Original Articles.

INSOLATION.¹

BY HENRY JACKSON, M.D.,
Assistant Visiting Physician of the Boston City Hospital.

DURING the heated term of last August it was my good fortune to have under my care at the City Hospital several cases of insolation; as they offered many points of interest to me, I feel that a short discussion of the subject may not be out of place in this Section.

The common terms "sunstroke" and "insolation" (derived from the verb "insolate," meaning to expose to the rays of the sun) are not wholly appropriate, as many cases of the most severe forms of this disease are developed in persons exposed to great heat in attics or overheated rooms, though entirely shielded from the direct rays of the sun. The term "thermic fever," though etiologically more comprehensive, is not in common use in our city, and I therefore choose the word "insolation" as the title of my paper.

As the result of exposure to severe heat, we may have two different diseases produced, namely, heat exhaustion and thermic fever.

The cases of slight prostration, headache and malaise produced by heat may be classified as the mildest types of heat exhaustion. During the hot week many persons that had been overcome by heat were brought to the hospital in the police ambulance; yet they were perfectly conscious, had a normal temperature, and after a short period of rest were allowed to go home, as their symptoms were not sufficiently severe to warrant their admission considering the overcrowded condition of the hospital. Several cases were admitted that were unable to leave the hospital on account of severe headache, dizziness and exhaustion, though when they reached the hospital, at all events, their temperature was not elevated.

As the result of exposure to heat, profound collapse, with loss of consciousness and relaxation of the whole muscular system, may be seen. In such cases the temperature is subnormal and the pulse rapid. The condition is comparable to profound collapse as seen in serious surgical accidents. I have not had any experience with cases of this form, though Dr. H. C. Wood speaks of this form of heat exhaustion as not uncommon in Philadelphia. The treatment suitable for cases of collapse from exposure to heat is the same as that for collapse from any other cause, namely, vigorous stimulation and the application of heat externally.

A third form of disease, the result of exposure to great heat is described, namely, a continued fever which may simulate typhoid fever. Dr. Guiteras has especially called attention to this disease, and expressed the opinion that many cases of so-called typhoid fever in Florida are really cases of insolation of this type. I report to-night one case of continued fever that I believe was due to the results of long exposure to great heat.

In summary, then, we may say that, as a result of exposure to excessive heat, we may have four distinct diseased conditions:

- (1) Exhaustion, with normal temperature.
- (2) Collapse, with subnormal temperature.
- (3) Intense fever combined with furious acute symptoms.

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(4) A continued fever with symptoms suggesting a continued fever similar to typhoid.

In 1895 Dr. C. F. Withington published a valuable paper on "Heat Prostration" in the sixth series of the Medical and Surgical Reports of the Boston City Hospital. In this paper he analyzed one hundred cases. Two-thirds were the result of exposure to the direct rays of the sun, and one-third to exposure to indirect heat. In the latter class were included workers in sugar refineries, iron foundries, bake-shops, furnace-rooms and stables. Of the 100 cases, 28 died and 72 recovered. In this series the highest recorded temperature was 111.5°, and the highest temperature with recovery 109.5°. In 84 cases there was loss of consciousness, and convulsions in 30. Dr. Withington noted that the pupils did not respond to light and were usually contracted, though at times dilated. This accords with the statements usually found in the text-books, though in all my severe cases, with a single exception, the pupils were contracted to a pin-point size. A secondary rise of temperature after the fever had been reduced by cold was not unusual. Of great practical importance is the fact that in the cold bath there may be a fall of temperature to a point far below normal, accompanied by symptoms of serious collapse. Therefore in using a bath the rectal temperature must be taken frequently; and when the thermometer registers 102° the patient should be removed from the bath, as the temperature usually continues to fall after the patient has been returned to his bed. In six autopsies quoted by Dr. Withington the chief pathological lesions were sub-endocardial and pulmonary hemorrhages, hyperemia and edema of the meninges, and a fluid condition of the blood as a whole.

