even days before the dangerous condition just described supervenes. There may be general malaise, disordered secretions, profuse and frequent micturition, restlessness, insomnia, apprehension of impending evil, hurried and shallow breathing, precordial anxiety, gasping, giddiness, headache, occasionally nausea or vomiting, thirst, anorexia, feverishness, which soon amounts to fervent heat of skin; the surface may be dry or moist, the pulse varies; and these conditions gradually become aggravated and frequently are worse at night, when the patient passes into a state of unconsciousness and dies.

The symptoms point to a profoundly disturbed state of the

cerebro-spinal nerve centres, and to pathological changes in the organs whose functions have been so greatly disturbed.

Death is caused by asphyxia and apnœa, in some cases probably by cerebral hæmorrhage. Recovery is often incomplete, resulting in permanent impairment of health, and generally in intolerance of heat and of exposure to the sun. These morbid conditions being due to heat alone are liable to occur whenever there is exposure to a high temperature, whether solar or artificial. Soldiers marching or fighting, when oppressed by weight of clothing or accoutrements, are apt to suffer either from simple heat exhaustion or from that form of insolation which results from direct action of a powerful sun on the head and spine. This is common enough in India and elsewhere during the hot season. It is not unknown in Europe, even in England during the dog-days. Soldiers, labourers, artificers, and people in factories, heated rooms, hospitals, barracks, tents, and even ships, may suffer from heat exhaustion, which may pass into the same dangerous condition of heat asphyxia. People in the hay-field, or otherwise exposed to great heat in this country, especially if they have indulged in excess of alcoholic stimulants and food, may suffer.

Men serving in the engine-room of steamers in the tropics—the Red Sea for instance—are often brought on deck in a state of complete exhaustion, from which they generally recover under the reviving influence of the cooler air, a douche of cold water, or a stimulant; weak persons with defective hearts may die in this state of syncope. Soldiers, or others, when exposed to great heat, may drop out of the ranks, fall in a state of syncope, and die on the spot, or pass into a state of coma and die later; or they may recover, after being in great danger, with damaged nerve-centres, and are rendered quite unfit for further service, or even residence in a hot climate. These cases occur on exposure to the direct action of the sun's rays when the atmospheric temperature is also high, and especially when unusual exertion is made, or when the individual is depressed by previous illness or the exhaustion due to dissipation, intemperance, or even undue indulgence in stimulants.

But the most serious cases are those that come on under

cover by night as well as by day, and apart from the direct solar rays. A form of disease described in India as ardent fever is of this character, supervening on the ordinary phenomenon of ephemeral fever. Heat alone, especially when the atmosphere is loaded with moisture so as to prevent evaporation from the person, is the real cause of the disease. Malarious and hygrometric conditions have no special influence beyond that which they may exert on the general vigour of the constitution, thus predisposing him to suffer.

The dry atmosphere of Upper India, with its hot winds, is much better tolerated than the damp atmosphere of Lower Bengal or Southern India, though the temperature is lower. Hot dry air favours evaporation, and thus keeps the body cool, whilst in the damp air, as evaporation is diminished, the natural cooling power is greatly diminished.

Vigorous, healthy persons of moderately spare frame, with sound viscera, and who are of temperate habits, if the atmosphere be pure and moderately dry, can sustain a great amount of heat. Acclimatisation has also some influence in conferring toleration. Fresh arrivals in the tropics are more prone to suffer than those who have become accustomed to the climate and have learned how to protect themselves. It is well known that a native can bear an amount of sun on his bare head and naked body with indifference, almost pleasure, that would rapidly prostrate a European. But when the temperature rises above a certain standard all succumb, and natives of India suffer and die like others in numbers every year from "loo marna," hot-wind stroke.

The extent and duration of the toleration of heat depend much on the vigour of constitution and actual state of health. The refrigerating powers of the body, when in health, enable it to support a very high temperature, considerably above that of the blood. Thus in the hot winds little inconvenience is felt so long as perspiration is free, but when that fails, suffering soon ensues, and the danger is great.

