third class is the complex dream which may be determined by different kinds of stimuli successively applied. These reports also suggest a practical matter that those who find dream pleasures a necessity, as the opium eater, might obtain a large measure of such pleasures by perfume and other stimuli which do not leave unhealthy reactions.

As to my own dreams I may mention a few facts which may be suggestive. My dreaming is commonly of places and persons which are totally unknown, but, of course, the types are familiar. I often dream of being in a crowd and studying faces which I have never seen before. Similarly I dream of being in a bookstore and picking up new books which I have never seen, and reading many pages, and looking at strange pictures. I once awoke from a vivid dream of this sort, and was able to recall several sentences, and to notice that they were far from my own style of writing, and had an individuality of their own which I could not recognize. But all this merely means that those in whom the constructive imagination is strong exercise it freely in sleep.

A singular case of dream stimulation is this: I dreamed of being in a strange hilly country, and a man appeared driving a tandem. In vain he sought to get up the hills, and the horses became so ludicrously tangled that I burst into loud laughter; this was heard in another room. In my laughter I heard other voices laughing, all from a single direction, but there was no visual image. It is highly probable that my dream of hearing others' laughter was stimulated by hearing my own laughter.

Maury makes the 'embryogeny of the dream' to consist in 'hypnagogic hallucination,' that is, in the stage of waking just previous to sleep visual and auditory hallucinations occur which are carried into sleep, but it appears to me that he lays much too great stress on the point. I noticed the other morning during a succession of cat-naps that the formation was not in any wise hallucinatory. Awake for a few seconds I thought of dressing, and had the images of the process but not hallucinatory, but knowing them to be ideas to be realized, but the senses quickly falling asleep, these images constituted a dream reality, I was really dressing. Very commonly our last waking thoughts turn into dream without any hallucinatory stage.

Hiram M. Stanley.

Lake Forest, Ill., January 23, 1899.

Trowbridge's Theory of the Earth's Magnetism.

In an article entitled 'The Upper Regions of the Air,' in the January number of the *Forum*, Professor John Trowbridge proposes a new theory to account for the phenomena of the earth's magnetism, of the northern lights and of thunder storms.

His theory, briefly stated, is that those waves of energy coming from the sun whose wavelengths are of the order of those concerned in the X-ray phenomena are completely absorbed by the atmosphere and transformed into electric and magnetic energy in the upper regions of the air, and that being thus transformed they fail to manifest themselves as light at lower altitudes. According to Perrin and Winkelmann, the X-rays have the property of communicating an electric charge to conductors. "If, therefore, X-rays reach the earth from the sun they are competent to give an electrical charge to our atmosphere. The side, therefore, of the earth turned toward the sun would receive a charge in the upper good-conducting regions of the air. This charge would tend to dissipation, and there would be a flow of electricity toward the side of the earth not turned to the sun. The rotation of the earth on its axis from west to east would bring forward at each revolution fresh regions of the upper air to receive the electrical charging from the sun. There would be an accumulation of electricity on one side of the earth and a diminution of electricity on the other. The conditions of the equalization of the electrical charge, or the flow of electricity, might be determined by the direction of rotation of the earth. If this flow took place from east to west, just opposite to the direction of rotation of the earth, and were sufficiently powerful, it would produce the magnetic north and south poles. It has been found that air submitted to the action of the X-rays continues for some time to manifest their influence. We should, therefore, expect a fall of electric pressure between the regions just entering into daylight

and those in the full glare of the sun. This condition would direct the resulting electric current from east to west, or in the direction opposite to that of the earth's rotation."

The author says we have no good theory to account for the earth's magnetism unless we are ready to accept the one he has proposed. Let us see, then, how the well-known magnetic phenomena of the earth are accounted for by this theory.

First. The north end of the compass needle points approximately toward the north. Applying Ampère's rule to Trowbridge's currents flowing in the upper regions of the air from east to west we find that the north end of the needle would point *south.* Hence the author's currents must be reversed, *i. e.*, they must flow from west to east, or in the *same* direction as that of the earth's rotation.

Second. The north end of the dip needle points down in our latitude; hence applying Ampere's rule again, the electric currents must go in the clockwise direction around the needle, or, in other words, must proceed from east to west, or contrary to the direction of the earth's rotation. We should have, then, here a peculiar state of things. In order to satisfy the phenomena of the horizontal needle, Trowbridge's currents must go from west to east; to account, however, for the known facts of the dipping needle, they must simultaneously go in a contrary direction.

In short, *if electric currents produce the observed phenomena of the compass and of the dip needle they cannot be in the atmosphere, but must be inside the earth's crust and proceed from east to west.* Let the author apply Ampere's rule to these currents and he will find that they will now completely represent the known magnetic phenomena.

The fact that the causes of the earth's magnetism must be almost entirely *within* the earth's crust was shown mathematicalty by Gauss half a century ago and has been amply verified by the recent investigations of Schmidt. His elaborate mathematical analysis has resulted in the following conclusions:

The earth's magnetic force consists of three parts, viz: (1.) The greatest part; this is to be referred to causes *within* the earth's crust, and possesses a potential. (2.) The smallest part about 1-40 of the entire force; this is due to causes *outside* the earth's crust, and likewise possesses a potential. (3.) A somewhat larger part than the preceding; this does not possess a potential, and, in consequence, points to the existence of vertical earth-air electric currents. These currents amount, on the average, for the entire earth's surface, to one-sixth of an ampere per sq. km.

L. A. BAUER.
UNIVERSITY OF CINCINNATI.

I AM much obliged to Professor Bauer for his courteous criticism of my theory of terrestrial magnetism, and I am inclined to give great consideration to the opinion of such an authority on the earth's magnetism. I imagined, however, that the electrical currents were largely localized at the region of the astronomical poles of the earth, and I supposed, also, that the earth, as a whole, is para-magnetic.

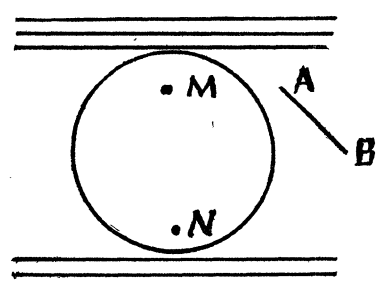

FIG. 1.

According to my theory, poles *M* and *N*, Fig. 1, might, perhaps, be formed in this magnetic matter, which would be competent to produce both inclination and declination of a magnet *A B*. Considerations of the earth's rotation and the temperature of the air currents led me to localize, so to speak, the electrical action at the poles of the earth. It has always seemed to me that Gauss' theory may be considered a mathematical theory, which would be true, considering the limited number of observations he had to work with, whether we suppose the earth's magnetic poles to be formed by currents in the crust of the earth or by rotary phenomena in the medium outside the earth.

JOHN TROWBRIDGE.