Through the kindness of my colleague, Dr. Sears, I am able to report 22 cases that entered our two services: 18 men, three women, and one boy of fifteen years.

METEOROLOGICAL RECORD.

According to observations furnished by Sergeant J. W. Smith, of the United States Signal Corps, August 6-13, inclusive:

Date.	Cases	Thermometer.			Relative humidity.			Weather.	
		Daily mean.	Maximum.	Minimum.	8.00 A. M.	8.00 P. M.	Daily mean.	8.00 A. M.	8.00 P. M.
T...6		65	69	65	91	96	94	Cloudy.	Cloudy.
F...7		77	90	61	95	74	84	Cloudy.	Clear.
S...8		75	80	64	95	76	86	Clear.	Clear.
S...9		82	92	72	68	79	74	Fair.	Clear.
M...10	2	86	95	76	70	70	70	Cloudy.	Clear.
T...11	5	82	89	76	62	64	63	Clear.	Clear.
W...12	12	82	89	75	68	71	70	Clear.	Clear.
T...13	2	76	81	70	74	79	76	Fair.	Fair.

One case entered some time after the heated term had passed by, the case of continued fever.

Eleven of the cases were mild; 10 were severe, with hyperpyrexia; and one was the case that I have mentioned as belonging to the type of continued fever due to heat. Seventeen of the cases were the result of direct exposure to the rays of the sun, and five were prostrated by indirect heat. Of the latter, three

were laundresses, one a baker and one a stableman who was working in the loft of a stable on Portland Street. Two of the severe cases suffered from indirect heat.

Five of the 22 cases died, namely, 50 per cent. of the cases severe enough to warrant one to make an unfavorable prognosis, 11 of the cases being evidently of a mild type.

Two of the cases entered on the fourth day of the heated period, five on the fifth and 12 on the sixth day; two were entered on the morning of the seventh day, but properly they should etiologically be entered as belonging to the sixth day, as they were both night-workers and were brought in in the early morning, after the temperature had been already lowered by a fresh east wind.

It is evident from this list that the ultimate cause of the prostration is to be found rather in prolonged heat than in the excessive heat of a single day. Most of the cases entered two days after the acme had been reached. These data are in accord with our practical experience that sunstrokes are not usual as the result of one or two days of excessive heat such as usually occur every summer.

During this period the humidity was not high and the weather was clear; the same may be said in a general way of Dr. Withington's series of cases. They did not occur in weather with a relatively high humidity. In Germany where sunstroke is rare amongst civilians, soldiers are not infrequently overcome by the heat during forced marches, or in military manoeuvres during hot, moist weather when the soldiers are burdened by heavy clothes and knapsacks. I remember Kussmaul said that he had not seen sunstroke except under such conditions.

The cases which I have to report I divide as follows: Mild, eleven cases, five without fever and six with low temperature; ten severe cases, with hyperpyrexia; one case continued fever.

FIVE CASES WITHOUT FEVER.

One of these cases was unconscious on entrance, two were conscious though dazed, one complained of severe headache and dizziness, and one was simply exhausted. In none of the cases were the pupils contracted, nor was there in any of them any loss of pupil reflex. One of the cases complained of abdominal pain, and had cramps in the hands. In all, the conjunctivæ were congested. In four of the cases where a history was obtained prodromal symptoms of lassitude, prostration, headache, and, in two instances, fainting, had preceded the extreme depression which caused their removal to the hospital. In only one case was there a distinct history of a cessation of sweating before the onset of more unfavorable symptoms. One had worked in a bake-shop on the last hot night of the series, and fainted twice before he was brought to the hospital with a normal temperature, though no baths had been given outside of the hospital.

All left the hospital in two or three days apparently well.

SIX CASES OF MODERATE FEVER.