In the Fourteenth Annual Report of the Sanitary Commissioner with the Government of India, 1877, it is stated that 235 cases of heat apoplexy and sunstroke occurred in the army in India, of which 70 were fatal. The admission rate,

4·1, is almost the same as in 1876, and exactly the same as in 1865. The death rate, 1·22, is below the average of the last six years. There is nothing calling for special remark in the ratios of the different Presidencies as compared with their former history. Of the 235 cases, 189 occurred during the four months of May to August. The disease was widely spread. In proportion to strength there is no remarkable number of attacks at any one place. It gives rise to a fatality of 12·2 per cent. in the first and second years of the European soldier's service in India.

The deaths per 1000 strength :—

SERVICE.		
1 to 4 years.	5 to 7 years.	above 7 years.
1·48	1·05	1·50

AGE.		
Under 25.	25 to 29.	30 and upwards.
·65	·99	2·33

But of those who recover, or rather who do not die, many are permanently injured and remain invalids for the rest of life, which is frequently shortened by the changes induced; and the cases hereafter cited, for which I am indebted to Dr. Christie, the able superintendent of the Royal Indian Asylum at Ealing, will show what sad effects sunstroke may have on Europeans in India. These may be due to obscure cerebral or meningeal changes, which affect the sufferer in various degrees of intensity. Irritability, impaired memory, epilepsy or epileptiform attacks, headache, mania, partial or complete paraplegia, partial or complete blindness, extreme intolerance of heat, especially of the sun's rays, rendering a person otherwise fairly healthy quite incapable of serving in hot climates or of enduring any exposure to the sun; or, it may be, gradually ending in complete fatuity, dementia, or epilepsy,

perchance both: chronic meningitis, with thickening of calvarium, accounting for the intense cephalalgia; or in a lesser degree in disordered innervation and general functional derangement, which seriously compromise health.

In cases where death has occurred suddenly, as from syncope or shock, there is no very remarkable morbid change. The heart may be firmly contracted—it has been found in animals that died from exposure to a high temperature, when the blood and nerve-centres were heated to 110°, 112°, or higher, that the heart was tetanically contracted—but not always so, for it is often flaccid. The lungs, brain, and its membranes may be congested, but not invariably; they are sometimes quite the reverse. As in cases of shock, the venous trunks, especially those of the abdomen, and the right side of the heart itself, may be filled with blood. The blood is dark and grumous, often imperfectly coagulated, and effused in patches of ecchymosis, rendering the body rapidly livid. The coagulability of the blood is impaired, and it is deficient in oxygen.

In death from ordinary cases of thermic fever (insolation), the lungs and pulmonary system are often deeply congested; the heart is firmly contracted with coagulation of myosin, and the whole venous system is engorged. The body, even before death, may be marked by petechial patches and extensive livid ecchymosis. The blood is generally more fluid and grumous than natural, and it may be acid in reaction. The globules generally present no abnormal change in form, but are sometimes crenated and have a diminished tendency to form into rouleaux. The body for some time after death retains a high temperature. When first opened, the viscera and interior feel pungently hot, and the incisions drip dark blood. Rigor mortis comes on very rapidly. The brain and membranes may be congested; in some cases there are evidences of cerebral hæmorrhage and serous effusions in the ventricles. But the disease is essentially asphyxia, not apoplexy.

In cases of simple exhaustion, remove the person to a cooler place, if possible. Give a douche, but not too prolonged, or it may over-depress. A stimulant may be useful; rouse, and

gently stimulate; remove tight and oppressive clothing. Treat as in ordinary syncope—ammonia to nostrils, &c.

Rest, and avoid exposure to over-fatigue or to great heat.

In the form of sunstroke where the person is struck down suddenly by a hot sun, remove him into the shade, and allow a douche of cold water to fall from a height on his head and body, from a pump (or from a mussuck in India), or other similar contrivance. This should be freely resorted to, the object being twofold: to reduce the temperature of the overheated centres, and to rouse by reflex action. During the assault on the "White House picket," at the capture of Rangoon in 1853, numbers of men were struck down by the fierce April sun. They were brought to me, and laid out in rows, perfectly unconscious, *in their red coats and black leather stocks* (they wore them, in those days, even in action under a tropical sun). They nearly all recovered—for the time, at all events—under the influence of the douche, freely applied over the head and body. In some cases, rousing by flagellation with the sweeper's broom was added with great effect, especially in the case of Brigadier-General W., who I thought must have died. All, or nearly all, recovered, except two, both of whom had been bled on the spot, before I saw them.

