Occurrence of the Amphipod *Orchestia bottæ* and Other Organisms in Britain

THE range of *Orchestia bottæ* M. Edws. is greater than that indicated by Messrs. Cain and Cushing¹. Besides the records from the Thames, I have specimens given me in 1945 by Mr. A. E. Ellis from the River Yare at Brundall, Norfolk. In 1947 I received specimens from the same area, but taken from much higher up the river, about twenty miles from the sea. In fact, it seems possible that this species is widely distributed throughout south-east England, and that recent discoveries disclose an established range rather than a late immigration from the Continent.

A similar case is that of *Eucrangonyx gracilis* (S. I. Smith), specimens of which I have from the Metropolitan Water Board's works at Lee Bridge; from a garden pond at Harrow (on the water system of the Colne Valley Water Co.); from ponds in Surrey; and lastly, in great abundance, from among floating dead leaves in a small backwater of the River Cherwell at Oxford in 1944.

Gammarus lacustris G. O. Sars has long been known to have a wide range in Scandinavian and other Continental fresh waters, and yet has only been discovered in Britain comparatively recently (1939). Despite this late discovery, persistent search has shown the species to be established in very many lochs in the north of Scotland, and so one concludes that it is really an old inhabitant.

In other words, it is not necessarily the range of some of these animals, I believe, that is increasing, but our knowledge of their range.

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¹ *Nature*, 161, 483 (1948).

Discovery of Radioactivity

IN *Nature* of January 3, a review entitled "Atomic Energy" by Prof. J. A. Crowther referred to the progress made "since the spontaneous release of atomic energy fogged a packet of photographic material in the drawer of Becquerel's desk".

This sentence seems to imply that the discovery of radioactivity by Henri Becquerel, my father, in 1896, was fortuitous—which is incorrect. He intentionally subjected a photographic plate—not a "packet"—to the action of salts of uranium. His first idea was that phosphorescence of uranyl salts might be accompanied by a radiation similar to X-rays, which had just been discovered. Instead of rays associated with phosphorescence, Henri Becquerel found a new spontaneous radiation, emitted by all uranium compounds, phosphorescent or not, and he established that this radiation was an atomic property.

Hence it is undesirable that any idea of radioactivity being discovered by chance should arise.

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I AM surprised that Prof. Becquerel should have read into a passing reference to his distinguished father's work, in my review of Prof. Gamow's book,

any suggestion that the discovery of radioactivity was in any way "fortuitous". No such suggestion was intended. I had always imagined that the historic photographic plate was enclosed in some sort of light-proof wrapping, and might be legitimately, if briefly, described as a "packet of photographic material".

J. A. CROWTHER

Operational Research

IN his admirable article on operational research in *Nature* of March 13, Sir Charles Goodeve makes the statement: "The application of the statistical tool is still on the increase, but there is no need or likelihood of the tool itself being developed further". Quite apart from the dangers inherent in making general prophecies about the likely advance (or lack of advance) in any field of science, this statement implies a degree of perfection in existing methods of dealing with statistical problems arising in operational research which would not, I think, be claimed by practising statisticians. In particular, the analysis of data (such as survey data) which can be classified in a number of different ways, and multivariate analysis, both require further development.

In the analysis of survey data it is often of considerable importance to determine differences between the different classes of any one classification, free from the disturbing effects due to disproportionate representation in the other classifications. The basic theory (that of fitting constants by the method of least squares) is well known, but no analytical technique suitable for routine application to extensive data has yet been worked out. In multivariate analysis, which is of the greatest interest in economics as well as in many other fields, progress in both theory and analytical technique may be expected.

The dependence of the development of any given technique of statistical analysis on the availability of suitable machines is often not sufficiently realized. Without the modern desk calculator, the development of the technique of the analysis of variance appropriate to experimental results, and the associated development in the theory of design of experiments, could scarcely have taken place. In like manner, multivariate analysis has been waiting on the further development of machine design which is only now being effected.

With Sir Charles Goodeve I confidently look forward to the introduction of novel methods primarily dependent on advances in other fields of science; but if these are to reach their maximum effectiveness they must be integrated with, rather than regarded as alternatives to, the statistical approach.

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March 23.

I AM grateful to Dr. Yates for correcting false impressions which may arise from my remark. Operational research as I have seen it has so far found the statistical tool adequate for that side of its work, but I might have guessed that there would always be 'frontiers' with unexplored fields or unsolved problems beyond.

CHARLES GOODEVE