normal function. By supposing that a constant of the theoretical normal curve, viz., its standard deviation, was itself a variable, and assuming for the latter a convenient form, he succeeded in obtaining a curve which effectively described certain symmetrical epidemics.

Brownlee did not, however, obtain any function which satisfactorily accounted for the marked asymmetry which characterises many epidemics. It is an interesting illustration of the way in which apparently disparate problems are interconnected that his work owes much to the remarkable memoir of Pearson and Blakeman on random migration, a memoir inspired by the problem of mosquito distribution suggested to Prof. Pearson by Sir Ronald Ross. These researches, then, which began in the *a posteriori* study of statistics and were continued on the *a priori* assumption of a normal function being at the root of the problem, have carried us some way, but have not so far provided us with a satisfactory mathematical law of epidemics. Sir Ronald Ross, whose interest in the subject dates from so long ago as 1899, and whose latest contribution has just been published, followed a different path. Avoiding any presuppositions as to the form which the law should assume, he looked at the problem as one of *transfer*, viz., of mutual interchange between groups of affected and unaffected individuals, an interchange complicated by the subjection of each group to certain rates of natality, mortality, emigration, and immigration. Being at first specially concerned with the case of malaria, he formulated the problem in the second edition of his treatise on the prevention of malaria (pp. 651–686) in a system of difference equations, the solution of which should provide the required law. A summary of this work appeared in NATURE of October 5, 1911, under the title "Some Quantitative Studies in Epidemiology." In the paper before us,[4] these ideas have been extended and clothed in a more convenient mathematical form.

Sir Ronald Ross's method may be illustrated by summarising the simplest of his cases. If P be the whole population, x the ratio of affected to all members, v and V measures of the variation due to mortality, natality, immigration, and emigration of non-affected and affected persons respectively, and if the proportion affected in time dt be $h \cdot dt \cdot P$ where h is a constant, then we have the following system of equations :—

$$dP/dt = vP - (v - V)xP$$
$$dxP/dt = hP(1 - x) + (V - N - r)xP$$
$$dxP/dt = xdP/dt + Pdx/dt.$$

Eliminating dxP/dt and dP/dt, we have :—

$$dx/dt = h - (h + v - V + N + r)x + (v - V)x^2.$$

If, now, $v = V$, the equivariant case, the last equation can be written

$$dx/dt = K(L - x)$$

where $K = h + N + r$ and $L = h/K$.

Now put $y = L - x$ and we have $dy/y = -Kdt$.

So that if y_0 is the value of y at the beginning,

$$y = y_0 e^{-Kt} \text{ and } x = L - (L - x_0)e^{-Kt},$$

which gives the proportion of the total population affected at time t, this proportion being x_0 when $t = 0$.

Sir Ronald Ross proceeds to investigate the properties of this curve; he then takes the case of v not equal to V, which is dealt with on similar lines, and ultimately considers the curve arising in the simplest case of departure from the assumption that h is constant. The latter results are, no doubt, still somewhat remote from the conditions obtaining in practice, but they suffice to illustrate the genesis of an asymmetrical curve, and incidentally show that a form regarded by Brownlee as inconsistent with an hypothesis of constant infectivity and the termination of an epidemic by the exhaustion of susceptible persons may not be so.

The advantage of Sir Ronald Ross's method, apart from its simplicity and elegance—advantages which are, however, no mean matters—lies in its generality, so that it may be possible to include the case hypothesised by Brownlee as a particular example, precisely as Prof. Pearson's system of skew frequency curves included the normal curve as a special case. It is, of course, too early to speak with confidence. As restrictions are relaxed, the analysis will inevitably become more intricate, and, having evolved an *a priori* law, one must devise, usually by the method of moments, a way of applying the law to statistical data. This is work for the future, and all epidemiologists will await with interest the promised second part of Sir Ronald Ross's paper. No sensible man doubts the importance of such investigations as these; it is high time that epidemiology was extricated from its present humiliating position as the plaything of bacteriologists and public health officials, or as, at the best, a field for the display of antiquarian research. The work of Sir Ronald Ross, of Dr. Brownlee, and of a few others should at least elevate epidemiology to the rank of a distinct science.

M. GREENWOOD, JR.

4 "An Application of the Theory of Probabilities to the Study of *a priori* Pathometry." By Lieut.-Col. Sir Ronald Ross. Proc. Roy. Soc., A, 1916, xcii., 204.

PROF. EMILE JUNGFLEISCH.

PROF. EMILE JUNGFLEISCH, whose death occurred on April 24, at the age of seventy-seven, was born in Paris in 1839 He devoted himself to chemistry and pharmacy, and at an early age joined the Paris Chemical Society. In 1863 he was appointed dispenser to the hospital of La Pitié, and in 1869 qualified as pharmacist and member (agrégé) of the School of Pharmacy. In the same year he became assistant (préparateur) to Berthelot, who had recently been appointed to the new chair of organic chemistry of the School of Pharmacy, and on Berthelot's retirement in 1876 was made his successor. In 1890 Prof. Jungfleisch was nominated professor of chemistry of the Conservatoire des Arts et Métiers, and in 1908, again in succession to Berthelot, was appointed to the chair of chemistry

at the Collège de France. In the following year he was elected a member of the Paris Academy of Sciences, where he took the place vacated by M. Ditte.