Four of these cases were perfectly unconscious on entrance; while two were semi-conscious, though much dazed and roused only with difficulty. In five of the cases the pupils were equal and reacted perfectly; in one the pupils were contracted. In all the conjunctivæ were injected. Prodromata were more

marked than in the preceding series. One had complained of vomiting and marked prostration for two days before the onset of unconsciousness; three had severe headache and general malaise; again, one only noted and spoke of a cessation of sweating. The range of temperature was from 100° to 104°; in all there was a slight elevation of temperature on the second day, the temperature being normal on and after the third day. In the case with contracted pupils there was retraction of the head, and an occasional convulsion of the whole body. In the other cases no untoward symptoms were noted except moderate headache and weakness. The only treatment employed was sponging with cold water.

All were discharged on the second or third day after defervescence. Two were laundresses; the others worked out of doors.

TEN SEVERE CASES.

One case entered moribund, death taking place in the bath given shortly after entrance; of this case I can only report that the temperature was 111° in the rectum. In the other nine cases the following symptoms were noted: In all there was profound unconsciousness, with stertorous respiration. In all there was marked rigidity of the whole body and the extremities were extended with difficulty, becoming immediately flexed when not forcibly held. In all the pupils were contracted to a pin-point in size, and did not react to light or other stimulus; the conjunctivæ were deeply injected, and in two cases the eyes were rotated sharply upwards. In eight cases there were general convulsions, frequently recurring. Profuse, involuntary dejections and vomiting were seen in five cases, and noted as absent in two. Albuminuria and casts were found in three cases, and noted as absent in only one instance. In all the cases the pulse was rapid and poor, being several times imperceptible at the wrist. Râles were heard throughout the chest in each case examined. I give the range of temperature with the result in each case:

106°	Death, 7th day, jaundice and pneumonia.
105°	Death in a few hours.
108°	Recovered.
110°	Death, 14th day, edema of pia.
110°	Recovered.
110°	Death in four hours.
111°	Entered moribund.
102°	Recovered (ice-bath at station-house).
109°	Recovered.
109.5°	Recovered.

CASE I. Temperature 106°. Baker. Entered on evening of August 10th. Temperature fell rapidly after ice-water baths, and toward morning he was semi-conscious. During the next few days jaundice developed, and he was delirious. The liver was enlarged. August 16th, consolidation of the lower lobe of the left lung, and death the next day.

CASE II. Temperature 105°. Was put in a cold bath, and removed when the temperature was 101°. He was wrapped in blankets, rubbed vigorously, and stimulated; but he failed to respond. The temperature fell to 98.6°, and he died in a few hours.

CASE III. Temperature 108°. Temperature soon fell under use of ice-cold packs, and in a few hours he was conscious. No untoward symptoms. Elopement on fourth day.

CASE IV. Temperature 110°. Boy of fifteen. Mentally deficient, and a resident of an institution. Profuse vomiting and involuntary dejections. Temperature fell rapidly under ice-cold sponging and packs. He never recovered consciousness. There was marked rigidity of

the neck, trunk and extremities: constant vigilance and occasional twitchings of face and legs. Death on the fourteenth day. Autopsy: Much edema of the pia. When the calvarium was removed the brain looked as if covered with a thick layer of wine jelly.

CASE V. Temperature 110°. Temperature fell quickly to 102° under ice-cold packs and sponging. He was then wrapped in blankets and rubbed vigorously. The temperature fell further to 99°, but rose again to 103° in the evening. There were several severe convulsions. There was moderate fever for several days, but no further untoward symptoms.

CASE VI. 110°. Death in four hours. Convulsions.

CASE VII. 111°. Moribund.

CASE VIII. 102°. Ice bath at the station. Convulsions, otherwise quick and uninterrupted recovery.

CASE IX. Temperature 109°. Was left in cold bath until the temperature reached normal. On removal the temperature continued to fall, reaching 98.6°. During the next two weeks the man was very weak, delirious at times, and the temperature normal or subnormal. On August 26th he was unable to walk alone, and the gait was ataxic; the muscles were flabby, knee-jerks present. Through September he was confined to the bed, but gradually recovered his strength and on October 8th he could walk alone.

