

## XXXI.

### THE SUNSTROKE EPIDEMIC OF CINCINNATI, O., DURING THE SUMMER OF 1881.

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*\* Health Commissioner.*

THE mortality in the city of Cincinnati, during the summer of 1881, was so much in excess of that of any previous summer since the organization of the Board of Health in 1866, that it became important to make due inquiry as to the cause.

The total mortality for the past ten years for the months of July and August was as follows: July, 5,239, an average of 523.9 per month; August, 4,514, an average of 451.4 per month. The percentage per 1,000 per annum for July, was 97.59, that for August, 84.18. For both July and August, 181.77.

The total mortality for these months of 1881 was for July 923, August 584; the percentage per 1,000 inhabitants per annum was, for July, 172.25, and for August, 108.74. For both July and August, 280.99. This number being 99.22 in excess of the average mortality per 1,000 inhabitants per annum during the previous ten years.

The greatest death-rate from any one cause during this time was from sunstroke. By reference to the following tables it will be observed, that the death-rate on each day, exclusive of those charged to sunstroke, is very large.

This is due, no doubt, to the excessive heat, as only those deaths attributed directly to sunstroke are so charged in the tables, while many other deaths occurred from diseases which might not have proven fatal had it not been for the extreme hot weather. Among those were many infantile deaths credited to cholera infantum, diarrhœa, convulsions, and also from old age, exhaustion, etc., etc.

The first death from sunstroke during the past summer occurred May 14. The last death on September 8. The severest of the epidemic commenced July 7, and continued until July 15. The largest number of deaths from sunstroke on any one day was fifty-four, which occurred July 12. The total number of deaths from all causes on that day was ninety-four. Maximum range of thermometer, 102.5° F., minimum, 82.2° F., mean, 91.4° F. Relative humidity, 45.8. Weather clear.

*Table of Deaths from Sunstrokes during the Summer of 1881, together with the Meteorological Observations and Total Death Rate.*

