UNIVERSITY AND EDUCATIONAL NOTES

BY the will of Lillie Hitchcock Coit, of San Francisco, the University of California receives the residue of her estate, which will probably amount to $300,000, for the support of the lecture foundation established by her father, Charles M. Hitchcock, in 1872. It is directed that the money be used to increase the endowment of the Hitchcock chair, and that it hereafter be known as the Charles M. and Martha T. Hitchcock Chair, in honor of her father and mother.

A GIFT of £20,000 has been made to the University of Edinburgh by Dr. Thomas Cowan, a Leith shipowner. This gift is in connection with Cowan House, a residence founded by him to be a social center for male students of British extraction. His desire is that the residence should attract young men of intellectual force or other personal characteristics who are likely to have a useful influence on their fellow-students.

DR. SIDNEY BLISS, associate professor of biological chemistry at McGill University, has resigned to accept the chair of biochemistry in the school of medicine of Tulane University of Louisiana, effective September 1.

DR. FRANKLIN C. PASCHAL, professor of psychology and associate dean of the college of arts and sciences of Vanderbilt University, has been appointed dean of the college.

DR. REGINALD D. MANWELL, head of the department of biology in West Virginia Wesleyan College, has been appointed instructor in the department of protozoology of the school of hygiene and public health of the Johns Hopkins University.

PROFESSOR ALLEN MAWER has been appointed provost of University College, London, as from January 1, 1930, in succession to Sir Gregory Foster.

A. W. ASHBY has been elected professor of agricultural economics in the University College of Wales, Aberystwyth.

M. TRAVERS, professor in the faculty of sciences of Marseilles, has been elected professor of industrial chemistry in the University of Nancy.

DISCUSSION

A NOTE ON THE ASSOCIATION OF DISEASES[1]

IT is a question whether any more complicated relations than those of "more" and "less" can ever be really proved by the use of statistical methods alone and unaided, and indeed in not a few cases there is some doubt inhering in a statistical conclusion that A is more than B or C is less than D. Perhaps in the long run it will appear that the chief usefulness of the statistical technique in the methodology of science is the not unimportant one of suggesting problems and lines of attack upon problems which must finally be solved, if they ever are solved, by the application of the methods of experiment and observation, or a close and integrated correlation of these methods with the statistical to reach a common end. It is of interest to note that this is essentially the position taken by Dr. C. A. Gill[2] in regard to the proper place of the statistical method in epidemiological research, in which it has generally been thought to be almost the necessarily preeminent if not exclusive method.

These remarks are occasioned by the consideration of the wider problems which are being opened out by a recent statistical study of the relation between cancer and tuberculosis.[3] It has long been a well-known objective fact of clinical experience that these two diseases are but rarely found together at the same time in florid activity in the same living person. The same objective result has been found in the statistical study of large collections of autopsy records, not alone by the present writer, but by a number of predecessors in this field of investigation. Furthermore, general vital statistics, with perhaps less precision and reliability, lead to the same objective finding. The correctness of this purely empirical objective result has apparently not been questioned by any serious student of the matter.

The difficulty arises, as is so often the case in statistical matters, in the interpretation of the objective findings. Considering generally the association of any two diseases, the objective findings seem bound to fall into one or another of the following three categories, *viz.*, (1) The two diseases are found to be significantly *more* frequently associated together in the same person at the same time than would be expected from the product of the simple probabilities of the occurrence of each alone; (2) The two diseases are found to be associated together in the same person at the same time to *the same* degree of frequency, within the limits of errors of sampling, as would be expected from the product of the simple probabilities

[1] From the Institute for Biological Research of the Johns Hopkins University.

[2] C. A. Gill, "The Genesis of Epidemics and the Natural History of Disease." An introduction to the science of epidemiology based upon the study of epidemics of malaria, influenza and plague. New York (William Wood and Company). 1928. pp. xxvi + 550. See particularly pp. 18–24.

[3] R. Pearl, "Cancer and Tuberculosis," *Amer. Jour. Hyg.*, 9: 97–159, 1929.

of the occurrence of each alone, and (3) The two diseases are found to be significantly *less* frequently associated together in the same person at the same time than would be expected from the product of the simple probabilities of the occurrence of each alone.