In addition to the douche, stimulants, such as mustard-plasters, to various parts of the body, legs, abdomen, &c., and stimulating enemata which relieve the loaded bowels and at the same time rouse, may be useful.

When I say such cases recovered, I refer to the reaction at the time. In some there were consecutive symptoms of fever, cephalalgia, &c.; and, were we able to trace their subsequent history, we should probably find that complete recovery never occurred. If recovery is incomplete, and followed by indications of lesion of nerve-centres, or of meningitis, other treatment of a more active character will be needed according to the conditions.

Future exposure to the sun should be carefully guarded against, and, unless recovery has been rapid and complete, the sufferer, if in India or the tropics, should be removed to a cooler climate, where he should be protected from all

excitement of mind or body, and the greatest care be taken not only to avoid all errors or excesses of diet, but also of stimulants.

In the graver cases of thermic fever, or heat asphyxia, heat being the primary cause of the disease, the object is to reduce temperature as speedily as possible and before tissue changes have been caused. As the hyperpyrexia is due not only to the direct operation of heat on the nerve-centres, blood, and tissues, but to the fever set up by vasomotor disturbance, remedies that may influence this disturbed condition are indicated. The result of the treatment in some cases seems to confirm the correctness of the theory. The use of quinine and of morphia by hypodermic injection have both been considered to produce good results by their influence in reducing temperature and blood pressure, and perhaps retarding tissue change. The quinine, I think, may do so; I doubt the morphia.

Bleeding has now happily been abandoned except in rare and peculiar cases. The congested livid surface, the coma and stertor which formerly suggested it are not now so treated. There are cases in which it may be necessary in order to avert suffocation, but they are, I think, the exception. In cases where it has appeared at first to give relief and to mitigate the symptoms, the improvement has been only transient, and followed by relapse into a more dangerous and fatal condition.

I do not think any absolute rule in this or any disease can be laid down in regard to abstraction of blood. It is possible that there may be more danger to life in the labouring and distended heart and the embarrassed lungs, than in the loss of a few ounces of blood; which, if it would have tided the patient over the danger, as I believe it sometimes might do, would be the lesser evil, and as such should be chosen. Each case must be treated on its own merits.

The treatment generally, consists in the judicious application of cold by affusion, or by ice, taking care not to reduce temperature too low. A thermometer in the axilla, mouth, or rectum, will keep you informed in this respect.

Great care should be taken not to prolong the cold application too far, as danger would attend continued depression

of the temperature below the normal standard of blood heat. The bowels should be relieved, and blisters may be applied to the scalp and neck, though I cannot but say I have not much faith in their efficacy. In the epileptiform convulsions that so frequently occur, the inhalation of chloroform may be useful, but the administration of it must be carefully watched. The earliest and most severe symptoms having subsided, the febrile condition that follows is to be treated on ordinary principles; the diet must be carefully regulated. As improvement progresses, symptoms of intra-cranial mischief may begin to supervene; where the indications are of meningitis, iodide of potash and counter-irritation, may be of service; removal to a cooler climate is essential. As a general rule it is desirable that the sufferer should not, for a long period at least, return to a hot climate, and he should be guarded against all exposure to heat, overwork, and anxiety of any kind.

The sequelæ of sunstroke are often very distressing, and render the patient a source of anxiety and suffering to himself and to his friends.

The less severe symptoms—those probably of the slighter forms of meningitis, or of cerebral change—occasionally pass away after protracted residence in a cold climate; they are, however, not unfrequently the cause of suffering, but of danger to, and shortening of life; pointing to permanently disturbed if not structurally altered cerebro-spinal centres.

The following cases, for which I am indebted to Dr. Christie, are very illustrative of the evil effects that, more frequently than is perhaps imagined, result from sunstroke.

“MY DEAR SIR,

“I send you, as far as I can learn them, short histories of seventeen cases of insanity following sunstroke. I believe the whole of them are uncomplicated with insobriety. As a rule, the previous histories are not very replete with information, and only in one or two cases have I therefore been able to go very fully into them.