Date, 1881.	Number of Deaths from Sunstroke.	Thermometer.			Barometer. Daily Mean.	Relative Humidity. Daily Mean.	Rain-fall. Inches.	Total Deaths from all Causes.	State of Weather.
		Maximum.	Minimum.	Daily Mean.					
May 14 . . . . .	1	87.0	64.5	74.2	29.876	69.0	1.21	27	Cloudy.
May 26 . . . . .	1	87.0	64.0	77.0	30.089	43.7	.00	15	Clear.
May 31 . . . . .	1	86.0	71.0	76.2	29.806	60.3	.03	16	Fair.
June 29 . . . . .	1	94.0	76.5	84.6	29.867	73.3	1.00	28	Fair.
July 1 . . . . .	0	82.0	65.0	72.3	30.105	54.0	.00	14	Fair.
July 2 . . . . .	0	85.0	65.5	74.3	30.210	55.3	.00	12	Clear.
July 3 . . . . .	1	92.0	67.0	79.0	30.185	51.7	.00	20	Clear.
July 4 . . . . .	1	94.0	73.0	82.2	30.095	51.3	.00	21	Fair.
July 5 . . . . .	1	93.0	75.0	83.7	30.061	56.3	.00	18	Clear.
July 6 . . . . .	0	97.0	78.0	88.0	30.047	58.0	.00	22	Fair.
July 7 . . . . .	16	98.0	82.0	88.9	30.003	57.5	.00	62	Fair.
July 8 . . . . .	18	99.5	81.0	89.4	30.019	53.7	.00	54	Clear.
July 9 . . . . .	21	100.5	79.5	89.9	30.060	53.7	.00	59	Fair.
July 10 . . . . .	30	103.5	80.5	91.1	30.058	50.5	.00	67	Clear.
July 11 . . . . .	39	102.5	82.0	91.7	30.021	47.7	.00	69	Clear.
July 12 . . . . .	54	102.5	82.2	91.4	29.966	45.8	.00	94	Clear.
July 13 . . . . .	42	99.2	82.3	89.3	29.990	53.3	.00	76	Fair.
July 14 . . . . .	13	94.3	75.0	83.8	30.040	67.3	1.54	44	Fair.
July 15 . . . . .	11	90.2	74.3	82.4	30.097	67.3	.20	28	Fair.
July 16 . . . . .	5	95.0	76.5	86.3	30.025	66.3	—	22	Cloudy.
July 17 . . . . .	5	87.0	69.5	76.8	29.944	68.3	.29	24	Fair.
July 18 . . . . .	1	85.0	68.5	75.8	29.943	53.3	.00	8	Clear.
July 19 . . . . .	5	87.5	67.2	75.0	29.919	55.2	.00	19	Clear.
July 20 . . . . .	0	90.0	68.0	80.6	29.878	51.3	.00	21	Fair.
July 21 . . . . .	1	87.0	72.8	76.2	29.849	87.7	.93	10	Cloudy.
July 22 . . . . .	3	86.0	71.0	77.0	29.792	73.7	.01	16	Cloudy.
July 23 . . . . .	1	86.0	68.4	76.4	29.955	61.7	.00	22	Clear.
July 24 . . . . .	0	90.0	69.0	77.8	29.949	59.2	.00	20	Clear.
July 25 . . . . .	0	89.6	72.4	79.7	29.924	52.3	.00	12	Fair.
July 26 . . . . .	0	81.0	69.0	74.0	29.995	56.3	.00	14	Fair.
July 27 . . . . .	0	81.0	63.5	72.7	30.023	56.7	.00	18	Clear.
July 28 . . . . .	0	82.0	64.0	73.3	30.036	55.3	.00	9	Clear.
July 29 . . . . .	0	83.0	66.0	73.1	30.080	68.0	.15	18	Clear.
July 30 . . . . .	0	84.0	66.8	75.3	30.141	64.3	.00	19	Clear.
July 31 . . . . .	0	89.0	67.8	77.8	30.150	60.3	.00	13	Clear.
August 1 . . . . .	0	90.5	70.8	80.3	30.101	57.7	.00	22	Clear.
August 2 . . . . .	2	91.5	71.7	82.3	30.090	57.7	.00	30	Fair.
August 3 . . . . .	0	95.0	74.0	84.0	30.100	57.0	.00	18	Fair.
August 4 . . . . .	2	98.0	73.8	84.5	30.084	50.0	.00	19	Fair.
August 5 . . . . .	2	98.0	78.0	86.7	30.035	51.3	.00	22	Clear.
August 6 . . . . .	2	93.0	75.0	78.7	29.984	73.3	.13	25	Fair.
August 7 . . . . .	0	82.0	72.3	75.9	29.998	70.7	.05	13	Fair.
August 8 . . . . .	0	84.3	64.5	73.8	30.053	59.3	.00	13	Clear.
August 9 . . . . .	2	97.2	70.0	85.4	29.900	50.3	.00	30	Clear.
August 10 . . . . .	0	94.0	77.0	83.8	29.895	51.0	.00	25	Clear.
August 11 . . . . .	0	90.3	71.8	80.5	29.966	44.7	.00	13	Clear.
August 12 . . . . .	0	101.0	72.7	87.1	29.880	47.0	.00	21	Fair.
August 13 . . . . .	1	93.0	75.0	83.0	29.884	57.7	.07	21	Cloudy.
August 14 . . . . .	1	81.5	65.0	72.3	30.017	56.7	.00	19	Fair.
August 15 . . . . .	0	83.5	62.3	71.7	30.111	45.3	.00	17	Clear.
August 16 . . . . .	0	85.3	63.0	74.5	30.097	46.3	.00	13	Clear.
August 17 . . . . .	0	87.5	68.0	78.2	30.019	62.3	.00	19	Fair.
August 18 . . . . .	0	82.0	68.3	72.3	29.954	66.3	.01	14	Cloudy.
August 19 . . . . .	0	81.0	66.9	75.0	29.956	52.3	.11	11	Cloudy.
August 20 . . . . .	0	85.0	70.5	77.6	29.917	64.0	.00	11	Fair.

*Table of Deaths from Sunstrokes during the Summer of 1881, together with the Meteorological Observations and Total Death Rate — Continued.*

