Examination of his best known plays shows strict regard for brevity in all scenes in which an audience of even a few people is present. In the court scene in the "Merchant of Venice," the Duke's longest speech is 135 words, Antonio's 149, Shylock's longest 229, Portia's 173. In situations which call for longer speeches, Shakespeare is careful to see that they are broken into short units. In "Hamlet," the recitation given in part by Hamlet and in part by the First Player, only 435 words in all, is twice interrupted by Polonius, once with the remark, "This is too long." Brutus' speech, after the assassination, in "Julius Caesar," is but 348 words in length, and is twice interrupted, the longest unit being 235 words. Mark Anthony follows with a speech of less than eleven hundred words, which occupies, as delivered by Mr. John Alexander, just eleven minutes. Yet it is interrupted a dozen times and the longest fragments are but little over 250 words in length. Nowhere, in these three plays at least, does Shakespeare permit a character to address an audience, without interruption, for more than three hundred words.

Since politely suggested "time limits" have not always controlled our after-dinner speakers, is not the advisability of an absolute rule forbidding talks of more than three hundred words indicated? Our speakers could not urge that their messages are too important for such brevity. Who among them chooses a theme more lofty than Paul's, is weighed with responsibilities graver than Lincoln's or brings to us a wealth of experience greater than Franklin's? Nor could they maintain in extenuation of their prolixity that these great men had many opportunities for speech-making. Gamaliel's immortality was gained by one speech, which bears the final stamp of approval, "And they agreed unto him."

Possibly, however, so exact a rule might be construed as a tyrannical limitation of Anglo-Saxon freedom of speech; in which case it might be possible to print on menu cards at all dinners for which formal talks are planned the following instructions for toastmasters and after-dinner speakers of all ages taken from the book of Ecclesiasticus. These directions occupy, it will be noted, in the English translation just 112 words.

> Have they made thee ruler of a feast? be not lifted up, be thou among them as one of them; take thought for them, and so sit down. And when thou hast done all thy office, take thy place, that thou mayest be gladdened on their account, and receive a crown for thy well ordering. Speak, thou that art the elder, for it becometh thee, but with sound knowledge: . . . and display not thy wisdom out of season.
>
> Speak, young man, if there be need of thee; yet scarcely if thou be twice asked: sum up thy speech, many things in few words; be as one that knoweth and yet holdeth his tongue.

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SCIENTIFIC BOOKS

An Introduction to Mathematical Probability. By JULIAN L. COOLIDGE. Oxford, Clarendon Press, 1925. xi + 215 pp.

IT is rare that one finds mathematics presented at once attractively and with the mathematical spirit closely guarded, but here is a book exposing many difficult parts of the theory of probability which is also in some sense literature. Its charm seems to be due specially to the fact that it has individuality. There is humor, too, and of an alluring quality, but it is not chiefly the author's sense of humor which holds the attention. Almost every paragraph and every demonstration bears the imprint of his own method of thinking. As a rule the theorems and the demonstrations are not essentially new, and only a few of them are selected from the author's earlier publications, but none the less they possess all the inspirational quality that usually springs only from true originality. The manner in which the story is told is all his own.

The thoroughness with which he has absorbed the ideas underlying his theory before expounding it has some disadvantages, to be sure. It makes the book less good for reference. More nearly standard notation and language would make much of it clearer to him who would read only a chapter here and there, but this is perhaps impossible and certainly quite unnatural if one starts out to put the whole theory in his own words and symbols. More numerical illustrations would be of service, however. To one who reads the whole the notation and language become so familiar that a newly stated theorem immediately has a meaning, but many readers do not approach a new theorem in that orderly fashion. They would like first to jump it, land on an illustration which would contain the essential idea, and then go back and look carefully at the theorem if it should seem interesting. In short, this book is, as it purports to be, chiefly a text for the student who will study it all. It gives the mathematical basis of the theory of probability and of its applications to various fields. In no one of these applications is there sufficient material to satisfy the specialist, only enough to give the mathematical reader an insight into its fundamental concepts. The specialist ought to study it because he ought to know the foundations on which his science rests, in so far as it may be said to rest on any, but in doing so he may be aware of injured feelings because the possibilities of his subject are not exploited. As an illustration, the application to statistics hardly mentions frequency distributions, and under the theory of sampling one does not find the probable error of a frequency—which is a rather fundamental notion.