His numerous contributions to organic chemistry include the study of the chlorine and nitro-derivatives of benzene and aniline, of which he prepared a large number; but, not content with the mere preparation of new compounds, he sought to discover the relation existing between their physical properties and constitution. He succeeded in showing that there exists a definite relation between the number of substituting atoms and their melting points, boiling points, density, and molecular weight. These results served to some extent as the basis of Kekulé's theory.

Another series of memoirs was devoted to the examination of substances exhibiting molecular asymmetry, and Jungfleisch was able to show that the different forms of tartaric acid discovered by Pasteur, when heated with water, are transformed into one another, yielding an equilibrium mixture varying with the conditions of the experiment. For these researches he was awarded, in 1872, the Jecker prize of the Academy of Sciences. Up to this time no compound possessing molecular asymmetry had been prepared artificially, and it appeared that the intervention of a vital force, as Pasteur held, was necessary to produce it. Perkin and Duppa had succeeded in converting natural succinic acid into racemic acid. Jungfleisch completed the synthesis by converting ethylene, according to the method of Maxwell Simpson, into succinic acid. He also showed that camphoric acid exists in four isomeric forms, the so-called dextro- and lævo-camphoric and *iso*-camphoric acids which he isolated. Following up a similar line of research, he succeeded in resolving inactive malic and lactic acids into their active forms.

Among his other numerous memoirs may be mentioned his work on acetylene chlorides, a new method of reduction of organic compounds by tin salts, a research on derivatives of thymol, on lævulose, which he prepared in the crystalline state, on inulin, chloral hydrate, phenylphosphoric ether, etc.

Jungfleisch collaborated with Berthelot in the study of the partition coefficient of a substance in presence of several solvents; he assisted Lecoq de Boisbaudran in isolating gallium in quantity, and applied similar methods to the preparation of indium.

One of his latest contributions to chemistry was the study of gutta-percha, which resulted in the valuable discovery that the leaves of the plant can be used as a source of the material more economically and less destructively than the stem.

Of his literary contributions to the science mention should be made of the *Journal de Pharmacie et de Chimie*, to which he contributed for twenty-two years a review of foreign researches and publications, and successive editions of his well-known "Traité de Chimie Organique."

J. B. C.

NOTES.

THE Government has appointed a Committee to recommend the steps to be taken for the relief of Sir Ernest Shackleton's Antarctic Expedition. The chairman is Admiral Sir Lewis Beaumont, G.C.B.; the other members are the hydrographer of the Navy, Major Leonard Darwin (representing the Royal Geographical Society), Sir Douglas Mawson, Dr. W. S. Bruce (who has intimate personal knowledge of the Weddell Sea area), and representatives of the Treasury, Board of Trade, and of Sir Ernest Shackleton. The Committee has already begun its meetings.

UNIVERSAL sympathy will be felt with Sir William Crookes, who has suffered the heaviest of all bereavements by the death of his wife on May 10. Lady Crookes, whose maiden name was Ellen Humphrey, was born on January 31, 1836, and was therefore in her eighty-first year. She was married to Sir William on April 10, 1856, and from the earliest times took the liveliest interest in his scientific work, helping him, amongst other things, in delicate chemical weighings and the working out of the calculations connected therewith. Her devotion to, and interest in, his work formed a great incentive, and in no small degree contributed to his successful efforts in research. Theirs was the first private house in England in which electric light was introduced, and Lady Crookes helped her husband greatly in carrying out the installation and designing the ornamental work. She was a familiar and ever-welcome figure at scientific gatherings, to which she frequently accompanied her husband, and was able to be present with him at the reception given after his election as president of the Royal Society in the year 1913. Sir William and Lady Crookes celebrated their golden wedding in 1906, when they were able to welcome a large number of their friends and acquaintances, and were also the recipients of letters and telegrams of congratulation from all parts of the world. Lady Crookes was spared to celebrate quietly with her husband last month the almost unique event of a diamond wedding, but she was then in failing health, and passed away peacefully on May 10. Several sons and a daughter survive her.

THE first meeting of the Standing Committee on Metallurgy appointed by the Advisory Council for Scientific and Industrial Research was held on Monday, May 8, at the offices of the Board of Education. The committee consists as to one-half of members nominated by the professional societies concerned, the other half being appointed direct by the Advisory Council, and it has been constituted with a view to the representation of both the scientific and the industrial sides of the industries. It consists of the following members:—Prof. J. O. Arnold, Mr. Arthur Balfour, Prof. H. C. H. Carpenter, Dr. C. H. Desch, Sir Robert Hadfield, Mr. F. W. Harbord, Mr. J. Rossiter Hoyle, Prof. Huntington, Mr. W. Murray Morrison, Sir Gerard Muntz, Bt., Mr. G. Ritchie, Dr. J. E. Stead, Mr. H. L. Sulman, and Mr. F. Tomlinson. Sir Gerard Muntz is the chairman of the full committee and of the Non-ferrous Sub-Committee, and Sir Robert Hadfield is the chairman of the Ferrous Sub-Committee. The committee was welcomed by Sir William M'Cormick, administrative chairman of the Advisory Council, and Dr. Heath, administrative secretary to the Council. Sir A. Selby-Bigge also attended, and gave an account of the genesis of the movement, and emphasised the importance which the Government attaches to the establishment of close relations between education, research, and industry. The committee then proceeded to consider various matters of fundamental importance