Date, 1881.	Number of Deaths from Sunstrokes.	Thermometer.			Barometer. Daily Mean.	Relative Humidity. Daily Mean.	Rain-fall. Inches.	Total Deaths from all Causes.	State of Weather.
		Maximum.	Minimum.	Daily Mean.					
August 21 . . .	0	82.3	70.3	75.8	29.932	66.0	.00	17	Cloudy.
August 22 . . .	0	82.0	67.0	74.3	30.055	54.0	.00	25	Clear.
August 23 . . .	0	84.5	65.5	74.5	30.148	45.3	.00	11	Clear.
August 24 . . .	0	88.5	65.5	76.3	30.194	44.7	.00	18	Clear.
August 25 . . .	0	91.5	66.8	78.3	30.169	46.7	.00	14	Clear.
August 26 . . .	0	91.5	68.0	79.5	30.120	53.0	.00	27	Clear.
August 27 . . .	0	92.0	69.4	80.2	30.095	55.0	.00	24	Clear.
August 28 . . .	0	95.0	71.5	83.3	30.046	47.7	.00	17	Clear.
August 29 . . .	0	96.0	77.0	87.0	30.062	53.3	.00	17	Clear.
August 30 . . .	1	94.5	80.0	86.8	30.170	59.3	.10	24	Fair.
August 31 . . .	0	91.0	72.0	81.8	30.117	64.7	.29	14	Fair.
September 1 . . .	0	87.0	71.0	79.4	30.063	65.3	—	16	Fair.
September 2 . . .	0	87.0	73.0	79.7	30.009	64.3	.00	21	Cloudy.
September 3 . . .	0	89.0	71.5	80.2	29.986	65.3	.00	17	Fair.
September 4 . . .	0	87.0	74.5	80.3	29.990	68.0	.54	14	Fair.
September 5 . . .	0	95.0	74.5	84.8	30.083	58.3	.00	17	Clear.
September 6 . . .	2	95.0	76.8	86.3	30.155	59.0	.00	16	Clear.
September 7 . . .	0	93.0	76.5	84.7	30.154	60.3	.00	29	Clear.
September 8 . . .	1	93.0	75.0	83.2	30.123	61.3	.00	16	Cloudy.
September 9 . . .	0	91.5	75.0	82.8	30.050	59.3	.00	18	Fair.
September 10 . . .	0	93.0	73.0	80.5	29.964	61.3	.00	19	Fair.
September 11 . . .	0	75.0	60.0	66.3	30.145	44.3	.00	16	Fair.
September 12 . . .	0	80.0	58.0	68.0	30.143	51.0	.00	13	Clear.
September 13 . . .	0	80.0	60.7	70.7	30.139	45.3	.00	17	Clear.
September 14 . . .	0	78.0	60.5	68.9	30.020	64.0	.15	19	Cloudy.
September 15 . . .	0	73.0	64.8	69.1	29.704	86.0	.94	20	Cloudy.
Total . . . . .	288	—	—	—	—	—	—	1,863	

27.40 per cent. of total deaths were from sunstroke.

72.60 per cent. of total deaths were from other causes.

The fatal cases of this disease are classified as follows :—

Whites . . . . .	279
Colored . . . . .	9
Total . . . . .	288

#### NATIVITIES.

Born in Cincinnati . . . . .	49
Born in other parts of the United States . . . . .	46
Total United States . . . . .	95
Born in Germany . . . . .	131
Born in Ireland . . . . .	53
Born in England . . . . .	2
Born in other foreign countries . . . . .	4
Birth-place not known . . . . .	3
Total . . . . .	288

In consequence of the prevailing impressions that a hot and humid atmosphere predisposes to sunstroke, we have taken great pains to analyze the meteorological observations, which are herewith submitted. These observations were taken by the United States Signal Corps, and are therefore reliable. The object in thus presenting these tables is to prove by the observations, that the *drier the atmosphere* the greater will be the increase in the death-rate from insolation.

During the epidemic of 1881, there were two hundred and eighty-eight deaths returned as due directly to sunstroke.

The following meteorological observations have been carefully compiled and studied, and will prove very interesting in their bearing upon this cause of death.

1st. When the maximum reading of the thermometer was from 100 to 105° F., there were 151 deaths, occurring in four days, an average of 37.75 per day. The mean reading being 88.5° F., and the weather clear. The humidity of the atmosphere (obtained by means of wet and dry bulb thermometer), 49.6, this being  $\frac{1}{10}$  of 1° below one half saturation (complete saturation being 100).

2d. Maximum reading of thermometer in three days, ranging from 87 to 102.5° F. Mean thermometer, 85.7° F. Humidity, between 40 and 50. Number of deaths, 89. Average per day, 29 $\frac{2}{3}$ .

3d. Maximum reading of thermometer in eighteen days, ranging from 82 to 103.5° F. Mean thermometer, 84.6 (average). Humidity, between 50 and 60. Number of deaths, 174. Average per day, 9.66 $\frac{2}{3}$ .

4th. Maximum reading of thermometer in eight days, ranging from 86 to 95° F. Mean thermometer, 79.9 (average). Humidity, between 60 and 70. Number of deaths, 22. Average per day, 2.625.

