MAGNETIC VARIATIONS.[1]

IN this paper the author refers to the ordinary variations of the magnetic elements as observed at Greenwich; the annual progressive change; the diurnal variation—large in summer, small in winter, and also larger when sun-spots are numerous and smaller when sun-spots are few; the irregular magnetic disturbances and magnetic storms, and the accompanying earth currents; phenomena which are generally similar at other places.

He then invites attention more particularly to magnetic disturbances. Those at Greenwich may, after a calm period, arise gradually or commence with great suddenness. When sudden, the movement is simultaneous in all elements. The first indication may be a sharp, premonitory, simultaneous movement, followed after a time by general disturbance, or the movement may at once usher in the disturbance. These initial movements are not always great in magnitude, sometimes, indeed, small, but they have a very definite character, and frequently occur nearly instantaneously, as is shown in the character of the photographic traces.

It has been long known that magnetic disturbances occur at the same time over wide areas of the earth's surface, but the accidental comparison in past years of the times of commencement of one or two disturbances at Greenwich with the times at other places has led the author to suppose that the coincidence in time is much closer than had been before supposed, and the definite, and on occasions isolated, character of the initial movement induced him to undertake the collection and comparison of the times of such movements for a number of days at observatories geographically widely separated.

The times of such movements cannot be caught by eye observation without continuous watching of the magnets, so that the photographic registers have to be relied upon, which is better, excepting that the scale of time is necessarily contracted; but, though in individual measures there might be variations, it was conceived that (supposing no systematic error to exist) the mean of a number of comparisons should give a good result. Seventeen days, occurring in the years 1882 to 1889, were selected for comparison, the observatories being those of Toronto, Greenwich, Pawlowsk, Mauritius, Bombay, Batavia, Zi-ka-wei, and Melbourne, and, for a less number of days, Cape Horn (as obtained from the Mission Scientifique du Cap Horn, 1882-83). It was desired to have times for Pola, but it was found that photographic registers during great part of the period did not exist. The variation in time at each place from the mean of times for all places is given for each day. The mean deviation at the different places varies from +2·4 minutes to −2·9 minutes, the agreement between four of the places—Greenwich, Pawlowsk, Mauritius, and Bombay—being very much closer, the mean values of deviation for Greenwich, Pawlowsk, and Bombay differing, indeed, by only 0·1 minute, equivalent to 6 seconds.

The question arises, Are the differences real, or due (considering the contracted time scale) to accidental error? If the magnetic impulse is really simultaneous over the whole earth, it is a striking physical fact, and if not entirely so, the circumstance is no less interesting; but greater attention to accuracy of time scale, or a more extended scale, may be necessary before the point in question can be definitely settled.

A table is added, showing the character of the magnetic movement at the several observatories, from which it appears that at any one place the movements on different days were in most cases similar, though different at different places, indicating on these occasions the occurrence usually of one general type of disturbance.

Reference is made to the question of earth currents. A comparison for thirty-one days, between 1880 and 1891, of cases of sudden magnetic movement and earth current at Greenwich, shows the earth current to precede the magnetic movement by 0·14 minute, equivalent to 8 seconds. The question of the relation between magnetic movements and earth currents is discussed.

The desirability of being able temporarily to obtain, when occasion requires, a more extended time scale for all magnetical and meteorological phenomena is pointed out.

The general result is that in the definite magnetic movements preceding disturbance the magnets at any one place are simultaneously affected; also that in places widely different in geographical position the times are simultaneous, or nearly so, a small constant difference existing at some places which may be real or may be accidental, but the character of which it seems desirable to determine. It is shown also that at Greenwich definite magnetic movements are accompanied by earth current movements which are simultaneous, but that neither magnetic irregularities nor ordinary magnetic variations seem to admit of explanation on the supposition of being produced by the direct action of earth currents.

[1] Abstract of paper "On the Simultaneity of Magnetic Variations at different places on occasions of Magnetic Disturbance, and on the relation between Magnetic and Earth Current Phenomena," by William Ellis, F.R.A.S., Superintendent of the Magnetical and Meteorological Department, Royal Observatory, Greenwich. Communicated to the Royal Society, on May 5, 1892, by W. H. M. Christie, F.R.S., Astronomer-Royal.

SCIENTIFIC SERIALS.

American Journal of Science, May.—Radiation of atmospheric air, by C. C. Hutchins. A stream of hot air was arranged so that it could be made to pass in front of one of the faces of a thermopile at a distance of 3 cm., and cause a deflection of a galvanometer needle, or the air could be discharged high above the thermopile, leaving it unaffected except by radiation from a large Leslie cube containing water at the temperature of the laboratory. There was no sort of agreement between measures made on eight different days to determine the absolute radiating power of a column of air 1 centimetre thick at a temperature near 100° C.; but in an ordinary room and under average conditions the value came out = 0·000001133 + 0·0000000711 $(t-t')$, where $t-t'$ is the difference in temperature between the air and the cube. Tyndall's result, that the radiation increases with the amount of moisture in the air, was confirmed, but no exact law of connection between the two was found. This is probably due to the presence of accidental impurities in the air employed. The increase of radiation proves to be proportional to the increase of temperature. There was a small increase of radiating power when sheets of air more than 1 centimetre thick were used; with sheets less than this thickness, no difference of radiation could be detected.—Atmospheric radiation of heat and its importance in meteorology, by Cleveland Abbe. In this interesting and exhaustive paper Prof. Abbe brings together practically all the conclusions that have been arrived at on atmospheric movements and their relation to radiation from the air. In his words, "A comprehensive study of fluid motions shows that air and water alike may be forced to ascend without being warmer and lighter, or to descend without being colder and denser, than the surrounding fluid. The currents and whirls behind any obstacle in streams of air or water are almost wholly independent of differences of density, and are caused by differences of pressure as modified by simple kinetic laws." These motions, which the air is forced to take for purely kinetic reasons, are specially discussed in detail, but it is impossible to enumerate, in an abstract, the many cases considered.—Experiments upon the constitution of certain micas and chlorites, by F. W. Clarke and E. A. Schneider. The minerals analyzed are waluewite, v. of xanthophyllite, clinochlore, leuchtenbergite, diallage, serpentine, and mica from Miask, Ural.—On the qualitative separation and detection of strontium and calcium by the action of amyl alcohol on the nitrates, by P. E. Browning.—The age and origin of the Lafayette formation, by Eugene W. Hilgard.—On the influence of swamp waters in the formation of the phosphate nodules of South Carolina, by Dr. Charles L. Reese. From the experiments it appears probable that both carbonic acid and the humus substances in fresh-water swamps play an important part both in the accumulation and the concentration of calcium phosphate, and thus in the formation of phosphate nodules, these being considered to be phosphatised marls.—Plattnerite, and its occurrence near Mullars, Idaho, by William S. Yeates; with crystallographic notes by Edward F. Ayres.—On the occurrence of Upper Silurian strata near Penobscot Bay, Maine, by William W. Dodge and Charles E. Beecher.—Zinc-bearing spring waters from Missouri, by W. F. Hillerbrand. The chief constituent salt in the spring in question is zinc sulphate. It forms about 56 per cent. of the total dissolved solids.—A meteorite from Central Pennsylvania, by Prof. W. G. Owens. A chemical analysis of the meteorite gave Fe 91·36, Ni 7·56, Co 0·70, P 0·09, S 0·06, Si trace = 99·77.—On two meteoric irons, by G. F. Kunz and E. Weinschenk. One of the masses examined came from Indian Valley Township, Floyd County, Virginia; the other from Sierra de la Ternera, Province of Atacama, Chili.—The molecular masses of dextrine and gum