discharge from the fine wire. In this corona discharge the air molecules are dissociated into ions and these charged ions quickly attach themselves to the particles of dust or tar. The intense electric field between the two electrodes then drags the particles of dust or tar to the large electrode, where they are deposited.

W. S. Franklin

A LOCAL MAGNETIC STORM

In Science, of March 21, reference is made to a paper just published by the Academy of Science of St. Louis with the above title. In this paper evidence is presented to show that atmospheric ions tend to set like magnets along the lines of the earth's magnetic field. The effect of gusts of wind in disturbing these ions, and in thus producing continual swaying of the lines of force due to variations in permeability, is pointed out.

A more local and somewhat similar magnetic storm may be artificially produced as follows:

Suspend a needle on a silk fiber. Provide it with a mirror, telescope and scale. Partially compensate the effect of the earth's field by bar magnets set in parallel position. Place two bar magnets on opposite sides of the needle, as in the Gaussian method of deflection. Place a plate of glass over one magnet, and sprinkle iron filings upon it. The deflecting effect of that magnet is increased. The needle no longer lies in the magnetic meridian. Balance the effect on the needle by adjustment of the other deflecting magnet and tap the plate. The permeability of the space around the magnet is again increased. A new readjustment may be made. Disturb the iron filings by means of a brush, applied to any small area of the plate. A magnetic storm is thus produced. If the filings were free to move without friction, they would all respond to the disturbance. The needle does respond. If the filings are made to accumulate near the poles, the deflecting effect of the magnet is greatly increased. If the magnet is supported at its middle part so that it is lifted above the plate of glass, the poles may be loaded with iron filings. The apparent magnetic moment of the bar may thus be increased about 8 or 10 per cent. Such a magnetic storm as is thus produced in the surrounding space appears to be similar to that produced in the field of the earth, when atmospheric ions accumulate around the magnetic poles of the earth. If any of these Faraday lines are disturbed, they are all disturbed. The balanced needle tells the story.

It seems very probable that the daily variations in the earth's field may be explained as due to this change in permeability brought about by ionization of the air by sunlight. The lines of force sway in opposite directions during the forenoon and afternoon of each day, their lateral motion being greatest in the equatorial belt. There is also apparently a similar swaying in a vertical direction.

In the forenoon the north end of the needle swings towards the west in the northern hemisphere, while the south pole swings towards the west in the southern. In the equatorial belt the needle suffers no change. These daily variations are modified by summer and winter conditions, as they should be if the above explanation is valid.

Francis E. Nipher

PLUS AND MINUS

In a review of my book, "On the Foundation and Technic of Arithmetic," in Science, April 18, 1913, Professor Cajori, after quoting a sentence, says:

> In view of the fact that historians have been in doubt as to the exact origin of + and —, the authority for Halsted's categorical statement would be interesting.

Hoping the readers of Science may be of the professor's mind, I venture an outline.

Minus, as the oral rendering of the symbol —, takes a sense which did not exist in Latin of any period. Murray says it probably originated in the commercial language of the middle ages. In Germany the Latin words *plus* and *minus* were used by merchants to mark an excess or deficiency in weight or measure. The earliest known examples of the

modern sense of *minus* are German. In the *Bamberger Rechenbuch* (1483) the tare to be deducted from the weight of a package is called *das Minus*. An Italian writer of the fourteenth century used *meno* to indicate the subtraction of a number to which it was prefixed. The symbol itself, —, De Morgan, most sound and erudite of mathematicians, says arose as a merchant's mark. Its adoption was helped by its likeness to the *obelus* used by ancient critics to indicate that a passage should be removed from the text. This obelus or obelisk was a straight horizontal stroke, either simple (—), or with a dot above and one below (÷), and in Denmark the sign ÷ is used for *minus*.

English examples of *plus* do not occur so early as those of *minus; e. g.,* 1481–90 *Howard Househ. Bks.* (Roxb.) 417, v. yerdys, mynus the nayle, welwet blake. Cajori says Eneström shows "that with Widman + meant simply 'und' (and)," but how can this be brought to tally with the fact that Widman explicitly directs that the signs — and + be read *minus* and *mer* (mehr)? He uses them as signs already well known in his "Behende und hübsche Rechnung auf allen Kauffmannschafft" (1489); "was — ist, das ist minus, und das + ist das mer."

The adoption of the form + would be greatly helped by its likeness to a form of & = et, and Widman seems to have used the long preexistent form + in the two senses, *mehr* and *et*.

GEORGE BRUCE HALSTED

SCIENTIFIC BOOKS

Schutzfermente des tierischen Organismus. Ein Beitrag zur Kenntnis der Abwehrmassregeln des tierischen Organismus gegen Körper-, blut- und zellfremde Stoffe. By EMIL ABDERHALDEN. Berlin, Julius Springer. Eight text figures; pp. xi + 110. Paper cover, 3.20 M.; bound, 3.80 M.

In this little pamphlet Abderhalden gives an interesting survey of a method which the living organism employs to protect itself from the effects of foreign soluble substances which have entered its circulating juices. Under normal conditions, for example, proteids do not reach the tissue cells in their native state, but only as fragments. This degradation of proteids is normally accomplished by the ferments of the gastro-intestinal canal, and some of the degradation products, after absorption, are then synthesized by the tissues into its own characteristic proteid. Native foreign proteids in the circulation are useless and often directly harmful to the tissue cells. However, when this contingency occurs experimentally or through disease, the invaded body is not entirely helpless, but digestive ferments are formed in the circulation, possibly from the leucocytes, which attack the foreign proteid and digest it. These protective ferments are formed very swiftly and have been demonstrated by Abderhalden in the plasma or serum twenty-four hours after the subcutaneous injection of the foreign proteid, while the plasma or serum of normal, non-injected individuals shows no trace of this ferment.

Similar results were obtained by Abderhalden when carbohydrates were injected, or when fats were driven unchanged into the blood by forced feeding. Here again he was able to show the presence of ferments in the blood which were able to split the foreign substance.

These facts were established by Abderhalden and his pupils largely through the use of the polariscope. When optically active or racemic substances are split by ferment action, the optical activity of the mixture changes and this change shows, in the first place, that a decomposition has occurred; in the second place, the character of the change may show what substances have been formed, provided that the chemical structure of the original substance used is accurately known, which is the case with many of the optically active polypeptids.

The facts briefly mentioned above have received an important application in the diagnosis of pregnancy. The circulation of the pregnant organism contains cells from the chorionic villi, and the maternal body reacts to these cells by forming peptolytic enzymes