5th. Maximum reading of thermometer in three days, ranging from 86 to 94° F. Mean thermometer, 91. Humidity, between 70 and 80. Number of deaths, 3. Average per day, 1.

6th. Maximum reading of thermometer in one day, 87° F. Mean thermometer, 76.2. Humidity, between 80 and 90. Number of deaths, 1. Average per day, 1.

It is an interesting fact to note that out of 288 deaths which occurred, 263, or 91.32 per cent. of the whole number of deaths occurred on days when the humidity (moisture) of the atmosphere was below 60, and 129, or only 44.79 per cent., occurred on cloudy or partly cloudy days.

The following tables have been classified, so as to enable us to better understand the meteorological conditions that were at this time present:—

Humidity (saturation being 100).	Number of Days.	Number of Deaths.	Rate per Day.
Between 40 and 50 . . . . .	3	89	29 $\frac{2}{3}$
Between 50 and 60 . . . . .	18	174	9.66 $\frac{2}{3}$
Between 60 and 70 . . . . .	8	21	2.625
Between 70 and 80 . . . . .	3	3	1.
Between 80 and 90 . . . . .	1	1	1.

Weather.	Number of Days.	Number of Deaths.	Rate per Day.
Clear <sup>1</sup> . . . . .	14	159	11.81
Fair <sup>2</sup> . . . . .	16	125	7.8
Cloudy <sup>3</sup> . . . . .	3	4	1.33½

The foregoing observations, which have just been presented, establish this fact: that as far as Cincinnati is concerned, the thermometer being the same, a dry atmosphere is much more conducive to sunstroke than a hot and moist atmosphere. This fact is contrary to the opinion of many authors, as will be seen in the following quotation from "Reynolds' System of Medicine," volume two, page 135, second edition:—

"There is no agreement among observers as to the effect of extreme dryness or moisture in increasing or diminishing the effect of heat. Insolation has been observed in both conditions. In the case of the Forty-third Regiment (English light infantry), the hot, dry, land winds were blowing. Mr. Longmore also notes the extreme dryness of the air at Barrackpore during the outbreak there, and in all the examples given, the disease disappeared with the first heavy fall of rain, attended with a rapid fall in temperature. On the other hand, Dr. Baxter, of the Ninety-third Highlanders, who gives four cases of sunstroke observed at Sealkote, considers that sunstroke is much more likely to occur when the atmosphere 'is largely impregnated with watery vapor.'"<sup>4</sup>

Mr. Naylor is of the opinion that cloudy days, with a moist condition of the atmosphere, favor the occurrence of insolation.<sup>5</sup> Exact observations on this point, with the wet and dry bulb, are much required.

"It would appear that a hot and moist condition of the air is most favorable to the production of insolation in barracks, because not only does such a condition diminish the cooling effects of evaporation from the skin, but interferes with the artificial means used to reduce the temperature of the overheated rooms."

No doubt this was the opinion arrived at by many eminent writers without being proven by actual meteorological observations. This opinion is not only questioned, but disapproved by the foregoing observations. For we find upon thorough investigation, that when the amount of moisture in the atmosphere was above 60, only 25 deaths occurred; while on the other hand, when the humidity was below 60, 263 deaths took place,—this being over ten times the number that died while the atmosphere was moist.

The number of sunstrokes and prostration from heat in our city was truly alarming. Many persons who suffered from this prostration during the extreme weather were not exposed to the direct rays of the sun, but succumbed

<sup>1</sup> Clear, means sky unclouded.

<sup>2</sup> Fair, means sky half or more clouded.

<sup>3</sup> Cloudy, means sky overcast more than three quarters.

<sup>4</sup> *Dublin Quarterly Journal of Medical Sciences*, No. 81, February, 1866.

<sup>5</sup> Morehead's *Clinical Researches*.

in some of the many factories or shops. Many others were taken while employed at their daily avocations, and others while on their way to and from their places of business. Many of those who were overcome by the heat became unconscious at once, while others were simply prostrated; and again many more were taken at their homes, and were not considered sun-struck. Many of those persons who became unconscious on the streets were taken at once to the City Hospital, which is located near the centre of the city.

We found that where patients in this condition were removed any great distance, the danger of the disease was greatly increased. To obviate this difficulty, temporary hospitals were established in each ward of the city, to facilitate the officers in summoning medical aid, and to protect the patient from the direct rays of the sun, and avoid the heated atmosphere which must necessarily be encountered in close-covered hacks or ambulances, by transporting them a long distance to the General Hospital.

