

BIOMETRY.

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THIS Journal is especially intended for those who are interested in the application to biology of the modern methods of statistics. Those methods deal comprehensively with entire species, and with entire groups of influences, just as if they were single entities, and express the relations between them in an equally compendious manner. They commence by marshalling the values in order of magnitude from the smallest up to the largest, thereby converting a mob into an orderly array, which like a regiment thenceforth becomes a tactical unit. Those to whom these considerations are new, will grasp the results more easily by thinking of the array in its simplest, though not necessarily in its most convenient, form for mathematical treatment. Let them conceive each value to be represented by an extremely slender rod of proportionate length, and the rods to be erected side by side, touching one another, upon a horizontal base. The array of closely packed rods will then form a plane area, bounded by straight lines at its sides and along its base, but by a flowing curve above, which takes note of *every one* of the values on which it is founded, however immense their multitude may be. The shape of the curve is characteristic of the particular group of values to which it refers, but all arrays have a family resemblance due to similarity of origin; they all drop steeply at one end, rise steeply at the other, and have a sloping back. An array that has been drilled into some such formation as this, is the tactical unit of the new statistics. Its outline is expressed by a general formula whose constants are adapted to each particular case, and, being thus brought within the grip of mathematics, the internal relations of an array and their relations to those of any other array can be expressed in exact numerical forms. The new methods occupy an altogether higher plane than that in which ordinary statistics and simple averages move and have their being. Unfortunately the ideas of which they treat, and still more the many technical phrases employed in them, are as yet unfamiliar. The arithmetic they require is laborious, and the mathematical investigations on which the arithmetic rests are difficult reading even for experts; moreover they are voluminous in amount and still growing in bulk. Consequently this new departure in science makes its appearance under conditions

that are unfavourable to its speedy recognition, and those who labour in it must abide for some time in patience before they can receive much sympathy from the outside world. It is astonishing to witness how long a time may elapse before new ideas are correctly established in the popular mind, however simple they may be in themselves. The slowness with which Darwin's fundamental idea of natural selection became assimilated by scientists generally, is a striking example of the density of human wits. Now that it is grown to be a familiar phrase, it seems impossible that difficulty should ever have been felt in taking in its meaning. But it was far otherwise, for misunderstandings and misrepresentations among writers of all classes abounded during many years, and even at the present day occasional survivals of the early stage of non-comprehension make an unexpected appearance. It is therefore important that the workers in this new field who are scattered widely through many countries, should close their ranks for the sake of mutual encouragement and support. They want an up-to-date knowledge of what has been done, and is doing, in it. They seek for opportunities of receiving judicious help from one another, sometimes in circulating questions, sometimes in discussing the preliminaries of new plans of campaign. Immense labour has too often been wasted in statistical research through a mistaken judgement of the value and real significance of the data employed. The fresh opinion of skilled onlookers is the safest test of the value of materials and affords a ready means of obtaining timely warning of the presence of vitiating conditions before an inquirer commits himself to any new statistical enterprise. Every investigator stands in need of expert criticism, for no pursuit runs between so many pitfalls and unseen traps as that of statistics.

This Journal, it is hoped, will justify its existence by supplying these requirements either directly or indirectly. I hope moreover that some means may be found, through its efforts, of forming a manuscript library of original data. Experience has shown the advantage of occasionally rediscussing statistical conclusions, by starting from the same documents as their author. I have begun to think that no one ought to publish biometric results, without lodging a well arranged and well bound manuscript copy of all his data, in some place where it should be accessible, under reasonable restrictions, to those who desire to verify his work. But this by the way. There remains another cogent reason of a very practical kind for the establishment of this Journal, namely that no periodical exists in which space could be allowed for the many biometric memoirs that call for publication. Biometry has indeed many points in common with Mathematics, Anthropology, Zoology, Botany, and Economic Statistics, but it falls only partially into each of these. An editor of any special journal may well shrink from the idea of displacing matter which he knows would interest his readers, in order to make room for communications that could only interest or even be understood by a very few of them. I am tempted to illustrate, or rather to over-illustrate, the coldness of welcome often afforded to a new departure in science, by an anecdote concerning the cause that really led to the foundation of the Geological Society

of London. I have rarely related it in conversation, fearing to give pain to some one, and I have never done so in print; neither can I find that any version of it has been published by others. But now that nearly a century has slipped past since the event, there can be no harm in digging up and bringing to light a buried but amusing historical fact.