“It appears that the attack in most cases was the same and of a violent character, the onset was of an inflammatory type from the symptoms displayed, gradually settling down into

imbecility; the few post-mortems gave confirmatory proof of this in the adherent and thickened membranes.

"The second case was interesting, as showing the violence of symptoms during the whole attack, and which appeared to arise from the pressure of the plates of the skull, not, however, altogether the result of the sunstroke, as there is evidence of injury when young; here a resemblance is observed in the case of Surgeon-Major M., in whose case the bony growths were hereditary, and the same violence of symptoms was exhibited. In no case was recovery complete; although improved, a certain amount of imbecility resulted.

"Looking at the result of the post-mortem, I am led to think that the worst of insanity after sunstroke is of an acute inflammatory character, attacking the membranes of the brain, and thus the grey substance, so that we find the mental symptoms more clearly defined than the physical; only in the one case of Surgeon-Major J. M. were the physical characters clearly marked, and in this case paralysis was permanent from the first onset of disease.

"How far an alteration of structure of bony growth may be traced to coup-de-soleil is a matter for further consideration; in all the cases I have had under care, the diploe has been found obstructed and the skull plates thickened, dense, and heavy, with, in two cases, distinct growth of bone; but both these cases are involved in their etiology, in the one case by an early injury, and in the other by a most decided hereditary taint.

"At the present time I have two cases under treatment, the one a case of acute mania, with partial recovery following coup-de-soleil in Bengal; the other a case that occurred last summer here in the country, not followed by actual mania, but an inability to use the brain as formerly, coupled with grave symptoms at the present time, such as headache, squinting, and incapability of fixing attention, coupled with sleeplessness. Of both of these cases I hope to get a complete history.

"Yours very truly,

"THOS. B. CHRISTIE."

CASE 1.

"Gunner J. M., aged 71 years.

"Went to India in the year 1839, and was a steady, well-conducted soldier. On the 13th April, 1843, was admitted into hospital for coup-de-soleil, and was discharged as recovered May 29th following. He was readmitted on the 18th of June, complaining of pains in the head and abdomen, but was discharged again in three days. July 12th he was again admitted, having been drinking, and became very excited, but was discharged on Aug. 12th. This went on, till the excitement increasing, he was admitted into the asylum, Jan. 23rd, 1844, for hypochondria, but soon after showing symptoms of imbecility he was sent home to England. On board ship he became violent, on several occasions, attacking those about him and threatening to throw them overboard. He arrived in England, Sept. 1844, and was admitted into the Asylum at Hackney. Here his case ran through the usual course, resulting in dementia, with general incoherence of language and silliness of manner. He is a Roman Catholic, and many of his delusions relate to the fasts of the church, fancying e.g. that Saturday is a fast-day, and will not eat meat. He is still living, with symptoms of cerebral atrophy."

CASE 2.

"Ensign P. F. T., age 51 years at death.

"This gentleman when about three years of age fell from a table and received a severe blow on the back of the head; very soon after he appeared drowsy and was sick, and in the course of a few days symptoms of acute inflammation of the brain came on, and he became perfectly unconscious. The attack soon subsided under active treatment, and he recovered. At the age of 17 he went to India, and within two years was attacked twice with fever, and apparently slight inflammation of the brain; subsequently, when exposed, he was struck down with coup-de-soleil, from which in a few days he apparently recovered. After this his correspondence was noticed to be irregular, and the style of his letters incoherent and

rambling. His conduct partook of the same character, until decided insanity necessitated his return to England. He recovered considerably on the voyage, and resided with his friends for a few years, during which they noticed a gradual increase of symptoms, till his violence was so great that he was sent to the Asylum at Hackney, where he was admitted July 18th, 1845, suffering from acute mania. His symptoms continued, and he became noisy, violent, fretful, and took a great dislike to his mother and relatives. In Aug. 1870 he was transferred to Ealing, and continued to show the same symptoms. On July 5th, 1871, he complained of great pain in the hepatic region, and he was ordered a purgative; this did not, however, remove the pain, and in two or three days violent diarrhœa came on, which was not checked by chlorodyne, opium, &c., &c.; on the 14th his temperature was 98½, and pulse 100; there was no tenderness, and the skin was acting freely. July 16th, temperature 99½, but the pulse fell to 98, the diarrhœa continuing with blood; this went on till the 24th, when he died.