Directions were also given as to the treatment to be resorted to in the absence of the medical attendants. The patient was to be placed in a cool place, ice to be applied to the head, and the whole body sponged with water, and ammonia and whiskey administered internally. After these measures had been taken, the number of fatal cases perceptibly decreased. The total number of cases of insolation that occurred was estimated to be over 2,000.

The number of cases treated by the physicians to the out-door poor was 308, of which 265 recovered and forty-three died, or 16 per cent., or one in seven.

The number of cases treated at the City Hospital was 130. Of these 107 recovered and 23 died, this number being 17.69 per cent. deaths, or one in six.

The greater mortality at the hospital may be accounted for by the fact that many were brought there in a dying condition, and some died on the way to the hospital.

I am indebted to Dr. Walter A. Dunn, *interne* to the Cincinnati Hospital, for the following facts in reference to the symptoms and treatment of cases that occurred in that institution : —

Table showing the Number of Cases admitted into the Cincinnati Hospital, together with Result of Treatment, Condition, Color, etc.

Number of Cases.	Number Recovered.	Number Died.	Number Unconscious.	Number Temperature Range above 103°.	Number Temperature Range above 107°.	Colored.	White.	Post Mortems.	Number Pulse above 120.	Opisthotonos Convulsions.	Number Dilated Pupils.	Number Contracted Pupils.
130 <sup>1</sup>	107	23	35	16	9	4	126	0 <sup>2</sup>	42	3 <sup>3</sup>	31	14

Table of Twenty-seven Cases treated at the Cincinnati Hospital, giving the Condition on Admission, and Results.

Temperature.	Unconscious.	Dilated Pupils.	Contracted Pupils.	Weak and very Rapid Pulse.	Stertorous Breathing.	Number of Post-Mortems.	Number of Cases Treated.	Treated before Arrival at Hospital.	Colored.	White.	Respirations.	Pulse.	Remarks.
101.0	x	x	x	x	x	x	x	x	x	x	30	90	Recovered.
107	x	x	x	x	x	x	x	x	x	x	132	132	Died in 5 minutes.
103	x	x	x	x	x	x	x	x	x	x	86	86	Recovered.
99	x	x	x	x	x	x	x	x	x	x	19	100	Recovered.
100	x	x	x	x	x	x	x	x	x	x	108	108	Recovered.
99	x	x	x	x	x	x	x	x	x	x	36	90	Recovered.
100	x	x	x	x	x	x	x	x	x	x	40	104	Recovered.
100	x	x	x	x	x	x	x	x	x	x	120	120	Recovered.
101	x	x	x	x	x	x	x	x	x	x	32	138	Recovered.
104	x	x	x	x	x	x	x	x	x	x	32	128	Recovered.
100	x	x	x	x	x	x	x	x	x	x	32	108	Recovered.
107	x	x	x	x	x	x	x	x	x	x	32	184	Recovered.
98	x	x	x	x	x	x	x	x	x	x	20	84	Recovered.
101	x	x	x	x	x	x	x	x	x	x	32	152	Recovered.
102	x	x	x	x	x	x	x	x	x	x	120	120	Died in 3 hours.
104	x	x	x	x	x	x	x	x	x	x	120	120	Opisthotonos; died 25 days after.
101.2	x	x	x	x	x	x	x	x	x	x	175	175	
101.4	x	x	x	x	x	x	x	x	x	x	108	108	
103	x	x	x	x	x	x	x	x	x	x	120	120	
101	x	x	x	x	x	x	x	x	x	x	100	100	Died in 30 days of meningitis.
103.4	x	x	x	x	x	x	x	x	x	x	132	132	
97.6	x	x	x	x	x	x	x	x	x	x	80	114	
98	x	x	x	x	x	x	x	x	x	x	120	120	
96.6	x	x	x	x	x	x	x	x	x	x	151	151	
104	x	x	x	x	x	x	x	x	x	x	108	108	
100.4	x	x	x	x	x	x	x	x	x	x	28	108	
103	x	x	x	x	x	x	x	x	x	x	36	144	

The following is the clinical history of three typical cases, showing the difference in the symptoms and course of the disease:—

CASE No. 1. Julia H. June 10, 1881, A. M. Age, 45; born in Ireland; single; occupation, laundress; drinker.

Previous history: She is very poorly developed and nourished. Blue eyes, light gray hair, contracted face and features, face covered with lines and

<sup>1</sup> In six cases insanity followed.

<sup>2</sup> Could not obtain consent of friends in time.

<sup>3</sup> Two recovered.

wrinkles. She is much debilitated by her bad habits and the discharge from an ulcer on the right leg.

