

## SCIENCE:

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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## LETTERS TO THE EDITOR.

\* \* \* Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

## Fluctuations of Air-Pressure.

It is probable that no problem in meteorology has been so puzzling as the explanation of the diurnal range of the barometer. This phenomenon is one of the most constant in meteorology; and, in fact, it is so regular near the equator, that Humboldt once said he could tell the time of day in that region by reading his barometer. On examining a barograph trace made in the tropics, we find a most surprising regularity both in the maximum and minimum points of the curve day after day, and also in the amplitude of the range. These conditions, however, do not exist in the temperate regions or in those farther north. Here there is superposed upon the diurnal range a mixed fluctuation, due in the main, if not entirely, to the passage of areas of high and low pressure. These areas are continually passing, and in consequence the diurnal range is masked, or even entirely obliterated on some days. It is known, however, that in general the diurnal range is much increased on bright, sunshiny days. Gen. Greely found a trace of this range at Fort Conger, 81° 44' north. It is known that the range has two maximum and two minimum points. The principal maximum occurs all over the globe between 9.30 and 11 A.M.,

and the principal minimum from 2.30 to 4 P.M. The two other points occur approximately at the hours of the same name at night. This remarkable fluctuation is observed at the tops of high mountains, showing that the cause is above the lower atmosphere. The voyages of the "Challenger" and of other vessels have shown that this range is the same over the ocean as on the land, though the water temperature changes very slightly over the former.

It would be impossible to give in a short space all the explanations that have been advanced for this phenomenon. Changes of temperature and moisture have been appealed to in vain. A potential effect has been suggested from the fact that there may be a re-action, as it were, from the air, owing to the increasing heat in the lower strata after sunrise. It is not too much to say that any and all explanations which ascribe this change in pressure to movements of any kind in the air, to a secondary effect from changes in temperature or moisture, and to any of the forces or agencies usually appealed to in atmospheric movements, have signally and utterly broken down. In 1881 J. Allan Brown (now deceased), after thoroughly examining this question, says (*Nature*, April 14, 1881), "If we suppose that the attraction of gravity is not the only attraction which affects the pressure of the atmosphere, but that this pressure varies through some other attracting force, such as an electric attraction of the sun depending upon the varying humidity of the air, and this again depending on its temperature, we should find another method of relating the two variations, which does not exist if gravitation alone is employed." In 1882 the present writer was called upon to give a course of twenty lectures upon meteorology before a class at Fort Myer, Va. In the nineteenth lecture of this course the remarkable similarity between the curves of diurnal range in air-pressure and of the declination magnet was pointed out, and a connection between these phenomena, as well as a common origin, were distinctly suggested (see *Annual Report of the Chief Signal Officer*, 1882, p. 142).

There has just come to hand an interesting paper on "Diurnal Variation of Terrestrial Magnetism," by Professor A. Shuster (*Philosophical Transactions of the Royal Society, London*, vol. 180, p. 509). I quote from the latter part of the paper.

"The late Professor Balfour Stewart has suggested that the earth's magnetic force might induce electric currents in the convection currents which flow in the upper regions of the atmosphere. One difficulty of this hypothesis was removed by an experimental investigation, by means of which I proved that the air can be thrown into a sensitive state in which small electro-motive forces will produce sensible electric currents. To bring the air into that sensitive state, it is only necessary to send an electric current through it from some independent source of high potential. It is very likely that the air in the upper regions of our atmosphere is in such a sensitive state; and it is quite possible, therefore, that the induced electric currents suggested by Professor Stewart really exist. In order that electric currents should be induced which could account for the observed movement of the magnetic needle, it is only necessary to imagine convection currents in the upper regions from east to west during certain parts of the day, and from west to east at other times. As regards the effect of the sun, we have, indeed, a daily period of the barometer which is probably due to thermal effects. It is curious and suggestive, that the horizontal motion which must accompany the change in pressure is just such as would account for the daily variation of the magnetic needle. In the tropics the principal minimum of the barometer takes place about 3.40 P.M., and the principal maximum about 9 A.M. According to the theory of waves, there would be a horizontal movement from west to east in the afternoon, and from east to west in the forenoon. The direction of the induced electric currents would be away from the equator in both hemispheres in the afternoon, and towards the equator in the forenoon. This is exactly the system of currents we have been led to, starting from the observed magnetic variation. The only difficulty I feel in suggesting that the cause of the diurnal variation of the magnetic needle is the diurnal variation of the barometer, lies in the fact that it would oblige us to place the electric currents into the lower regions of the atmosphere, as these only will be much affected by the thermal radiation of the sun."