An unfortunate mistake, already noted by other reviewers, needs the reader's attention. Theorem 2 of page 36 should read "minimum" instead of "maximum." The error is due to an incorrectly turned inequality sign on the line just preceding, and the change invalidates Coolidge's proof of the Bernoulli theorem which follows. As it stands, Theorem 2 is proved incorrect, not proved correct, as the author states, by the expression for the approximate value of a zero discrepancy (9) on page 42; for the denominator of (9) is a maximum when p equals one half.

The table of contents indicates fairly the scope: meaning and elementary principles of probability, Bernoulli's theorem, mean value and dispersion, geometrical probability, probability of causes, errors of observation in one and in many variables, indirect observations, statistical theory of gases, life insurance and some tables.

The first chapter contains a thoughtful discussion of the basic definition of probability, and it is enormously important that one's concept of this notion be made precise at the outset. The author shows clearly that, from the practical point of view, one needs two assumptions, either of which might be taken as a definition, the one containing the limit idea and the other the relative frequency idea. In general the arguments here are searching, though occasionally something is wanting, as in the following case (page 8): "We make this affirmation (that a spinning coin is equally likely to turn up head or tail) only upon the hypothesis that it is . . . nearly homogeneous, with the center of gravity near the middle, while the method of spinning is such that it had no tendency to favor the one face at the expense of the other." We certainly must go farther and define what is meant by "nearly" homogeneous, and "near" the middle. In fact we do not make the affirmation that the probability of head is one half in case the coin is exactly homogeneous, exactly symmetrical, and spun with no bias whatsoever; for then it would remain on edge, "and the boys would have to study." Also, the author does not here sufficiently insist that fundamental to the concept of probability is the correlation of *two* events; commonly called cause and event, or universe and individual. Probability is the relative frequency with which the individual is found in the universe. To insist on this duality is to be able to point out with better emphasis the sad state of Bayes' theorem, and so-called *à posteriori* probability, as will be shown in a moment. Coolidge says, in concluding his Chapter VI on this theorem: "We take it with a sigh, as the only thing available under the circumstances. 'Steyning tuk him for the reason the thief tuk the hot stove—bekaze there was nothing else that season.'" The reviewer believes that Bayes' theorem does not have a meaning in the practical cases to which it is applied, and that in the artificial cases for which it does have a meaning it is really not a new or different kind of probability at all and would better not be handled as such. Coolidge almost says as much himself. Indeed, after reading his earlier remarks one wonders whether after all he did think Bayes as good as a hot stove or whether he took him for the literary allusion. But, unfortunately, this pleasant hypothesis has to be abandoned on reading further, for it is discovered that he is to be used in deriving the so-called Gaussian law. For this demonstration Coolidge rejects the idea of fundamental or elementary errors, which was exploited by LaPlace, and originally due to DeMoivre—antedating Gauss by half a century—because he does not believe they actually exist. Admittedly there is difficulty about this hypothesis, but one does not rid oneself of difficult assumption when one forsakes elementary error and cleaves to Bayes. That is to jump from the frying pan into the hot stove. Let us suppose a concrete case. The length of this room is to be measured a million times. What will be the frequency distribution of the measurements? That is the problem Coolidge has before him. Will it be the normal ("Gaussian") law? In order to prove that it will, he talks about the probability that the true value (which is 20.00 feet) shall take on a certain value x when a certain set of ten measurements has a mean value 20.10 feet. Remember our insistence that probability, to have a meaning, involves two events, the universe, and the individual. If the true value is to be the individual, what is to be the universe in this case? One may think of a universe constructed as follows. Imagine 100,000 equal observers to take ten measurements each. There results 100,000 means, and some of them have the value 20.10 feet. This latter sub-group of means is the universe. The probability that the true value is x must now be the relative frequency in this universe with which the true value is x. But this is nonsense; at best one must say that this probability is zero unless x is 20.00 feet. The true value is a constant, and does not depend on the observations. Of course, one may construct a case, as in the proof of Bayes' theorem, where a meaning for the probability of the true value being x does exist. One may begin by supposing 100,000 different observers, each observing one of a set of many rooms, chosen in some manner; but this is quite artificial and has no relation to the problem before us. We are interested in the distribution of many measurements of one room, not in the distribution of many measurements of several rooms. Further, with regard to the difficulties with the hypothesis of elementary errors, it certainly is true that elementary errors do exist in some cases. For example, the error made when a long range gun is fired is a function, perhaps approximately linear, of errors made by the gunner, in estimating elevation, direction and force of wind, temperature and composition of powder, etc. We do not wish this hypothesis to be available in all cases of physical measurements, for it is not true that all cases give a normal distribution, and we do not wish to be put in the embarrassing position of having to prove too much. May it not happen that the question of the observance of this law in a given case does in reality depend on the applicability of just this hypothesis?

