impressed, but only the time taken to reach the steady state is affected by its magnitude. The effects of collisions and of molecular and demagnetising fields are essentially the same as in Voigt's case.

Like Dr. Chapman and others, I have considered the possibility of dissociations increasing the intensity of magnetisation of hot bodies, and I have plans for experiments in this field. If the gyroscopic behaviour of a magneton is to account for cosmical magnetism (and it was the contemplation of this which led me to the rotation experiments), we must, as has long been evident, assume a constitution of the earth and sun different from that of materials on which experiments have previously been made.

On my theory, a magneton in a diamagnetic or paramagnetic body set into rotation is acted upon by the same alignment forcive as if alone or in a ferromagnetic body. But the intensity of magnetisation in the latter is small, for the same reason for which it is small when the body is placed in an ordinary magnetic field. In the former it is zero, because, on the assumption I have made, with Weber and Langevin, the magnetons are grouped rigidly together so that no element with a magnetic moment can have its orientation changed. This is the only point on which Dr. Chapman's theory, as I understand it, differs from mine. Rotation experiments on diamagnetic and paramagnetic bodies by Lébedew and by Mrs. Barnett and myself have hitherto given no magnetisation.

S. J. BARNETT.

Washington, D.C., January 31.

I FULLY agree with Prof. Barnett's statement of the theory of magnetisation by rotation, and regret that through misunderstanding his treatment of magnetic intensity I suggested that his theory required modification. I am glad to know that he contemplates experiments on the rotation of hot bodies; this point, and the greater possibilities afforded if the magnetic elements remain intact at high temperatures, are the matters to which chiefly I wished to direct attention. Experiments made here with Dr. Oxley have negatived my suggestion that diamagnetic and paramagnetic bodies should also show magnetisation on rotation, thus confirming the previous results mentioned by Prof. Barnett; experiments on hot ferro-magnetic bodies are not yet advanced sufficiently to state whether they support the view that the earth's magnetism may depend on its high internal temperature. Further trial seems to preclude the possibility of trustworthy calculation at present, and the view must be tested by experiment. Until this is done it seems useless to enter into further details of the earth's field and its secular variation.

As regards the sun, later consideration of the narrow radial limitation of its magnetic field leads me to think that no simple magnetisation, by gyroscopic action or otherwise, is the probable cause; any such view requires two hypotheses, one to explain the production and the other the neutralisation of the field. A unitary hypothesis, such as the second of those indicated by Sir J. Larmor in the British Association Report for 1919, seems preferable.

S. CHAPMAN.

The University, Manchester, February 22.

Transcendental Premises in Science.

PERHAPS you will permit one who belongs to a considerable section of your readers who are neither mathematicians nor neo-physicists to state how the very remarkable discussion on Prof. Einstein's theory in NATURE of February 17 appears to some of us.

Mathematics to us is a very precise and complete form of deductive logic applied to space and number. It differs from ordinary logic only in having its arguments set out in a symbolical shorthand instead of in words, and thus enables a long deduction to be condensed into a short statement. This unfamiliar form of notation and condensation of the argument are the chief stumbling-blocks to the outsider.

Like other forms of logic, it is an art rather than a science, namely, the art of drawing legitimate conclusions from premises. In essence, it has nothing to do with the truth or falsity of the results. These depend entirely on the nature of the premises. The most faultless string of equations, like the most immaculate collection of syllogisms, may conclude with an absurdity or a stupendous error if the premises are faulty. The logical mill by which the results are obtained may turn out good flour or only chaff. This depends entirely on what it is fed with.

This is why the Philistine who is not a mathematician sometimes shakes his head when he is presented with a series of equations on the blackboard and his teacher says to him: "Look there. What do you say to that?"

What the Philistine doubts is not the accuracy of the deduction in this case, but the validity of the premises used in the new departure, which turns largely on the nature of space and time as defined by the neo-physicists. Granting that they are legitimate, the results are unquestionable. Are they legitimate? Let us turn to space. The first remark I would make is that, whatever its value, the definition in question represents something entirely and confessedly different from space as known to the great mass of men and to all philosophers, mathematicians, and physicists until the last few decades, and it has, therefore, no claim to be called space at all.

Space was defined by Newton by two predicates, namely, extension and immovability. I would presume to add a third one, quite necessary as things are now marching, namely, that any finite portion of space may be measured by three co-ordinates at right angles to each other and passing through one point—or, in other words, space has three dimensions. This is the only space known to human experience, as it was to the early geometers. The addition of a fourth or any number of other dimensions as factors of space is inconceivable unless we entirely alter the comprehension and connotation of the words "space" and "dimension." You may call the result what else you will; you are misleading a great many innocent people in calling it "space," like the Pragmatist is doing when he defines the "truth" he writes about as "the useful."

When Riemann read his famous paper before the Göttingen Academy at the instance of Gauss, who presided on the occasion, he first introduced the notion of space with more dimensions than three. He spoke entirely as a pure mathematician. His premises were not facts, but definitions of abstractions which could not materialise into realities. With his abstract postulates he was able to frame a series of equations which were quite legitimate in form, but the conclusions of which were also abstractions, and could not be presented in a mental picture or as representing anything in Nature. Since then, a large literature has grown up in regard to these phantasms of mathematical abstraction. Attempts—very futile attempts, as it seems to me—have been made to translate the conclusions of Riemann's equations into