Present condition: There is a large ulcer on the anterior and lateral surfaces of the right leg, about five inches above the ankle. The ulcer is about four inches in diameter, and is filled with poor, bluish granulations. This ulcer began about ten years ago, and has continued ever since, becoming better when she laid up and had it treated in the hospital. Twice during this period of ten years the ulcer almost healed, and she never stayed long enough to have it completely healed. Ordered flaxseed poultice.

*June 15.* The discharge is greater and consists of healthy pus. The granulations are becoming redder and more active, and are springing up from the floor of the ulcer.

*July 7.* The granulations looked very healthy. Skin-grafting was advised at this time; she refusing that treatment was discharged from the house.

Diagnosis: Ulcer of the leg. Condition improved.

*July 13.* She was admitted in the morning, very profoundly unconscious. Eyes were rolled up; pupils dilated; head thrown back; mouth widely opened.

Respirations were short, very slow and gasping, with apparently some obstruction about the larynx. Pulse 168, very weak and intermittent, — 1-15; could not be felt at all at the wrist. Temperature, 106. Involuntary evacuations of fæces had occurred some time before. She had a black eye on right side; no other bruises were noted.

Treatment (immediately), hypodermic. Digitaline, one sixtieth grain. This stopped the intermittent character of the pulse very soon, but did not lessen the frequency, nor appreciably increase the force of the pulse. She was placed in a bath of hydrant water, and had ice caps applied to her head and cold water poured on her head from a height while in the tub. She was given hypodermic injections, one sixtieth grain atropia, and again fifteen gts. aqua ammonia and ten gts. sulphuric ether, all without any effect, upon either the pulse or respiration. The temperature fell to 99, and she was removed and placed on a stretcher. Pulse, 168. Respiration gasping, though possibly a little deeper and more frequent. Inhalations of ether were then given, endeavoring only to get the stimulating effects. The respirations almost immediately became fuller, longer, more natural and easy. The pulse became stronger and slower. Inhalations stopped. A few minutes after she returned to her old condition, same as on entering, temperature alone remaining down. Inhalations were again tried with a result similar to before; consciousness did not return.

When respiration became quiet again, was sent from the accident ward to the medical ward.

The same symptom, that of very difficult respiration, again manifested itself in the ward, and was again relieved by ether. This symptom returned again and again, and was controlled each time in the same manner.

The temperature remained at the normal, but the heart began to fail, and would not respond to any of the agents employed hypodermically. Death resulted about eight hours after attack. No autopsy.



CASE No. 2. Mike B. Was admitted about midnight, July 12. He was brought from Hammond Street police station. Had been there some time before the ambulance could be got there.

His condition was so bad that the officers thought it was not worth while to take him to the hospital, as he would surely die on the way. On admission his pulse was 175, and very weak; temperature, 105; pupils contracted. He breathed with the greatest difficulty. Convulsions were coming on at intervals of a few minutes, and were marked by opisthotonos. Lividity of face, frothing at mouth, and tonic contraction of muscles, involving more especially the upper extremity, and especially dangerous as affecting the muscles of respiration.

The sphincter-ani muscles were relaxed, and involuntary evacuations of fæces had occurred. Was given hypodermic injections of digitaline, atropia, ether, and alcohol in rapid succession, without any material effect; his temperature increased and the pulse rose.

Cold was applied, and this seemed to induce the convulsions more frequently. The pulse became very rapid, could just be felt at femoral artery, and rose to 280 per minute.

Thinking the man's condition could not be made worse, sixty minims of aqua ammonia were given hypodermically. Immediate effect was noted; the heart responded, and in five minutes beat 140, with fair strength. Ether was next required, viz., to quiet the convulsions, and was repeated as often as the convulsions returned. About three A. M. he was sent to the ward, and the ether was continued whenever the convulsions returned. He became better gradually, and was rational in the morning.

July 15. Abscesses developed where the ammonia had been injected. They were opened and a large quantity of pus escaped.

He became stupid and lost all reason about this time, and appeared "idiotic." The abscesses were dressed daily, but he grew weaker and worse, and died in two weeks afterward, on August 4, of septicæmia.

CASE No. 3. "Doc" M. July 13, 1881. Aged 43.

