by symbols on paper. Industry and business have benefited considerably from the application of this *unbusinesslike* mathematical method!

The fact is that the most practical sciences, and the only sciences that have been applied industrially, are the exact sciences of chemistry, physics, and engineering—sciences which can predict effects from known causes.

No statement of evidence is really a fact until all the factors are known, and, therefore, statistics cannot predict, and man cannot forestall disease or economic distress, in spite of the sciences of biology and medicine and the "science of economics."

W. WILSON LEISENRING.

IN a notice (NATURE, May 6, p. 596) of an address by Dr. Hoffman, the words are used: "Imagination is what the mathematician is ever trying to get rid of." As such misconceptions as this are unfortunately rather widespread, it may be useful to protest against them. Imagination is essential to mathematics. The work of the great mathematicians affords many striking examples of creative imagination, and for the proper understanding and appreciation of even the elementary parts of the subject the use of imagination is necessary. One of the most important qualities of a good mathematical teacher is the power of stimulating the pupils' imagination, and it is, perhaps, the neglect of this faculty by some teachers which is responsible for the dulness and lifelessness of what is too often taught in schools under the name of mathematics. F. E. CAVE.

Girton College, Cambridge, May 10.

DR. HOFFMAN'S charge against the mathematicians was not that they lack imagination but that they set before them as the ideal of their science the getting rid of it. The quotation from Prof. Whitehead, who certainly is not lacking in that faculty, makes the meaning clear. There is, however, a drawback in our language in the fact that we use the same word for imagination when we mean æsthetic creation, what the Italians call *fantasia*, as we do when we mean the anticipation which is pure reproduction, what the Italians call *immaginazione*. It is of course the æsthetic creation the mathematician aims at dispensing with in order to preserve the purely logical character of his ideas. Even Kant represented it as a kind of handicap that mathematical concepts should require sensuous intuition for their expression. THE WRITER OF THE ARTICLE.

The Elliptic Logarithmic Spiral—a New Curve.

IF, in an elastic system with one degree of freedom, and friction proportional to the velocity, the relation of the "free" force to the displacement be considered, an interesting curve results.

Thus if the displacement be

$$x = ae^{-kt}\cos nt$$

the force is given by

$$F = be^{-kt}\cos(nt+\epsilon),$$

and by eliminating the cosines we have

$$\frac{x^2}{a^2} - \frac{2Fx}{ab}\cos\epsilon + \frac{F^2}{b^2} = e^{-2kt}\sin^2\epsilon,$$

which may be termed an elliptic logarithmic spiral or a damped Lissajous' curve.

If the vibrations are maintained or forced by a force of harmonic character, the force displacement curves become ellipses.

The same equations hold for the compounding of two damped harmonic motions of equal periods at right angles, so that the path of a body at the lower part of an oiled sphere or of the bob of a conical pendulum in a viscous medium would be, in plan, an elliptic logarithmic spiral. H. S. ROWELL,

Director of Research.

Research Association of British Motor and Allied Manufacturers,

15 Bolton Road, Chiswick, W.4, May 3.

Intelligence Statistics.

I WAS interested in a short note in NATURE of February 16, p. 218, on the dependence of the standard of intelligence of individuals on the part of the year in which they were born. Statistics appear to show that the standard of intelligence is higher in individuals born in the autumn (say October) than in those born in the spring (say April). At first sight this result may seem rather unexpected, as one might expect that the influence of summer would be beneficial to a child born in the spring, whereas, in the case of a child born in the autumn, it would not be surprising if the succeeding winter were to have a deleterious effect on the mental growth.

It appears to me that the chances of a child surviving the first year of life are greater for a child born in the spring than for one born in the autumn, and I do not doubt but that statistics have shown that this is so. Coupled with this one would expect that the general "fitness" of the survivors of the first year of life would be greater for individuals born in the autumn, because the weaklier members have been weeded out by the severity of winter in the first few months of life. This would appear to be sufficient to explain the result mentioned at the beginning of this letter. We should thus expect that, in the southern hemisphere, children born in the spring (April) would in later life have a higher average standard of intelligence than those born in the later months of the year. Statistics from the southern hemisphere would thus be of value in this connection.

It is possible that this aspect of the problem has already been dealt with. As the papers on this work are not accessible to me, however, I have not seen the explanations offered for the above-mentioned interesting phenomenon. ROBERT W. LAWSON.

The University, Sheffield.

A Rainbow Peculiarity.

IN NATURE of March 9, p. 309, Major Lockyer asks if it is a fact of general observation that "the whole area of the inside of the primary bow is brighter than the region outside," and he refers to the phenomenon as "a fact in Nature which appears to have been rarely noticed visually." The following quotation from "The Divine Adventure," by Fiona Macleod (William Sharp), shows that the mystic poet not only saw clearly into the heart of Nature, but was also a keen observer of her outward manifestations:

> It is not Love that gives the clearest sight:
> For out of bitter tears, and tears unshed,
> Riseth the Rainbow of Sorrow overhead,
> And 'neath the Rainbow is the clearest light.

Probably the phenomenon was commonly known amongst the Western Isles he loved so well.

JOHN P. DALTON.

University of the Witwatersrand, Johannesburg.

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