made by Dr. W. R. Miller, surgeon to the West Riding convict prison. Dr. Miller experimented on about four thousand prisoners for thirteen years, and obtained results that differ sensibly from those of Mr. Hansen; for he found that the season of maximum increase in weight in adults is from April to August, and the period of minimum increase in adults from September to March. Dr. Miller found the body became heavier in summer, and lighter in winter; and he attributes the loss of weight to the more active excretion of carbonic-acid gas in the colder months.

DIFFERENT PHYSIOLOGICAL SENSES FOR HEAT AND COLD.

IN connection with the researches of Professor Hall and Dr. Donaldson of Johns Hopkins university, recently given in *Mind*, it will be of interest to state that Mr. A. Herzen has lately published in the *Archiv für physiologie*[1] the results of a series of experiments showing that the physiological sense of cold is different from that of heat. His attention was first directed to the subject by a simple incident, the verification of which may be readily made by any observer. Awakening one night, he found one of his arms lying without the bed-clothes, 'alseep;' in touching it with the other hand, he perceived a distinct sensibility to warmth, while that of touch was gone. Bringing his arm, however, in contact with cold substances, he was surprised to find no sensation.

Pursuing the subject further, he produced artificially this condition of semi-paralysis by the compression of nerve-trunks, and by experimentation discovered that the sensibility to cold remained a short time after tactile impressions had disappeared, and that the sensibility to warmth remained much longer, but not quite as long as the power of detecting pain; also that the impressions of warmth require more time for transmission to the brain than those of cold, bearing, in fact, the same relations to each other as the sense of pain does to that of cold. These results were further supplemented by observations on a person with complete and permanent tactile anaesthesia of the legs, but in whom the sense of pain remained normal. The subject was able to distinguish quite well the differences in temperature between 150° F. and 81° F., which was the normal temperature of the surface of the leg. Below the latter temperature, however, no sensation was produced, not even by the contact of ice on the inner side of the thigh. Other cases showed the same peculiarities, in which, with the disappearance of tactile sensibility, the susceptibility to cold was also lost, while that to warmth yet remained.

Vivisection experiments upon cats and dogs lead the author to the following conclusions: 1. The so-called sense of heat and cold is composed in reality of two senses quite independent both anatomically and physiologically; 2. Observations on healthy and diseased subjects show that the sensations of heat and cold are transmitted through different nerves, by different routes, and to different brain-centres; 3. The gyrus sigmoideus contains the centre (or the centripetal branches leading thereto) of touch and cold perceptions; 4. These sense-perceptions are transmitted through the posterior columns of the spinal cord, while those of the senses of pain and warmth are conveyed through the gray substance.

Although the senses of cold and touch on the one hand, and heat and pain on the other, seem to be more nearly related, yet one cannot unite them, or consider the different perceptibilities of heat and cold mere modifications of those of touch and heat. The researches of Blix and others have demonstrated the existence of separated, isolated, irregularly distributed points upon the body, of which one may be only sensible to cold, another to warmth, and a third to touch. Doubtless most persons have noticed the different degrees of susceptibility of different parts of the body to heat and cold: the author points out striking examples of such.

[1] *Ueber die spaltung des temperatursinnes in zwei gesonderte sinne*, xxxviii. p. 93, December, 1885.

RAINFALL IN SOUTH AFRICA.[1]

LITTLE has been known until recently on the subject of rainfall in South Africa, taken broadly over the whole country, although observers have for many years been keeping records at isolated stations. There has been for many years a meteorological commission in existence at Cape Town; and in the report for 1883 an interesting table was published, giving the means, monthly and yearly, at all stations where records have been kept for at least five years, with the altitude above sea-level, and the latitude and longitude for each station.

From these data Mr. Tripp has prepared a map of South Africa, with the idea of showing the distribution of the total yearly rainfall. The curves divide the area into districts, where the mean yearly rainfall is—

(1) Under 5 inches.
(2) From 5 " to 10 inches.
(3) " 10 " " 20 "
(4) " 20 " " 30 "
(5) Above 30 "

There are doubtless, particularly along the moun-

[1] Abstract of an article by William B. Tripp, in *Symons's meteorological magazine.*

tain ranges, many wet strips and spots where no definite records are kept, and which therefore cannot at present be shown on the map. Multiplication of records, as well as general local knowledge, will, no doubt, reveal many such places.

South Africa may be described as a central tableland, rising in successive terraces from the seacoast. The country has been subject to great erosion from water; and the mountains with which the country is studded, and the deep valleys, locally termed 'kloofs,' with which it is intersected, are principally due to this cause. In some cases the hills are covered with forests, but generally they are now denuded of such covering. Where the streams take their rise in an area denuded of forest, their volumes are highly variable, their beds being dry for, in some cases, three hundred days in the year; their only existence being, in fact, as torrents after sudden thunder-storms. When, however, it fortunately happens that the streams take their rise in an area still largely clothed with forests, they are frequently perennial.

The climate over such a large tract of country as South Africa varies, of course, considerably. The rainfall varies from 2 inches to 50 or 60 inches doubtless, and perhaps more in some of the mountain districts: in the north-west corner of Natal it is considerably over 30 inches. Dividing the country according to the half-yearly distribution of rainfall, we find that on the western and southern sides the fall is generally greater in the winter half of the year from April to September, than in the summer half from October to March; May, June, and July being the wettest months, and the north-west the general rain-bearing wind. On the eastern side, however, the fall is greater in the summer half, March and February being the wettest months, and the south-east the rain-bearing wind. On the south-east coast the dividing-line between these two different characteristics appears to run out to sea very nearly at Port Alfred, where the fall in both halves of the year appears to be very nearly identical, that in the summer half being rather the greater of the two.

Mr. Tripp resided and kept records for some years at King William's Town, in the eastern province, where, on a total of 283 days, from June, 1880, to May, 1883, 70 inches of rain were registered, 30.25 inches of which (recorded on 242 days) were made up of falls under 0.50 of an inch, 19.88 inches (on 28 days) from 0.50 of an inch to 1 inch, and 19.87 inches (on 13 days) of falls of from 1 inch or upwards, in twenty-four hours. The heaviest fall on any one day was 2.04 inches, and the next heaviest fall was 3.11 inches, in forty-eight hours.

Although this record proves that the rains are moderate and tolerably distributed, and do not all occur in sudden storms, yet the author has heard accounts of sudden falls there of a very different character, and most disastrous in their results.