(3) The relation between the electrical axis of Einthoven and the cardiac muscle fibres excited at any given instant, as demonstrated by many observers.

It has further been possible to demonstrate that the curve recorded from these simple muscle strips can be shown to be entirely at variance with the previously accepted theory of the spread of the so-called wave of negativity.

3062

The constitutional element in the etiology of pneumonia.

RAYMOND PEARL.

[*From the Institute for Biological Research of the Johns Hopkins University, Baltimore, Md.*]

A detailed genetic and biometric study has been made of a family of 13 brothers and sisters all of whom have had broncho or lobar pneumonia one or more times. One has had it twice, and one has had it three times. Seven of the 13 have died of it. One has tuberculosis of the lungs, and another presents clinical symptoms which make it probable that he also has. There have been in the sibship 87.2 person-years exposure to risk, counting the "infant" deaths to have occurred at 0.3 year, which is probably as fair as any other assumption, it having been shown that the deaths of the first year of life center at 0.3 year. In these 87.2 person-years of exposure occurred 16 cases of pneumonia, or 18 per 100, and 7 deaths, or 8 per 100 person-years exposure. Unfortunately, owing to lack of morbidity data, we cannot make any exact comparison of the case incidence rate of pneumonia in this family with that in the general population. But that it is enormously higher is obvious. Every day experience indicates that nothing like 100 per cent of all persons have pneumonia before reaching the age of 19.

In the case of mortality a more exact approach is possible. If the age-specific mortality rates for pneumonia in the U. S. Registration Area (exclusive of North Carolina) in 1910 are applied to a group of 13 children having the same age distribution as the

TABLE I.

Expected deaths from pneumonia in a family of 13 children, if the age specific death rates of the general population operated, compared with the actual deaths in the family here discussed.

Age	Deaths expected among 13 children	Actual deaths in the family studied
Under 1	0.2	6
1-4	.04	0
5-9	.004	0
10-14	.002	1
15-19	.003	0

sibship under discussion, the results shown in Table 1 are obtained.

It is thus seen that there had occurred in the particular sibship studied, up to the time of this investigation, more deaths from pneumonia than would be expected in twenty-five families of this size on the basis of the usual mortality from this cause.

The material from which the data of this paper are derived is contained in two histories of the Family History Records* of this laboratory. The mode of collection of the records has been described elsewhere.[1] It will suffice to say here that trained field-workers visited the families and collected the information under a variety of critical safeguards to ensure accuracy, and that these records were supplemented by hospital, sanitarium, and health department records.

In the pedigree there are detailed records of 202 blood relatives of the 13 children whose pneumonia presents the problem of the study. The data regarding these 202 relatives were submitted to biometric analysis, with the following results:

It is first of all shown that the explanation of such an extraordinary incidence rate of pneumonia as that observed in this sibship cannot, in any significant degree, be environmental. While the environment surrounding these children was certainly not perfect, quite as certainly it was neither worse than, nor essentially different from, that surrounding thousands of similar sibships in

* Financial aid in the collection of these Family History Records was furnished at different times in the development of the project, by grants from the National Tuberculosis Association, the Russell Sage Foundation, and the Commonwealth Fund. To each of these agencies it is a pleasure to acknowledge my indebtedness.

[1] Pearl, R., Studies in Human Biology. Baltimore (Williams and Wilkins), 1924. *Cf.* Chapt. xii.

TABLE II.
Summary of Results.

	Father's side	*Mother's side*
1. Case incidence of tuberculosis	6.25 per cent	1.7 per cent
2. Sex ratio (per cent males)	56.5 " "	53.5 " "
3. Fertility rate	23.6 " "	15.9 " "
4. Infant mortality rate	14.0 " "	3.7 " "
5. Total mortality rate	1.61 " "	1.42 " "
6. Total poor health rate	7.7 " "	8.5 " "
7. Total respiratory illness rate	1.3 " "	1.1 " "
8. Infant respiratory illness rate	0.8 " "	3.9 " "
9. Childhood respiratory illness rate	1.3 " "	3.2 " "

Baltimore who exhibit a pneumonia rate no different from that of the general population. Furthermore, the time incidence of the pneumonia among these children practically precludes the possibility of simple contagion of the disease from one to another being any significant part of the explanation.

Table II summarizes the similarities and differences between the two unrelated genetic stocks which were combined to form the children of the sibship under discussion.

These results may fairly be stated in the following way: The two stocks which produced the children in the family discussed were, as groups, substantially similar biologically in respect of sex-ratio, of total mortality rate, of total poor health rate, and of total respiratory illness rate. The differences between the groups in these respects are not great enough to suggest that there is, in so far, any significant biological differentiation between them. But, on the other hand, the group on the father's side has an excessive incidence of tuberculosis, a higher fertility rate, a markedly higher infant mortality rate, and lower infant and childhood respiratory morbidity rates, than does the group of people who make up the mother's side of the pedigree. Not all of these differences between the groups are statistically significant, and, in so far as they are not, must be regarded as suggestive rather than probative.

The interpretation of the whole pedigree reached after careful study of all the evidence is that we have, in the father's kinship, a group of people with a definite tendency towards constitutional inferiority of the respiratory system, which manifests itself chiefly in a tendency to breakdown from pulmonary tuberculosis in early adult life. This particular constitutional inferiority is absent in the mother's kinship, but in that group of people there is

definitely manifest a constitutional tendency to generally non-fatal respiratory infections, bronchitis and broncho-pneumonia, in infancy and childhood. When these two constitutional traits were combined, by the mating of the father and mother of the 13 children in the sibship under discussion, there was produced a group of children with extremely low resistance to any sort of respiratory infection, with a consequent 100 per cent incidence of pneumonia in the years of infancy and childhood.

A complete account of this investigation, presenting the detailed evidence, is now passing through the press.

3063

Effect of light of different wave lengths on penetration of 2,-6,-dibromo phenol indophenol into Valonia.*

MATILDA MOLDENHAUER BROOKS.

[*From Division of Pharmacology, Hygienic Laboratory, Washington, D. C.*]

The marine alga, *Valonia,* was placed in solutions of .00035 M concentration of the oxidation-reduction dye, 2,- 6,- dibromo phenol indophenol dissolved in sea water. The dishes containing the plant were then screened with glass screens transmitting various wave lengths from 300 to 700μ and were placed in diffuse daylight before an open window or were kept in darkness. The pH of the solution was 5.4. The temperature was 22° C. with a variation of about 0.5°.

The results show that as the length of the incident light decreases towards the ultra violet end of the spectrum, the amount of dye in the sap increases.

By extrapolating the curves to equilibrium, it was found that the penetration of the dye follows the course of a unimolecular reaction.

By calculations from curves of relative energy distribution in the visible spectrum obtained from figures as given by Luckiesh[1]

* Published by permission of the Surgeon General.

[1] Luckiesh, M., Color and its application. D. Van Nostrand and Co., New York, 1915, p. 20.