The fluviatile origin of the different gravels, as well as the greater action of ice at the higher levels, is therefore confirmed, as is also the suggestion that the volume of water carried down at the period in question by the rivers was infinitely greater than it now is. At the same time the view now given both explains the origin of the loess, so long an unsettled problem, and harmonizes with the hypothesis before advanced in explanation of the accompanying general phenomena.

XIII. "On the Simultaneous Distribution of Heat throughout superficial parts of the Earth." By Professor H. G. Hennessy, F.R.S. Received June 19, 1862.

(Abstract.)

The principal object of this memoir is to develope the laws of the distribution of temperature in the portion of the atmosphere in contact with the earth, and to point out the connexion between the phenomena of aërial temperature and those of soil and oceanic temperature. The author maintains that hitherto no perfect physical representation of the distribution of heat over the earth's surface has been obtained. Humboldt's luminous method of representing the distribution of mean temperatures necessarily presents us with the temperatures of places at those hours of local time when the temperature happens to be equal to that of the entire day. But such hours occur at different places not at the same moment of absolute time, and therefore the isothermal lines traced by the aid of their results alone, are not true isothermal lines in the same sense as we understand an isothermal line or surface within crystals, or other definite geometrical solids which have been recently the subjects of thermological inquiry.

The distribution of sunshine at the outer limits of the atmosphere and at its base is first considered, and the nearly circular shape of the lines of equal sunshine is pointed out. After showing the connexion between these lines and the simultaneous isothermals for the air, land, and water, the author proceeds to more particularly discuss the aërothermal lines. As the term isothermal line has become universal in the sense of a line joining places possessing the same mean temperatures, the author proposes to designate the true lines of si-

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multaneous equal temperature as synthermal lines. If any number of places have the same temperature at a given hour corresponding to the mean time of any one meridian, these places will be synthermal, and a line joining them will be a synthermal line. For this purpose the meridian of Greenwich has been selected, and a series of synthermal Tables have been calculated for different places corresponding to the Greenwich hours. For the construction of these Tables, the hourly observations of temperature made at the British Home and Colonial Observatories, the observations of Russia, Austria, Prussia, and Central Europe, as well as those of the United States, have been employed. The few series of hourly observations made by Arctic and African travellers have been also applied; and in addition to the Tables thus directly constructed, others have been deduced by interpolation for stations whose geographical position rendered it desirable to bring them into the general view of temperature-distribution. All results expressed in Centigrade and Reaumur degrees have been reduced to the Fahrenheit scale. A fresh set of Tables has been formed from those corresponding to local time, with hours corresponding to the meridian at Greenwich.

The synthermal Tables thus obtained show, as might be *à priori* expected, still greater differences between the temperatures of places in the same parallels of latitude than the Tables of mean temperature. Thus Rome and Tiflis differ in latitude by only 13′, and the mean temperature of Rome is 5°·1 in excess of that of Tiflis. At 8 A.M. Greenwich time, they are synthermal, both possessing the temperature of 59°·1, while at 7 A.M. Tiflis surpasses Rome by 0°·6, and at all other times besides these Rome surpasses Tiflis. At 4 A.M. this excess amounts to 9°·5. Although Pekin is situated in the isothermal line which passes close to the Isle of Wight, it is synthermal at 5 A.M. (Greenwich) to some place 6° warmer than Rome, and probably therefore on the north coast of Africa, and is synthermal with a point north of the Orkneys at between 8 and 9 in the evening. Similar comparisons of distant places in both hemispheres lead to similar results. It appears that during certain periods of the day, alternately hot and cold spaces exist in the interior of the continents compared to the surrounding oceans. In the southern hemisphere the rising of synthermal temperatures appears to be a little inferior to what it is in the northern, if we compare together stations

with nearly corresponding latitudes and differences of longitude in both hemispheres.

From the results tabulated in his synthermal Tables, the author has projected on an equatorial map of the world, the synthermal lines of 4 A.M. and 2 P.M. Greenwich time. This map clearly exhibits the risings of the synthermals, and the existence of spaces of maximum temperature. The synthermals in both hemispheres rise towards the poles opposite these spaces, and converge towards the space of minimum tropical temperature. In islands circumstanced like the British Isles, the synthermals may be represented by two systems of closed curves, one for the day with an interior space of maximum temperature, and the other for the night with an interior space of minimum temperature. These groups would be connected somewhat in the way of the magnetic curves delineated by Gauss in his Theory of Terrestrial Magnetism (Taylor's Scientific Memoirs, vii.). The shapes of these groups would closely resemble the isothermals already published by the author*, and which, from the small differences of longitude in our islands, may be conceived to represent very closely the synthermals of 9 A.M. and 8 P.M.

The probable shapes of the lines of equal soil temperature, or syngeothermals as the author calls them, are next considered; and it is shown that they must not only present far more remarkable deviations from equatorial parallelism than the synaërothermals, but also that their diurnal rising must be very considerable.

The author points to the connexion between some of his results and the diurnal law of the wind force discovered by Mr. Osler; and he also shows how the abnormal regressions of temperature in the latter months of spring may be partly explained by the circumstance that, although the isothermals of mean temperature during these months do not deviate widely from equatorial parallelism, the synthermals not only swing to a greater extent than during most of the other months of the year, but that they are also more closely crowded together.

These results are most strikingly developed during the month of May.

* Proceedings, vol. ix., and Atlantis, vol. i.