The story was told me long, long ago, in the 'forties, by Mr George Bellas Greenough, F.R.S. I was then an eager youth fresh from college, and he an elderly man; it was as follows. In 1806-7, when Geology was in its infancy and travellers were scarce owing to European wars, Mr Greenough and a few young friends compiled a list of questions with the view of ascertaining how far the facts of Nature might agree with the competing geological theories current in those days. Sir Joseph Banks was the President of the Royal Society at that time, an office which he exercised despotically for 43 years (1777-1820), becoming almost an autocrat over English scientific men. So it was to him that Mr Greenough and his young friends naturally went. They brought their questions and begged that copies of them might be circulated under official sanction among suitable persons, including foreign correspondents of the Royal Society. Sir Joseph was sometimes gracious in mood, frequently the reverse, and on this occasion he might be described as bearish. Not content with an emphatic "no," he dismissed them with words to the effect (in almost those very words, if my memory does not deceive me) that a few fools could ask more questions in half an hour than wise men might answer in years. The deputation departed, ready to burst with suppressed fury, and the moment they were quit of the house, agreed to circulate the questions on their own responsibility, which considering the persons and circumstances was an act of rare audacity. Out of this impromptu coalition, aided by a multitude of elsewhere recorded circumstances, the Geological Society was evolved, with Mr Greenough as its first President. (The official account of its origin is judiciously reticent, but not inconsistent with this little piece of history. It will be found in the preface to the first volume of its *Transactions*, published in 1811.) It is not in the least my intention to insinuate that Biometry might be served by any modern authority in so rough a fashion, but I offer the anecdote as forcible evidence that a new science cannot depend on a welcome from the followers of older ones, and to confirm the former conclusion that it is advisable to establish a special Journal for Biometry.

The primary object of Biometry is to afford material that shall be exact enough for the discovery of incipient changes in evolution which are too small to be otherwise apparent. The distribution of any given attribute, within any given species, at any given time, has to be determined, together with its relations to external influences. This affords a standard whence departures may be measured and the direction and rate of their progress ascertained. Evolutionary changes are exceedingly slow as a rule, but supposing that a thousand years or thirty generations of mankind, would suffice in some particular case for some conspicuous alteration in a species, exact measurements ought to discover its progress well within the limits

of a human lifetime. Moreover the forms by which distribution is expressed in the new method are excellently fitted to bring to light any survivals of a less advanced type, which may serve as evidence of recent change. Also they quickly indicate incipient changes, through their power of isolating aberrant forms, and then of measuring the degree in which any of these may be favoured by natural selection. The organic world as a whole is a perpetual flux of changing types. It is the business of Biometry to catch partial and momentary glimpses of it, whether in a living or in a fossil condition, and to record what it sees in an enduring manner. It is an after-process to combine those glimpses into a continuously changing scene, much as some tumultuous procession is made to live and move again by means of a "biograph." Each biometric investigation may be compared to a solitary boring in a level plain, whose underlying geology has to be ascertained. A comparison of the cores brought up, will supply evidence of the depths of each of the buried strata and will justify many interpolations of unseen portions between the borings. For instance, it may not require many investigations to establish statistical laws of heredity on a secure basis, by ascertaining the limits within which those that have been already observed may hold good in a moderate number of widely different types of plant and animal life. Biology could soon be raised to the status of a more exact science than it can as yet claim to be, if each of many biometricians would thoroughly work out his own particular plot, although those plots may be very far indeed from occupying the whole of the area that admits of being directly explored.