which was subsequently identified, on the basis of serological reactions, with that described by Horsfall and Hahn.[2] Dochez, Mills and Mulliken[3] and Gordon, Freeman and Clampit[4] have described similar pneumonia-producing viruses isolated from apparently normal mice. The second type of pneumonia encountered was likewise found to be due to a filtrable virus, but the microscopic demonstration of elementary bodies, the characteristic appearance of the early lesions,[5] the greater virulence and the serological reactions definitely distinguished this virus from the former.

Three strains of this virus were isolated from mice during the course of serial lung passages initiated with throat washings from three different cases of clinical influenza. Two strains were subsequently isolated from apparently normal mice in the course of serial lung passages initiated with the lungs of uninoculated mice. These five strains of virus were apparently identical.

The etiological agent was found to pass through a Berkefeld N filter. When stained with Giemsa, Castaneda and Macchiavello stains, virus particles of variable morphology, similar to those described for psittacosis and lymphogranuloma venereum, were demonstrable.

The virus was readily cultivated by the method of Cox[6] in the yolk sac membrane of the developing chick embryo, the morphological characteristics of the cultivated virus being in every way identical with those seen in lung preparations from infected mice.

The earliest pulmonary lesions observed in mice consisted of scattered pinpoint raised gray focal lesions. With progression of the infection these lesions coalesce to produce complete pulmonary consolidation grayish red in color. Intranasal inoculation of 0.05 cc of a 10^{-1} suspension of infected mouse lung kills mice within 24 hours.

Upon intracerebral inoculation of mice, the virus was recovered from both brain and lungs but could not be passed serially from brain to brain. Upon intranasal inoculation, virus was recovered from the lungs and spleen but not from the brain. These observations indicate both pneumotropic and viscerotropic properties.

A more complete presentation of the study of this virus will appear in a subsequent publication.[7]

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2 Frank L. Horsfall, Jr., and Richard G. Hahn, *Jour. Exp. Med.*, 71: 391, 1940.

3 A. R. Dochez, K. C. Mills and B. Mulliken, *Proc. Soc. Exp. Biol. and Med.*, 36: 683, 1937.

4 F. B. Gordon, Gustave Freeman and J. Marion Clampit, *Proc. Soc. Exp. Biol. and Med.*, 39: 451, 1938.

5 A personal communication from Dr. Monroe D. Eaton and Miss M. Dorthy Beck has called my attention to the similarity between the elementary bodies and pulmonary lesions characteristic of this virus, the pneumonitis virus described by Eaton, Beck and Pearson (Monroe D. Eaton, M. Dorthy Beck and Harold E. Pearson, *Jour. Exp. Med.*, 73: 641, 1941) and the meningo-pneumonitis virus of Francis and Magill (Thomas Francis, Jr., and T. P. Magill, *Jour. Exp. Med.*, 68: 147, 1938).

6 Herald R. Cox, *Public Health Rep.*, 53: 2241, 1938.

7 Clara Nigg and Monroe D. Eaton. To be published.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

COMPUTING SCALES FOR CALCULATING PERCENTAGE DEVIATION FROM AVERAGE WEIGHT[1]

THE accompanying scales were set up to calculate the percentage by which a man of specified age, height and weight differs in weight from the average of accepted white male life insurance applicants of the same age and height.[2] To use these scales, first set a pair of dividers on the appropriate rulings on the left-hand scale. These rulings have been so calibrated that the span between the divider points represents the logarithm of the average weight of men whose heights and weights are specified. The dividers are then lifted; one point is placed, as illustrated, at the proper place on the weight scale, and opposite the lower point, one can read off the percentage deviation. In this operation, one subtracts the logarithm of the expected weight from the logarithm of the observed weight, obtaining the logarithm of the ratio of observed to expected weight. The lower part of the right-hand line is labeled so that the ratios can be read off directly.

The net effect is to replace three variables, height, age and weight by one new variable, percentage weight deviation. In certain statistical problems[3] this represents a useful simplification of the data. The computing scales of Fig. 1, or a slide rule described elsewhere,[4] may be used in problems in which height, weight and age are under study.

In other problems involving multiple correlation or joint correlation, it may be advantageous to make

1 From the Division of Industrial Hygiene, National Institute of Health, U. S. Public Health Service, Washington, D. C.

2 Assoc. Life Insurance Med. Dir. and the Actuarial Soc. Amer. Medico-Actuarial Mortality Investigation. Vol. I. 1912.

3 P. A. Neal, R. H. Flinn, T. I. Edwards, *et al.*, *Public Health Bulletin* No. 263, 1941.

4 T. I. Edwards, A slide rule and two nomograms by which the percentage deviation of a man from the average weight of men of his height and age may be calculated. *Amer. J. Hyg.* In press.