When admitted was unconscious. Pupils dilated, pulse 72, and weak; temperature, 96. [Had been treated before his admission.] He was sent to the medical ward from the accident ward. On his arrival there it was found that his temperature had risen to 106. Pulse quite rapid and weak; stertorous breathing; contracted pupils; profound unconsciousness. His temperature was reduced by cold. Stimulants were administered hypodermically. He remained unconscious for a day or two; this was followed by delirium, which in turn continued for a few days, and then he appeared to be rational, though he was flighty at times. A day or two later he sat up and was much better. A week after he was walking about the ward. In the mean time it was discovered that he took outside about 3j of morphia every week, and was a hard drinker. A day or two later he had nervous attacks, a "general tremulous" condition of all the muscles of the body, with sleeplessness and easy fatigue, and unsteadiness of speech. Thinking this was in a measure due to the sudden withdrawal of the whiskey and morphine to which he had been accustomed, small doses of morphia were

ordered for him. At this time he was quite rational, but absolutely refused to take the morphia, saying he wanted to break off the habit.

*July 24.* He was about the ward apparently rational, and gave material and intelligent assistance to the *interne* in treating cases. In one case particularly, where a man was inclined to refuse all medicine offered, he displayed a great deal of ingenuity in getting him to take it. His condition was about the same from day to day.

*August 6.* Nearly four weeks after admission, while talking to him, the *interne* discovered that he had just begun to recollect things. He had never heard of the man with whom he had displayed so much ingenuity in getting to take medicine; did not know he had been sick himself. In short, this whole period of some three weeks and more was a blank in his memory. He recovered fully, and was discharged well.

Sunstrokes can very appropriately be arranged into three varieties:—

I. Marked congestion of brain, denoted by contracted pupils, unconsciousness, full, rapid, bounding, incompressible pulse, high temperature and congestion of surface, particularly well marked in the upper extremities and head and neck, great difficulty of respiration, and at times *convulsions*. In these cases the heart's action was reduced, when the temperature was reduced.

II. Partake of the nature of the first, with the symptom added of great enfeeblement, or depression of the heart's action, instead of increased action of the heart; in other words, the heart's action is changed, possibly by involvement of the cardio-inhibitory centre.

III. Cases of profound depression, where the patients lie unconscious, dilated pupils, pale face and lips, pulseless at the wrist, very feeble and rapid action of the heart, shallow and insufficient respirations, and often, after return of consciousness, still retain a weak and rapid pulse, and a general enfeebled condition of vital force, as shown by muscular effort, weak stomach, etc.

#### CONDITION OF CASE CONSIDERED IN REFERENCE TO TREATMENT.

It will be noticed that the three classes of cases are marked by a great difference of the symptoms, and that the treatment varies with the symptoms, "in other words, no set line of treatment for sunstroke can be laid down." The treatment is entirely *symptomatic*, and needs careful and accurate observation, in order to be able to treat them scientifically or satisfactorily.

The symptoms demanding most attention and most active treatment were,—

1. Temperature. (a.) Elevated; (b.) Depressed.
2. Heart. (a.) *Increased action*, being rare and not in any of our cases requiring treatment; (b) *depressed action*, calling forth all means, often without avail.
3. Convulsions, with opisthotonos, demanding careful administration of ether.
4. Respiration. (a.) Difficult and slow, connected with spasmodic con-

ditions of larynx; (*b.*) failure of respiration; three, requiring artificial respiration;—two patients were saved in this way.

After treatment had reference to the condition left, the former habits, and the indications in the weather: first, prevention, ice caps, and cold cloths to head; second, nourishing diet, tonics, and small amounts of stimulants.

#### METHOD OF TREATMENT PURSUED. — IMMEDIATE TREATMENT.

1st. *Temperature.*—(*a.*) Temperature below normal. Warm flannels, wrung out of hot water, and warm beef tea, by mouth or per rectum.

(*b.*) Elevated temperature were treated by *cold* in some form. Where  $103^{\circ}$  and above, baths cooled from  $95^{\circ}$  to  $90^{\circ}$ , and careful watching of the temperature of the body, to see that it did not get below normal. Where the case required repeated baths, sometimes cold packs and sprinkling with ice water was resorted to. Small pieces of ice, with the edges carefully rounded, were placed in the rectum until it was packed full, and in all cases ice caps were applied to the head in or out of the bath.

2d. *Consciousness.*—In order to stimulate the return of consciousness, ice water was poured on the forehead in small amounts and in a continuous stream from a height, thereby using the “reflex action” of the fifth nerve to arouse consciousness.

3d. *Convulsions* were controlled by careful administration of ether, enough to get the cerebral centres quieted, yet not enough to produce depression in them.

