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

JULY 25, 1929

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.).

Normally the number of chromosomes is reduced by one half when the embryo-sac mother cell divides. In *Alnus rugosa* there is no such reduction. The pairing of homologous chromosomes does not take place so the embryo-sac initial has the sporophytic or diploid number of chromosomes, twenty-eight.

From one to four embryo-sacs may form in one ovule from as many embryo-sac mother cells. Embryos arise in these embryo-sacs from the diploid egg, which, of course, has not been fertilized (parthenogenesis) and by budding of the nucellus. Well-developed embryos appear to have had their origin in the synergids and the antipodals. Such embryo formation would be cases of apogamy. Several very interesting preparations suggest the origin of certain embryos from the endosperm. One ovule, in particular, has an embryo from the diploid egg and another embryo forming in a massive endosperm, being completely surrounded by it and bearing a suspensor, the cells of which merge into the endosperm material. Serial sections show that this embryo is not connected with the nucellus at any point. The initial stages in embryo formation from synergids, antipodals and endosperm have not yet been observed.

One to five embryos may mature in one embryo-sac. Several embryos may mature in each of two embryo-sacs in the same ovule. Germination tests show that two embryos from the same seed can both develop to normal seedlings.

Polymorphism, irregular mioses, parthenogenesis, apogamy, nucellar budding and polyembryony all point to a hybrid origin for *Alnus rugosa* of the New England region.

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A BOMBARDING DICAELUS BEETLE

I AM writing concerning an experience that I had with a ground beetle on November 3, 1928. While the Pi Chapter of Phi Sigma was having a picnic at Stone Mountain, several of the members were collecting various specimens. I turned over a rock and picked up a species of Dicaelus, and while I was holding it between my thumb and forefinger and using the other fingers to unscrew the cap from the cyanide bottle, it gave off a very strong discharge of gas which turned to a dense smoke. This appeared to come from the anterior end of the beetle, instead of from the posterior end as in the genus Brachynus. I placed it head first into the bottle, when it gave off another discharge, which also appeared to come from the side of the head. The bottle was filled so densely with this smoke that the beetle was almost entirely hidden; when I took off the cap to show several of the party, the smoke escaped to a distance of over a foot from the bottle. I am very anxious to hear from any reader of SCIENCE that has had a similar experience with a beetle of the genus Dicaelus. I have known several Brachynus beetles to discharge the gas, which always appeared to come entirely from the posterior end of the body.

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QUOTATIONS

THE SEVENTIETH BIRTHDAY ANNIVERSARY OF THEOBALD SMITH

ANNIVERSARIES play an important part in national life as they do in one's personal experiences. They serve not only to arouse retrospect and encourage a review of what has gone before, but also to awaken an interest in the impending possibilities of the future. The experience of the past tends in no small measure to kindle new enthusiasms for what coming years may reveal, or to dampen an ardor for plans and projects that history has indicated to be futile or unlikely to be accomplished. It has become customary to select the centennial anniversary of the accomplishment of some notable purpose or the birth of a distinguished person for the celebration of achievement and the review of its significance and bearing on progress. It seems equally fitting at times to refer to significant contributions before their consequences have become so familiar that the merits of the maker are all but forgotten.

The seventieth birthday anniversary of Theobald Smith, at the time of his announced retirement from the active directorship of the Department of Animal Pathology of the Rockefeller Institute at Princeton, N. J., affords a welcomed opportunity to hail one of the eminent American contributors to the advancement of science and the development of medicine. The demonstration of the existence of insect vectors in the transmission of disease—a phenomenon that the medical student of to-day, only a generation after the epoch-making discovery, accepts without debate or hesitation—marked Smith as one of those rare pioneers who sense great opportunities, who see what others have persistently failed to observe, and who have the strength and courage to give force to their convictions.

A popular writer has remarked that it was Theobald Smith who made mankind turn a corner. "He was the first, and remains the captain of American microbe hunters," showing men an entirely new and fantastic way in which a disease may be carried—by an insect. It is fortunate as indeed it is gratifying that with the progress of popular education the significance of such a discovery may to-day be thoroughly appreci-