The college laboratory is totally different from a factory. Any student can make an ounce of a material, but when it comes to multiplying that by three thousand technical education is necessary.

PROFESSOR M. T. BOGERT.

It appears to me that the employers of technical chemists really want two kinds of chemists. In the first place, they need what may be called technical directors; men who are trained more thoroughly on the mechanical side than on the chemical side; who understand the handling of both men and machinery and who know in a general way the chemical processes to be carried out; and secondly, scientifically educated chemists. The training of these two classes of chemists, it seems to me, is quite different. The man who has to do with a particular chemical problem and work it out in the laboratory needs a very thorough and highly specialized training in chemistry. Engineering is not necessary. The value of the results accomplished have been placed too much, in my opinion, to the credit of the technical director. The man who is working in the laboratory, the man behind the guns, is the man who has accomplished results in Germany as well as in this country. I think the progress in Germany in technical chemistry has been due largely to the work in the research laboratories by men who have no engineering training, and I plead with the employers for recognition of the work of the men in the laboratories and for greater patience in their dealings with them, and for a more enlightened policy in establishing research laboratories, for, in my opinion, it is only through such establishments that the American chemist can hope to compete with the German chemist.

MR. W. H. NICHOLS.

The young man who goes to college to get his technical training should determine whether he is going to use it in the realm of pure research or whether he is going to be a chemical engineer. The mechanical engineer can not take the place of the chemical engineer, as he goes to the other extreme. We have already the purely scientific chemist and the engineer; between the two we have the technical chemist or chemical engineer and there is plenty of opportunity for him.

It should be remembered in this connection that a college course is simply a foundation, on which the further education is to be built in after life; for it is not possible to furnish the thoroughly educated man in four or even in five years.

SCIENTIFIC BOOKS.

Skew Frequency Curves in Biology and Statistics. By J. C. KAPTEYN, ScD., Professor of Astronomy at Groningen. Published by the Astronomical Laboratory at Groningen. Groningen, P. Noordhoff. 1903.

This paper is almost unique in that it attempts to be at once a popular presentation of statistical methods and a mathematical derivation of a new theory regarding skew frequency curves, thus attempting to 'benefit all students of statistics' by his ideas. It is only necessary for the non-mathematical reader to take his mathematics for granted and apply the formulæ deduced, while the mathematician need not waste much time over the first ten paragraphs.

The author mentions how Francis Galton has shown that important biological conclusions may be derived from a discussion of the normal curve, and deplores the fact that most of these deductions can not be extended to the skew curves of Quételet and Pearson. This, he says, is due to the purely empirical nature of these curves; they furnish a mechanical representation of the data without having any real and vital relation to them. The advantages claimed for the new theory are: "(*a*) It assigns the connection between the form of the curves and the action of the causes to which this form is due; (*b*) it enables one to reduce the consideration of any skew curve to that of the normal curve; (*c*) the simplicity of the application."

A popular discussion of the origin of normal curves follows. The curve, as is well known, is given by the expansion of $(1/2 + 1/2)^n$. Professor Pearson derives his skew curves by studying the expansion of $(p + q)^n$, where $p + q = 1$. Now Professor Kapteyn considers the exponent n as giving the number of causes which enter into the problem of growth, and shows that with a sufficiently large value for n, and natural causes must be looked upon as almost infinite in number, $(p + q)^n$ approximates closely to a normal curve or, quoting Bessel: "Whatever be the effect of the various causes of deviation, as long as they are: (*a*) very numerous; (*b*) independent of each other; (*c*) such that the effect of any one cause is small as compared with the effect of all such causes together, we shall obtain a curve which approximates the nearer to the normal curve the greater n is."

But, though we may assume the effect of certain causes in producing deviations in certain quantities x to be independent of the value of x, this can not be the case with quantities proportional to x^2, $1/x$, or any non-linear function of x. The resultant curves under these conditions are the skew curves. To obtain these the author supposes that 'on certain quantities x, which at starting are equal, there come to operate certain causes of deviation, the effect of which depends in a given way on the value of x.' Let us imagine certain other quantities depending on the quantities x in the way given by $z = F(x)$.

Then we have

$$\Delta z = F'(x)\Delta x, \text{ or } \Delta x = \frac{\Delta z}{F'(x)},$$

where Δz represents a series of deviations of the quantity z independent of the value of z. Thus the effects of the causes of deviation operating on x are proportional to $1/F'(x)$. Now since, according to assumption, the quantities z are distributed in a normal curve, say

$$y = \frac{h}{\sqrt{\pi}} e^{-h^2(z-M)^2},$$

the quantities x must be distributed along the curve

$$y = \frac{h}{\sqrt{\pi}} F'(x) e^{-h^2(F(x)-M)^2}.$$

This is the frequency curve generated under the influence of causes, the effect of which is proportional to $1/F'(x)$, no limits being placed as to the form of this function.

The author next takes up the case

$$F(x) = (x + \kappa)^q$$

the equation of the curve now being

$$y = \frac{Ahq}{\sqrt{\pi}} (x + \kappa)^{q-1} e^{-h^2[(x+\kappa)^q - M]^2},$$

and derives complete formulæ and tables for the finding of the five constants A, h, M, q, κ for the five possible cases

$$q \gtreqless 0 \text{ and } q = \pm\infty.$$

The solution is left in a rather unsatisfactory state, as we can not find A directly, while it is necessary to know A in order to find the other constants. As A is in most cases unity, he assumes this value for it, and computes the other constants. These having been found, A is readily computed. If A computed $\neq A$ assumed, try again with some other value for A until a perfect agreement has been obtained. Another weakness of the solution is that only four of the observations of a set are used. These are so chosen that their abscissæ are in arithmetical progression. The author, however, considers this very fact an element of strength.

It can not be denied that Professor Kapteyn gets some very good results and his theory is undoubtedly full of possibilities.

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The Mammals of Pennsylvania and New Jersey. A Biographic, Historic, and Descriptive Account of the Furred Animals of Land and Sea, both Living and Extinct, Known to have Existed in these States. By SAMUEL N. RHOADS. Illustrated with plates and a faunal map. Philadelphia, privately published. 1903. Pp. 252.

Mammalogists have been so busy in recent years describing, classifying and getting their