4th. *Respirations* were stimulated by ether and atropia hypodermically, using 15 m. ether and  $\frac{1}{40}$  to  $1\frac{1}{20}$  gr. atropia.

5th. *Pulse and Heart.*—Failure of the heart in both “anæmic” and “congestion” varieties, was a most alarming symptom. Intermittent action of the heart was controled by digitalis or by digitaline. The force of the heart was sometimes increased by it. The other agents used in stimulating the heart were whiskey, ether, atropia, and aqua ammonia.

6th. In the marked cases of the congestive variety, hot water treatment was tried: baths of a temperature of  $110^{\circ}$ , and patient immersed, with his head surrounded by ice caps, and with cold water poured on it, with the view of increasing the capillary circulation of the body, and thereby decreasing the amount of blood going to the head. In all cases where this was tried it was unsuccessful.

#### MODES OF ADMINISTRATION AND WAYS OF REDUCING THE TEMPERATURE.

*Reducing Temperature.*—In all cases where the temperature was  $102^{\circ}$  or below, sponging the naked body, first with tepid water, and afterward with successively colder and colder water, advancing by a few degrees each time, seems the best, easiest, and most satisfactory way.

Above  $102^{\circ}$ , baths cooled from  $95^{\circ}$  to  $90^{\circ}$ , with careful watching, seemed the best, although circumstances required us to resort to “cold packs.” A sheet closely tucked over the naked body, and using hydrant water at first, and in cases of persistent high temperature, finally resorting to colder and colder water, until you reach ice water. In all cases the heads were covered and surrounded by ice caps and bladders filled with ice.

*As regards Administration of Remedies.* — The order to which preference should be given is about as follows, though we were guided by the effects obtained : first, by mouth ; second, by rectum ; third, by hypodermic ; fourth, by inhalation.

*By Mouth and Stomach.* — In most severe cases, unconsciousness, convulsions, vomiting, or other difficulties, made the administration by the mouth difficult and tedious, when rapidity was necessary ; and in other cases, where the stomach was overloaded with beer, etc., vomiting followed so that much time and medicine was lost ; again, in greatly prostrated cases with very weak and rapid pulse, absorption, or the effect as noted from the medicine, was slow in coming. Still, in certain cases, where rapidity was not desired, and when it could be used, it was found to be easy and undoubtedly proper ; and in cases where the action is not sufficient, other means can be resorted to.

*By Rectum.* — Many severe cases had relaxed sphincters, and others had diarrhoeas and involuntary discharge of fæces. In all cases of this kind, the method of administration by rectum had to be abandoned for others. Whiskey, warm beef tea, tincture digitalis, and carbonate of ammonia, were used, and the effect appeared to be better and more rapid than when administered by the mouth, and suitable to cases where, for other reasons, the stomach could not be reached.

*By Hypodermic.* — In cases where rapid action is necessary, and where other means fail, this can be used, by combining a number of different agents. You can undoubtedly get a larger amount of stimulation than by any one agent, and with less danger of producing bad effects from too much of a single remedy. *Digitaline* for the heart, when intermittent, *ergotine* for contraction of the capillaries, *atropia* for stimulating heart and respiratory centres, *whiskey* and *aqua ammonia* and *ether* for stimulating effect on the heart.

Carefully noting your case and its symptoms, you choose the one best adapted to the symptoms. If you do not get a good and rapid effect by the others, and where death seems inevitable, "heroic treatment" by hypodermic of aqua ammonia, as in Case No. 2 (Mike B.), is justifiable and right. Experience seems to show us that deep injections of aqua ammonia, diluted one fifth, do not often produce an abscess. You can use alcohol or water for diluting it.

*Amount or Doses Administered.* — (1.) Ammonia carbonate, 20 gr., repeat 2 hours. (2.) Whiskey,  $\frac{3}{4}$  j.  $\frac{3}{4}$  ss. and repeat p. r. n. (3.) Tinct. digitalis, 10–20 gtt., repeat p. r. n. (4.) Digitaline (hypod.),  $\frac{1}{16}$  –  $\frac{1}{8}$  gr. (5.) Ether, 10–20 m. (6.) Aq. ammonia, 10–60 m. (7.) Whiskey (hypod.), p. r. n.

We found we could not adhere to any established doses ; and in all cases were guided in frequency of administration and amounts given by the effects produced.

Ether administered by inhalation produced three effects, not all noted in the same case : First, it sometimes stimulated the pulse, which became stronger and less frequent ; second, it made respiration easier and deeper ; and third, it quieted convulsions.