"Post-mortem revealed an enormously enlarged liver, and adherent to the diaphragm: on attempting to separate it, an abscess of the size of a cricket-ball burst, in addition to which the right lobe was found to contain six separate and distinct cavities. Intestines congested, villi distinct with ulceration of the glands, especially in the colon. Kidneys pale, but healthy. Spleen small. Right lung adherent, and a small abscess over the liver in the lower lobe, partially hepatized, and corresponding to the liver. Heart healthy.

"Calvarium dense and heavy; over right parietal bone an apparent bulging, and over the middle suture thickened; the result of early injury. Membranes thickened, arachnoid opaque, with patches of lymph, the result of old inflammation. Convolutions flattened, grey substance pale and very defined, brain generally firm but anæmic. Brain small and atrophied. Base of skull rough, with prominences of bony deposit, some being very sharp."

CASE 3.

"Gunner A. F., aged 26 years.

"Admitted into Colaba Asylum, Bombay, Feb. 22nd, 1845, after about two years' treatment in hospital for coup-de-soleil; during that time he complained of headache, ringing in the ears, loss of sleep, and delirium; this went on till Sept. 1844. when he became violent, and shouting continually. On admission he was suffering from low fever and diarrhœa. Imagined people were talking and speaking to him, and that they were trying to force air into his bowels. The usual treatment was pursued, and he was sent home, arriving in England in May 1846. He improved considerably on the voyage, but still had delusions; these, however, soon disappeared, and he was handed over to the care of his friends in the following month of June. Nothing more has been heard of him."

CASE 4.

"Gunner R. M., aged 31 years.

"As far as can be learned, a sober steady soldier. Was admitted into Regimental Hospital July 25th, 1849, suffering from the usual symptoms of coup-de-soleil, from these he recovered and left; but was brought back in a few days from being found wandering about and talking incoherently; he gave sensible answers to questions, and there did not appear to be any suspicions as to drink. This went on, leaving the hospital for a short time, and being readmitted again, till he was sent to the Asylum at Fort William, and admitted there March 19th, 1851. He was treated with cold baths, purgatives, &c., and not improving was sent home to England and admitted to the Asylum at Hackney, April 30th, 1852, having sunk into a state of dementia, with general incoherence; he continued thus till he died from phthisis, on June 4th, 1856. Post-mortem revealed the calvarium very adherent to the membranes, the plates of the skull of unusual thickness, being at least $\frac{1}{4}$ of an inch, with the diploe filled up; the arachnoid contained about 2 ounces of serous fluid; pia mater, opaque and thick. The substance of the brain was firm, but appeared healthy. The brain was small. Lungs studded with tuberculous matter."

CASE 5.

“Private J. F., aged 22 years.

“Believed to be a sober man. Was attacked with sunstroke, April 12th, 1852, and taken to hospital; he improved slightly under treatment, but gradually became much excited and subject to various delusions, imagining people were trying to kill him. On the 30th of April, 1853, he was admitted to the Lunatic Asylum, Madras, and after a short time sent home to England, arriving Sept. 14th, 1853, and admitted into the Asylum at Hackney; he was in a state of dementia and in weak bodily health; in the following January, viz. the 7th, he died from chronic dysentery. The result of post-mortem examination was as follows: calvarium dense; brain substance firm, and apparently healthy; membranes adherent, with about five ounces of serum within the arachnoid.”

CASE 6.

“Private J. T., aged 30 years.

“This man had an attack of coup-de-soleil in Bengal, in August 1857, after which his mind was disordered, and he appeared to be suffering from general paresis. On the 13th July, 1858, he was admitted into hospital, and found in a state of amentia; was transferred on July 21st, 1859, to the Lunatic Asylum, Madras, and sent home to England, arriving April 10th, 1859, suffering from general paresis. The disease ran the usual course, and he died July 17th, 1860, but no post-mortem appears to have been made.”

