diffused into the metal on the surface of which it was collected. Recently, Maracineanu (*C.R.* 176, 1879, 1923), working in Mme. Curie's laboratory, has obtained evidence that the apparent period of polonium is appreciably shorter if the lead on which it is collected is heated for a while.

G. HEVESY.
A. OBRUTSHEVA.
Universitetets Institut for teoretisk Fysik,
Copenhagen.

Evolution, and the Age and Area Hypothesis.

DR. WILLIS's assumption that new genera and new species may arise directly by mutation is rather startling to most students of evolution. He supports his contention, chiefly, by the observation that the frequency distribution of genera containing 1, 2, 3 . . . species follows a regular, hollow curve, with monotypic genera the most frequent. Mr. Yule (Phil. Trans. Roy. Soc. B. 403) has shown that assuming (1) that species give new species by chance at an irregular rate, constant on the average and the same for all species, and (2) that species give new genera in the same way, by mutation, then the frequency distribution of size of genus will approximate closely to that observed in Nature; the latter being such that log. number of species plotted against log. number of

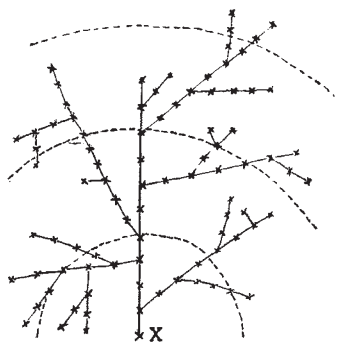

FIG. 1.

genera gives practically a straight line. That all genera arise directly by mutation is implied throughout, since they are all supposed to start as monotypes. Finally, Mr. Yule concludes that viable specific mutations probably do not occur, in all the flowering plants over the whole earth, more often than about once in thirty years; hence that our failure to observe them cannot disprove their occurrence. This conclusion is disquieting; and we clearly cannot accept this mechanism if we can otherwise explain the evidence adduced for it.

It is natural to try to harmonise Dr. Willis's curves with the usual view that genera arise through the extinction of intervening links; and some insight into this question can be obtained by graphical means.

Agreeably with the conventional evolutionary tree, Fig. 1 represents all the species descended from a single species, supposing that none have died out.

We can assume, with some justification, that at increasing distances from the original species (X in Fig. 1) the chance that a species will survive to the present time increases; the survival rate being, for example, 1/3 in the innermost circle, 2/3 in the next, 3/3 in the last. In any area the effect of random extinction of species is shown by numbering the points in the area, taking a random selection of these numbers, in the specified proportion, and deleting the appropriate points from the plan. A distribution such as that of Fig. 2 is obtained; an isolated point, or group of points, representing a genus.

In an actual experiment, the original number of species was 884, divided into 12 areas by concentric circles; and about one-half the species were exterminated. First, it was assumed that roughly 1/12 survived from the first area, 2/12 from the second, and so on. In a second trial, the corresponding proportions were taken as, roughly, a^{11}, a^{10}, a^{9}, etc. The species were

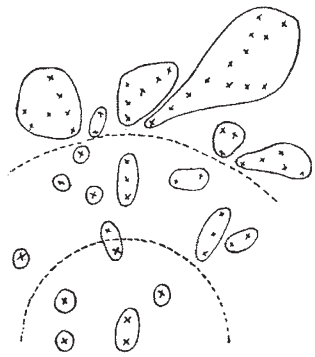

FIG. 2.

then classified by assuming that any point, or group of points, separated from all its neighbours by more than a fixed arbitrary distance, forms a genus. Any other procedure would simply confront us with the ordinary difficulty of the systematist—where to draw the line between two genera. The results for the frequency distribution of number of species per genus, in the two trials, were:

No. of species .	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15—21	22
No. of genera . (1)	78	41	21	10	3	2	1	1	1	1	0	3	1	1	0—0	1
„ . (2)	90	45	21	8	5	4	1	1	1	1	0	1	0	1	0—0	1

The curves of Fig. 3 approximate fairly closely to linear form.

It seems likely, therefore, that Dr. Willis's curves accord with the expectation if genera are formed by the dying out of intervening links. The scheme I have given is, I am fully aware, open to objections. Apart from assumptions inherent in the use of a graphical method, difficulty arises over the distance necessary to give a generic gap, the proportion of

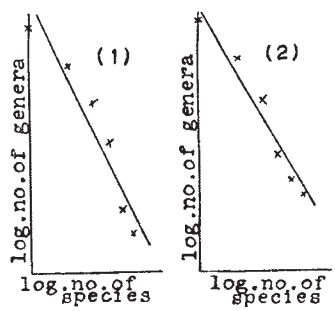

FIG. 3.

species surviving from successive horizons, etc. Such questions it does not seem profitable to discuss at the present time; especially as similar, and other, objections apply equally to the theory of generic mutation. I suspect, too, that the scheme I have given would give similar results with widely different assumptions as to form of the original distribution and the manner of dying out.

A. E. WATKINS.
St. John's College, Cambridge.