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SPECIAL ARTICLES

THE OPAH OR MOONFISH, LAMPRIS LUNA, ON THE WEST COAST OF FLORIDA

LATE in July, 1926, one of my former students, Dr. Louise M. Perry, of Asheville, N. C., called at my office and showed me a pencil sketch of a fish which I at once recognized as *Lampris luna*. On showing her the colored figure in Couch's "British Fishes"[1] and reading the description in Jordan and Evermann's "Fishes of North and Middle America,"[2] Dr. Perry declared this to be the fish in question.

This fish came ashore on the bay side of Captiva Island, west shore of Florida, during a heavy southwesterly blow, in the period of full moon during the first week in May, 1926. Dr. Perry has a winter home on the waters of Charlotte Harbor, which is separated from the Gulf of Mexico by Captiva, Sanibel and other islands, and being an ardent fisherman and student of natural history, is particularly on the lookout for unusual specimens. None of the local fishermen on Captiva and Sanibel Islands, the "oldest inhabitant," nor the local taxidermist (who for many years has been mounting specimens for sportsmen in these localities) had any knowledge of the fish. Fortunately Dr. Perry made a careful sketch of the fish and asked for its identification.

This fine specimen was carefully mounted and is in the collection of Dr. Franklin K. Miles, of Fort Myers, Florida. It and the cast in the U. S. National Museum, presently to be referred to, are the only mounted specimens on record in the new world.

Dr. Perry writes that the fish could not have been dead long before she examined it since "the brilliant red and silver of its fins and body were still undimmed." The fish was four feet long between perpendiculars, and weighed 125 pounds. Dissection showed its stomach to be full of the small clam, *Donax variabilis*. Since the opah is commonly reckoned to be a pelagic fish this is very interesting, for it shows that it had been feeding in shallow water—*Donax* being a shallow water dweller. So far as I know there are but two other references to the food of *Lampris*. Cuvier and Valenciennes[3] dissected a two and five tenths foot specimen taken at Marseilles which had in its stomach a large number of the beaks of small cephalopods and also remains of rhizostomous jellyfishes. Later Lowe[4] dissected several Madeiran specimens. In one of these (three feet, four and a half inches long) he found that "the oesophagus was filled with half-decomposed remains of the softer-coated isopodous Crustaceæ (sea woodlice)"; in another (three feet long) "both the oesophagus and stomach were filled with various small soft-coated Crustaceæ, and traces of remains of fish."

This seems to be the fifth recorded opah from the waters of North America. David Starr Jordan, under date of October 26, 1888,[5] reports the capture on the Grand Banks of Newfoundland of a five-foot specimen. This was based on a description and figure sent him by Everett Smith, of Portland, Maine. In *Forest and Stream* (1893, Vol. 41, p. 293), Dr. R. W. Shufeldt records the capture of a specimen on Le Have Bank in latitude 42° 49′ N. and longitude 63° N. This fish was in such fine condition that a cast was made and Shufeldt's article is illustrated by a figure of this fine cast, which shows all the fins covered with dots.

Goode and Bean[6] describe this same fish and figure it without the spots. They say further that "it has been reported from off Newfoundland, Nova Scotia (?), and Maine," but give no records. B. W. Evermann in 1896[7] puts on record a specimen taken at Monterey, California. Jordan and Evermann (1896) describe this Monterey specimen and add that it has been "taken off Newfoundland, Maine, and Cuba, also at Monterey and other places in Califor-

[1] Vol. II, 1863, to face page 133.

[2] Vol. I, 1896, p. 954.

[3] "Histoire Naturelle des Poissons," Vol. 10, 1835, pp. 39–60.

[4] "Fishes of Madeira," London, 1843–60, pp. 27–35.

[5] Bull. U. S. Fish Commission for 1887, 1889, Vol. 7, p. 202.

[6] "Oceanic Ichthyology," 1895, p. 223.

[7] "Recreation," 1896, Vol. 4, p. 41.