CASE 7.

“Private J. F., aged 30 years.

“A sober, steady man, had sunstroke at Moulmein in Oct. 1857, and was sent to hospital, where he was under treatment till Aug. 1858, and appeared to recover so as to be sent to duty. On the 9th January, 1859, he was again sent to hospital for irritability and strangeness of manner, refusing to do his duty, &c., and was then thought to be insane, though he did not appear to have any prominent delusions. Not improving,

he was, on the 2nd of March, 1860, sent to the Lunatic Asylum at Madras, and forwarded home to England, arriving on the 28th of June, 1860, and admitted into the Asylum at Hackney. He was suffering from chronic mania, and did not improve, dying on April 8th, 1861, from disease of the liver. Post-mortem examination:—The calvarium was thick, dense, and heavy; the diploe being obliterated. Dura mater thick, with opacity of the pia mater. The brain substance appeared firm; the grey matter varying from $\frac{1}{4}$ to $\frac{1}{2}$ an inch in depth. The ventricles contained a small amount of fluid, and a large number of cysts were on the choroid plexis; the convolutions seemed natural.”

CASE 8.

“Gunner P. F., aged 29 years.

“Appears to have had sunstroke in 1859, and was admitted into hospital Nov. 12, suffering from cephalalgia. Complained of pain, principally at the occiput; he was strange in his manner as evinced by his dress, putting his belts on wrong, &c.; he improved for a few days, and then gradually became worse; but was kept under treatment till he was admitted into the Lunatic Asylum, Colaba, Bombay, on the 26th of August, 1860. He did not improve, and was sent home to England, arriving April 25th, 1861, and admitted into the Asylum at Hackney. He remained very silly, and on Sept. 16th, 1865, he was sent to his friends in Ireland, and nothing more has been heard of him.”

CASE 9.

“Seaman, T. T., aged 22 years.

“Had sunstroke on the voyage out to India, and on arrival there was found to be insane, so was sent home to England, arriving Aug. 8th, 1863, and was admitted to the Asylum at Hackney, suffering from mania. He gradually improved, and on Feb. 16th, 1864, was sent home to his friends, and nothing more has been heard of him.”

CASE 10.

“ Private J. M., aged 27 years.

“ Of sober habits and healthy constitution. Admitted into Depot Hospital at Benares suffering from acute symptoms, the result of coup-de-soleil. His brain was very active, and he suffered from violent delirium, requiring force to keep him quiet. After a few days this passed off, leaving him very low. His memory seemed affected, and although not violent, he was unmanageable and subject to occasional paroxysms of violence. There is no history of hereditary taint. Treated with cold affusions and tonics.

“ Admitted into Fort William, Bhowanipore, Dec. 30th, 1858, suffering from sleeplessness, subject to despondency and paroxysms of violence. Treated by tonics. Sent home to England, and on ship's arrival in Sept. 1859, was so far recovered as to be allowed to go to his friends.”

CASE 11.

“ Pensioner J. D., aged 40 years.

“ Admitted into General Hospital, Sept. 1863, with the loss of the use of his right side after coup-de-soleil. From this he recovered and was discharged. After this he had a loss, and it appeared to prey on his mind, so that he was admitted into Bhowanipore Lunatic Asylum, Nov. 28th, 1863. Was violent and noisy, striking his head against the wall, attempting suicide; but after a short time he became quiet, and was sent to England, arriving April 26th, 1864, and admitted into the Asylum at Hackney, suffering from dementia and general paresis. The disease ran the usual course, and he died April 29th, 1867, but no post-mortem was held.”

CASE 12.

“ Lieut. R. M., aged 26.

“ Had sunstroke at Arrah, but no particulars were sent with him. He was of temperate habits, and was admitted into Bhowanipore Lunatic Asylum, Dec. 9th, 1864, labouring under various delusions of a personal character. Was noisy and

violent, imagining his relatives ought to be shot for cowardice. He was sent home, arriving in England Jan: 28th, 1865, and admitted into the Asylum at Hackney. He remained much the same, and was removed by his friends Jan. 29th, 1866."

CASE 13.

"Lieut. C. M., aged 40.

