recognition of the academies and indeed of the state itself. No greater gift could be made by one people to another than an illuminating idea; it would deserve a people's welcome.—*Sir William Bragg in his presidential address at the anniversary meeting of the Royal Society.*

# SCIENTIFIC BOOKS

## PROBABILITY

*Scientific Inference.* By HAROLD JEFFREYS. Reissue with additions. Pp. vii + 272. Cambridge, University Press, 1937. (First published in 1931.)

JEFFREYS treats probability as relating a proposition to another one which expresses the data. He postulates that the probability of $p$ given $q$ be equal to, greater than or less than that of $r$ given $s$, and that it be maximal or minimal if $p$ is a logical consequence or contrary of $q$. To these he adds two more postulates (in the Addenda). Then, by way of conventions determining the assignment of numbers to probabilities, he adopts the usual additive law and assigns 1 to logical consequence. From this basis the other usual laws are derived.

But the basis is somewhat vague. In speaking of the probability of $p$ given $q$ Jeffreys presupposes, not a simple relation of $p$ to $q$, but a binary function; *i.e.,* a triadic relation connecting $p$, $q$ and some third object figuring as value of the function. These third objects are not numbers, for Jeffreys assigns numbers later. Then what are they? Is "greater than," as applied to them, a further primitive relation? Does its transitivity demand another postulate? Possible adjustment: assume just the tetradic relation, "$p$ is more probable given $q$ than is $r$ given $s$"; adapt Jeffreys's postulates to this, and add a transitivity postulate.

Further, an anomaly appears in the probability of $p$ given $q$, where $q$ is a contradiction. In an appendix Jeffreys argues that this probability is indeterminate, rather than 1. But this is in exception to the second postulate above, because $p$ is a logical consequence of any contradiction $q$. The opposite case, where $q$ is logically necessary, is left unconsidered; we might expect it to yield absolute probability, in some trivial sense.

Jeffreys's decision to treat probability postulationally, rather than definitionally, typifies his general program: formulation, not substantiation. He applies empirical method to empirical method, seeking to isolate a minimum of principles which *would,* if true, justify the scientist's observed behavior. The most notable result is resuscitation of the principle that the probability of a law increases with simplicity—a principle which Poincaré described as long since repudiated. Supposing all quantitative laws expressible as differential equations, Jeffreys proposes measuring their simplicity inversely by the sum of the order, the degree and the absolute values of the coefficients. Whatever other difficulties this theory may involve, one cited by Jeffreys himself is that it requires the totality of possible laws to be denumerable; but on this point his worry seems unwarranted, for the *expressible* laws are in any case denumerable—they form a progression when ordered according to increasing typographical length and lexicographically within each length.

Jeffreys presents and supports Laplace's analysis of the probability of inferences from samples to totalities; stressing, however, that the analysis applies only where we have no prior clue as to how many objects have the investigated property. Closing his statistical studies with an account of the estimation of error, he proceeds to a brief operational analysis of the physical magnitudes. Like Carnap ("Physikalische Begriffsbildung") he construes measurement as assignment of pure numbers to objects, and eliminates the magnitudes themselves, or impure quantities, as mere abbreviative idioms. Unlike Carnap, he insists on the basicness of the additive magnitudes and perceives no convention in the choice of their zero points and scale forms.

In the exposition of number which Jeffreys includes in his analysis of magnitudes, there are remarks (pp. 85, 106) which suggest an over-estimation of Whitehead and Russell's "elimination" of classes. Actually, the so-called propositional functions to which classes are "reduced" are subject like classes to the theory of types, and are indeed the same as classes, except for suspension of the extensionality principle. It is for this reason that classes are accepted as primitive in current logistic, supplanting the propositional functions.

There follows an illuminating treatment of physical geometry, which Jeffreys constructs operationally and then compares with the Euclidean prototype. Then come two useful chapters in which the fundamentals of Newtonian dynamics and relativity theory are formulated from the point of view of methodology. Remaining matters include a brief criticism of the probability theories of Venn, Keynes and others, and some sensible remarks on cause and reality.

The Addenda, appended as the distinguishing feature of this new edition, include indications of the applicability of the simplicity principle in testing the significance of added parameters; also a discussion of the simplicity principle in its rôle of substitute for the traditional postulate of determinism; also some corrections, among them the insertion of two postulates as mentioned above.

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