Now, as has been pointed out above, the experience of clinicians, pathologists and statisticians over the last three quarters of a century indicates that cancer and tuberculosis appear to fall into category (3) in respect of their association. At the same time it is equally well known that occasionally the two diseases *may* occur in florid activity in the same person at the same moment.

There are at least two possible interpretations of this situation. Stated in the briefest way, one is that the reason why cancer and tuberculosis are not more frequently associated in active form is because there is some wholly unknown sort of "antagonism" or incompatibility between the two diseases. The other is that the result is purely fortuitous, the infrequency of association arising from the assumed fact that the time relations of the disease between onset and death are such as to make impossible the complete freedom of joint association which is an implicit postulate of the simple probability theory. Or putting the point less formally, it can be alleged that the reason why persons with cancer are clinically found to have florid tuberculosis less frequently than persons without cancer (of the same age, of course) is because the cancer kills them before there is time for florid tuberculosis to develop. And *mutatis mutandis* the argument may be made the other way about.

So far as evidence has yet developed there appears to be no way of determining conclusively which of these alternative interpretations of the objective findings is the true one. In the paper referred to above[4] the first interpretation was adopted because the weight of all the evidence available seemed to point in that direction. This interpretation may have been erroneous. If so, the fact will doubtless be developed as further evidence comes to hand. It should be said, however, that a considerable element in leading to the adoption of the "antagonism" interpretation was derived from biological rather than statistical considerations, particularly from the study of the clinical histories, while they were living, of the individuals included in the autopsy material, on the one hand, and from the study of the course of the two diseases in each individual as revealed in the autopsy findings themselves, on the other hand. Many diseases, and particularly cancer and tuberculosis, leave in the body a record of their development and course from which there can be reconstructed a picture of the events long prior to death.

[4] R. Pearl, *loc. cit.*

Investigations which have been made since the publication of the statistical paper have tended to strengthen the opinion that the interpretation adopted was the correct one. These have been chiefly along two lines: (*a*) a very careful and detailed study, from the original material, of the cases in the Johns Hopkins Hospital autopsies in which both cancer and tuberculosis occurred together in florid form. These studies have been made by Dr. W. T. Howard, Jr., a pathologist of long and wide experience. The results will presently be published in detail. (*b*) The results of treating cancer experimentally with tuberculin, regarding which a preliminary report[5] has already been published. A detailed report will follow in due time. Both these lines of investigation appear to indicate that the products of metabolism of the tubercle bacillus, if present in sufficient amounts, have a definite and marked effect upon the characteristics of at least certain types of malignant cells.

But the question of the association of diseases is a much broader one than that merely of these two. We are now investigating the association of a considerable number of important pathological conditions, such as diabetes, nephritis, various heart diseases, arteriosclerosis, etc., both among themselves and with cancer and tuberculosis. It is hoped that such a comprehensive study may help to throw light upon the correct interpretation of the statistically infrequent association of these two, in addition to its own intrinsic interest.

RAYMOND PEARL

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PARTHENOGENESIS AND POLYEMBRYONY IN ALNUS RUGOSA (DUROI) SPRENG.

Alnus rugosa is polymorphic. Plants exhibiting such variability usually furnish material which is of interest cytologically, in so far as the reproductive cells are concerned. Due to irregularities of microsporogenesis, pollen formation in this alder produces only 2 or 3 per cent. of morphologically perfect pollen.[1] Although thousands of ovaries at various stages of development have been examined microscopically, no pollen tubes have been seen.

The plant, however, sets an abundance of viable seed. When seed-producing catkins are so bagged that pollination can not take place, embryos are formed in the ovules just as under normal conditions. Germination tests of normally formed seed and of bagged seed proved equally successful in seedling production.

[5] R. Pearl, A. C. Sutton and W. T. Howard, Jr., "Experimental Treatment of Cancer with Tuberculin," *Lancet*, May 25, 1929, p. 1078.

[1] R. H. Woodworth, "Cytological Studies in the Betulaceae. II. Alnus and Corylus," *Bot. Gaz.* (in ed.).