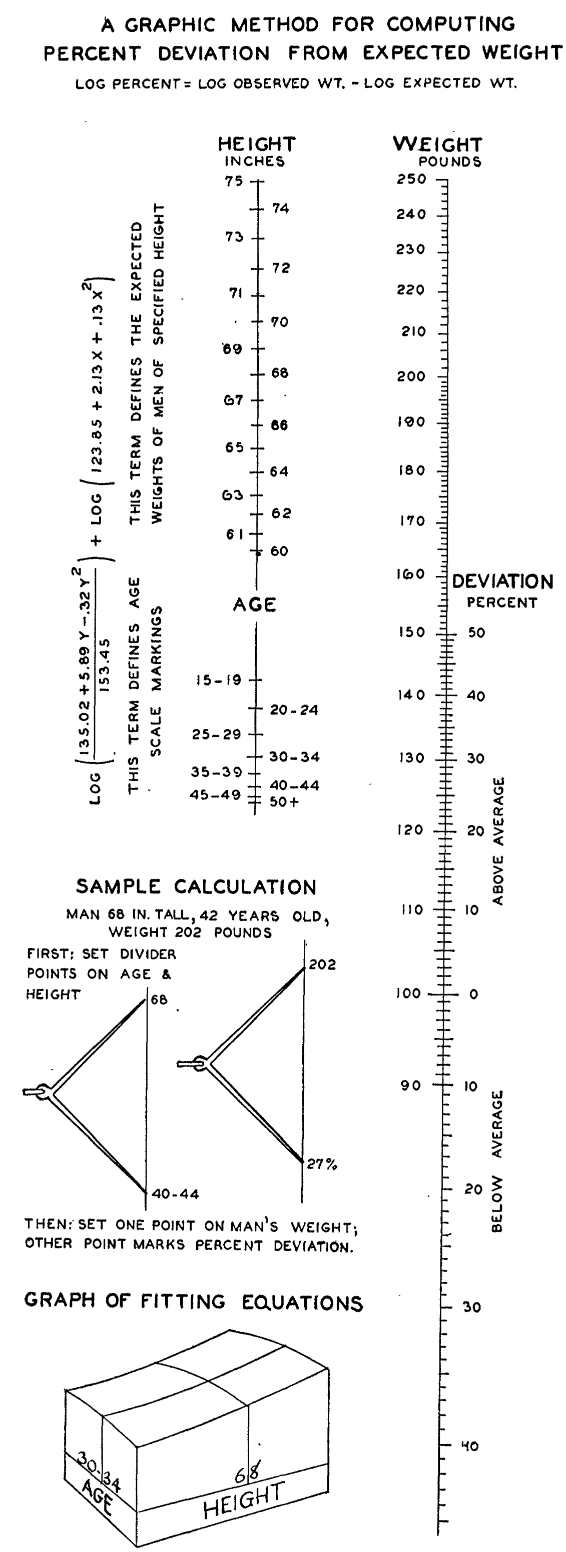

FIG. 1

allowance for an entirely different set of variables. A brief discussion of the principles on which Fig. 1 is based may be helpful to an investigator who wishes to make a similar computing device to fit his own data. No novelty can be claimed for arranging logarithmic scales so that computations can be carried out with dividers. In 1620, Edmund Gunter (1581–1626) arranged logarithmic scales so that the operations of multiplication and division could be carried out with compasses. Such scales, under the name of gunters, were used for many years by mariners. In more recent times, however, the method seems to have been neglected.

The height-weight-age data under discussion are an instance of multiple correlation. That is to say, if the relation between weight and height is determined for men aged 30–34, the same relation may be made to apply to men of any other age group by translocating the weight-height equation along the age axis. Ordinarily, translocation would be accomplished by adding certain amounts to the equation describing the weight-height relation for men aged 30–34 (or subtracting them, as the case might be). In this instance, the computing scales were meant to yield a ratio, and this made it desirable to work in logarithms throughout. The easiest way to make the weight-height relation describe different age groups was to multiply it by an appropriate factor.

The equations used to fit these data are shown in Fig. 1 and are plotted at the foot of that figure. They were obtained by the method of least squares. There were 128 average-weight values in the set of data on which these equations were based, representing 16 height classes from 60 inches ($x=1$) to 75 inches ($x=16$) and 8 age classes from 15–19 years ($y=1$) to 50 years and over ($y=8$). All but about half a dozen of these 128 average weights can be predicted to within a pound by means of these equations. The aberrant values lie in the extreme corners of the table.

In this example, the computing scales have been used to reduce three variables to the form of a ratio. This, of course, is not the only operation which can be expedited. Almost any operation involving the addition or subtraction or the multiplication or division of three variables that can be carried out on special slide rules or by other nomographic methods can be set up as computing scales, or gunters; in many instances with less labor. Before making many computations it would be advisable to protect the scales by a strip of scotch tape or some other transparent material. Dividers fitted with a fine adjustment screw are convenient.

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