CASE X. Temperature 109.5°. Was placed in an ice bath and kept there until the temperature reached 102.5°. After removal the temperature fell lower, to 98.6°. During the evening there were convulsions and a secondary rise of temperature to 107°. He was conscious the next morning; and except for a moderate fever for four days no other symptoms developed.

All of the cases were treated by external application of ice-water, some by full baths and others by pouring cold water over the body as they lay on rubber sheets in bed. In all cases the importance of stopping the application of cold by the time the temperature reached in the rectum 102° was fully emphasized. In those cases that I watched personally I felt that the cold baths were much more efficacious when the superficial circulation was stimulated by the alternate use of vigorous friction and wrapping the patients in woolen blankets for short periods. In addition to the application of cold, the patients were stimulated by the subcutaneous use of brandy and sulphate of strychnia. Sulphate of morphia apparently had a beneficial effect in controlling the convulsions.

The clinical phenomena of severe cases of sunstroke all point to a direct and profound disturbance of the nervous system—coma, contracted pupils, convulsions—all symptoms suggesting some direct effect upon the brain as a whole, rather than discrete focal lesions. In Case IV, the boy, the clinical symptoms strongly suggested some pathological process in the meninges, and the autopsy confirmed the clinical diagnosis, showing that the disturbing factor was an extensive edema of the pia.

Two main theories may be advanced in explanation of the nervous phenomena which follow severe sunstroke; they may be the direct result of pathological changes produced in the brain and meninges, or they may be dependent upon the poisonous action of some toxine set free in the body as the result of the disturbance of the heat equilibrium. I have been unable to find many reports of the post-mortem appearances found after sunstroke, but such as I have found suggest that we may find sufficient cause for the clinical symptoms in the lesions of the brain and meninges.

ONE CASE OF CONTINUED FEVER.

Woman, age twenty-four. Entered my wards August 26th. No items of importance in her family or previous history. On one of the hottest days of the hot period she went in bathing at South Boston Point and stayed four hours in the water. Her head was not protected, and she says she did not wet her hair. Severe headache followed. Five days later a doctor was called who found her temperature 103.8°. She became delirious; had severe headache and backache; pupils regular and small. The pulse was occasionally irregular. The temperature continued, but gradually fell, reaching almost the normal point when she entered the hospital. She entered the hospital, as she was much annoyed by any noise. Typhoid fever was considered, also meningitis, which was suggested by the intense headache and the focal signs in the pupils.

I found the following condition: Herpetic eruption on the lips (rarely if ever seen in typhoid). No enlargement of the spleen. Abdomen negative. Urine negative. She had much headache and seemed weak. After entrance to the hospital there was no fever, and she gradually improved without the occurrence of unfavorable symptoms.

Before she entered the hospital she had symptoms evidently pointing to meningitis, according to the account given me by the doctor who saw her in consultation. I believe that those symptoms were the result of lesions produced by sunstroke.

THE TEACHING OF CLIMATOLOGY IN MEDICAL SCHOOLS.

BY ROBERT DE C. WARD, BOSTON,
Instructor in Climatology in Harvard University.

THE time has come when climatology should be generally taught in our medical schools. It is a subject of great importance to medical men, and one about which they should all have some rational information. In the hope of arousing the interest of the medical profession and perhaps also of provoking further discussion of the subject, the present paper is herewith presented.

The intimate relations existing between atmospheric conditions and health have been the theme of comment and investigation from the days of the earliest writings on medicine and on meteorology down to the present time. From the statement made by Hippocrates over two thousand years ago, that "Whoever wishes to study the healing art properly must do this—first, he must attentively consider the seasons of the year," down to the most recent articles in the last numbers of our medical journals, there will be found abundant proof that medical men have been and are fully alive to the important influences which climatic conditions have on disease. The last few years, especially, have witnessed a remarkable increase of interest in this meteorologic or climatic side of medicine, both on the part of medical men themselves and on the part of meteorologists also. The present activity along these lines seems to be largely, if not wholly, due to the fact that meteorology is itself so young a science that it has not been able, until recently, to offer as its contribution to medical or sanitary climatology anything like systematic and reliable