LETTERS TO EDITOR

THEORY OF THE EARTH'S MAGNETISM.

In the previous issue of the JOURNAL, page 90, Mr. Norman E. Gilbert, who had kindly verified the proofs of the abstract of my paper on the "Cause of the Earth's Magnetism," makes two brief criticisms to the effect, first, that an electric field which does not revolve with the Earth is required; and second, that all evidence goes to show that under the conditions ruling inside the Earth the materials there ought to be good conductors rather than insulators, and, therefore, to make the existence of any electrostatic field impossible.

To the first criticism I would reply that I presume it means that, as all magnets on the surface of the Earth revolve with it, it is necessary that static charges which are to produce the Earth's magnetic field must be at rest, so as to allow of the supposed required relative motion between magnet and charge. In the original paper I touched upon this matter, omitting to do so in the abstract for the sake of brevity. But it is not necessary that a static charge should move relatively to a magnet in order to produce on it the effect of an element of current. The static charge by its motion *relative to the ether* sets up in it those whirls which we study as lines of magnetic force. Now, it is not necessary that, once these lines of force are generated in the ether, they should lose their magnetic effect on a magnet simply because it is moved with the same velocity in the same direction as the charge whose motion brought them into existence; for if this were so, then motion of a magnet in any magnetic field could deprive the field of its power to affect the magnet. The matter is one to be ultimately decided by experiment, and is a question of great interest; but as our conceptions stand at present, it seems to me more reasonable to assume that the motion of static electricity in Rowland's experiment establishes a magnetic field which would still affect magnets moved with the electricity.

As to the second criticism, I presume it is founded on the ordinary experience that high temperatures diminish the insulating powers of insulators, but I do not know that we have any evidence as to the extent to which the action of high temperatures is neutralized by high pressures. All analogy goes to show that a symmetrical application of pressure which increases the rigidity of a material also increases its chemical stability. It remains for experiment to decide whether the effect of pressure in restoring insulating power, which would be lost through

high temperatures alone, is powerful enough to let us assume the existence of the required amount of insulation in the interior of the Earth.

While therefore I would agree that Mr. Gilbert's criticisms emphasize two important matters which I had not overlooked in my original paper, I can not allow that they are fatal to the possibility of the cause suggested for the Earth's magnetism.

The theory which I have proposed for the magnetic variations does not give the results obtained under the direction of Bauer in the very interesting magnetic observations on the day of eclipse, May 28, 1900 (*Ter. Mag.* v, page 90). According to the theory, the Sun's radiation causes a downward electric current through the atmosphere, and therefore the effect of an eclipse is to superpose on the Earth's usual magnetic field the field due to a traveling cylinder with the moon's shadow on the Earth for base, and an upward current flowing across each section of the cylinder. Thus as the moon's shadow approaches a place, the magnetic effect will depend on its situation relative to the track of the center of the shadow. At places to the north of the track, magnets ought to be deflected to the west, and at those to the south they should be deflected to the east as the shadow passes. Places in the track should not experience any appreciable change of magnetic declination, but should show a decrease of horizontal force at the beginning of the eclipse, and an increase at the end. These effects are different from the general result of observation found by Bauer in America; namely, that the principal effect at six stations consisted in an eastward deflection of the needle by from 20'' to 40'', while at one station the horizontal force was increased for a brief time after totality. A study of the detailed observations and results promised in full in a Bulletin of the Coast and Geodetic Survey will be very interesting to magneticians.

WILLIAM SUTHERLAND.