"Had sunstroke, followed by insanity. No history of his case. Still living."

CASE 14.

"Lieut. B., aged 36.

"No history; but was a sober, steady man, and became insane after sunstroke."

CASE 15.

"Lieut. B., age 39.

"The same."

CASE 16.

"R. L., aged 22 years.

"Was out in the sun, shooting one morning; after exposure to solar influence, he returned home and soon after became insensible, with stertorous breathing and convulsions. No medical man saw him, and he was sent to Kyouk Phyoo Aracan, Burmah, for treatment. He gradually became conscious, with loss of power in the lower extremities. His general health gradually improved, but with loss of speech and defective intelligence. He was sent to England, arrived Dec. 24th, 1878, and was admitted into the Asylum at Ealing, suffering from dementia. He had recovered the use of his limbs, but his mental power was weak. He has improved considerably, but lately tonic contractions of the extensor muscles of right arm have set in, so that I am led to think there is mischief connected with the centres relating to the arm. Still under treatment."

CASE 17.

"J. M., aged 43, and a widower, Surgeon-major, Madras.

"Was much affected at the loss of his wife, and while at Pulney, Madras, in the year 1868 had coup-de-soleil from

direct exposure, followed by headache on the left side, difficulty of articulation, and other signs of cerebral disturbance; this was followed by singing noises in the left ear, and defect of vision of the left eye from dilatation of the pupil, followed by great contraction. The memory became defective of recent events, and an eccentricity of conduct and manner became evident. Exaltation of ideas, great excitement, and a loss of control, was followed by excess of depression. He was placed under appropriate treatment, but the symptoms of violence and aberration increasing, as evidenced in striking those about him, and his wish to purchase property on a large scale, he was sent home, and came under my care at the Royal India Asylum, on August 25th, 1870, suffering apparently from general paresis. His ideas were exalted and bombastic, facies unhappy and perplexed; tongue tremulous and quickly receding, pulse varying from 76 to 93; temperature also from $96\frac{1}{4}$ to $99\frac{3}{4}$, gait unsteady and tripping. These symptoms continued till about August 1872, when there was a great improvement altogether; he became more rational and his walk more steady, so that he was enabled to leave the asylum, and resided for the following two years in Scotland. I saw him occasionally during this time; he lived temperately, and as far as I could learn had not shown any signs of venereal excess. He took interest in various things, and played golf, thus of course taking a large amount of exercise. On Nov. 5th, 1874, he was readmitted. At this time he is noted as suffering from the second stage of general paresis, very indistinct in speech, and labouring under extravagant and exalted delusions that he is to play a great part in India, that he is very rich, &c. &c. His pulse was small and quick, pupils strongly contracted, and temperature normal. Was treated with Ex. 1. Physostig. gr. $\frac{1}{4}$ three times daily. The symptoms gradually increased in intensity, and the paralysis became more marked till the beginning of December 1878, when he took to his bed. From this time I believe contraction of the lower extremities set in, and the limbs became strongly flexed towards the chin; he became rapidly worse, and died Jan. 27th, 1879, from exhaustion; he took food freely to within a few hours of his death.

"Post-mortem examination as regards the head only, was made about sixteen hours after death, and the following observations made:—Rigor mortis persistent; body much emaciated; calvarium strongly adherent, the plates dense; diploe obliterated; membranes very vascular, thickened, and adherent to the surface of the brain along the median fissure: this was found on separation to be caused by three or four bony plates, of the size of a sixpence, with small spiculæ passing into the surface of the brain on the left side; the brain was smaller than usual, and weighed only 44 ounces; the grey matter was deficient, and the convolutions flattened, and apparently not so numerous. Nothing unusual appeared in the substance of the brain beyond very slight softening in the right thalamus opticus.

"I think from the short notes of the above case, as I said before, great interest occurs from the close resemblance at the autopsy of the facts observed in the brother's case, plates of bone being there found as large as a shilling; the brother had never been in India, was not the subject of coup-de-soleil, and yet the disease ran somewhat the same course, but was of shorter duration. Venereal excess still may be to blame, but it must be remembered that he was well known as being a highly moral man, and did not mix in the society of those who would lead him into this form of dissipation."