MATHEMATICAL OBFUSCATIONS IN BIOLOGY*

BY

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Mathematics and Micromathematics

THAT averages should be corrected for probability; that a rupee when tossed with the same balance and force will give as many heads as tails only when the number of tosses is large; that fluke chances turn up; and that the chances with a rupee are essentially different from those with a dice, we are pleased to know. We will even buy books and renew our acquaintance with algebra and differential calculus. This is mathematics. That figures must be plotted on complicated curves; that equations well stocked with $\int$s, d's and $\surd$'s should be constructed; and that many letters of the alphabet should be distorted or dislocated to trap and hold some elusive quantities, before we record observations on events in the lives of plants and animals, we may not consider significant. This is micromathematics. Probably Providence ruled the early cosmos with rigid mathematics even of the micro variety. The rigidity has definitely been relaxed since the birth of protoplasm. So far as its application to the activities of the protoplasm is concerned the micromathematics is a figment of the mathematicians.

Examples of Failure of even Simple Arithmetic to Account for Well-known Biological Occurrences

Mendelism is too well known to be discussed in detail here. The nearest approach that Mendel made to his 3 : 1 ratio in a lifetime, was 2·81 : 1 (Holmyard)[1] or 2·84 : 1 (Ride).[2] The latter day knowledge of the behaviour of chromosomes in the formation and fertilisation of gametes, which is a histological fact, leaves no doubt whatsoever regarding the correctness of the ratio. So far as protoplasmic activities are concerned, however, 2·81 or 2·84 must be accepted as 3. A closer approximation is not possible.

Another, even more outstanding, example of the failure of simple arithmetic occurs in immunology, in the following relationship between the toxin of the diphtheria bacillus and the anti-toxin made to neutralize the toxin:—

1. A minimal lethal dose (M.L.D.) of diphtheria toxin is the smallest amount which kills a guinea-pig weighing 250 grammes in 4 days.

2. A completely neutralized dose (L_0) is the largest amount of toxin completely neutralized by 1 unit of diphtheria anti-toxin. It does not kill the guinea-pig.

3. A re-toxicated dose (L_+) is the smallest amount of toxin, which when mixed with 1 unit of diphtheria anti-toxin just kills the standard animal in the standard time. It acts like 1 M.L.D.

Dose 3 *minus* Dose 2 should be equal to Dose 1

or

L_+ *minus* L_0 should equal 1 M.L.D.

In actual practice $L_+ - L_0 = 8$ to 12 M.L.D. (Hewlett and McIntosh).[3]

One unit of the anti-toxin neutralizes 100 M.L.D.'s (Ehrlich's original standard). The excess, therefore, is 7 to 11 per cent.

Explanations of this anomaly, which are 'probably' correct, have been given. The fact, however, remains that the same looseness of relationship exists between all antigens and anti-bodies (including toxins and anti-toxins) regardless of the method used in testing.

The Figment of the Mathematicians is not used even in Important Human Activities of Peace and War

The producer of the raw material mostly works without machinery and has little scope for mathematical refinements. The manufacturer of goods works with machinery yet uses very little mathematics. The seller of goods prefers advertisement and *creation of demands* to the statistical analysis of the *existing demands*.

In sport, judging of form, handicapping or even forecasting of events by professional advisers is not based on a complicated system of calculation at all. If the existing system were faulty the micromathematicians would have at their disposal the wealth of all the totalisators in the world. Such is not the

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case. They have not fared any better than ordinary folks even at Monte Carlo where the protoplasmic interference with the turn of events is minimal.

When the leaders of nations choose between peace and war they do not do so in an atmosphere of higher and pure mathematics.

The High Threshold of Life Defies Micromathematics

The *threshold* is familiar to physiologists. Vital receptors take no cognizance of what comes to them unless it is worth considering. That is why micro-mathematical quantities are without effect. Even the non-living products of living organisms are imbued with the same peculiarity of reaction. The physical basis of the peculiarity in either case is the highly complicated structure of the protein molecule.

Thresholds are known in the behaviour of non-living matter. Flow of electric currents shows a hesitancy under certain conditions. Certain chemical reactions appear to sit on the fence for a while. The *quantum* is essentially a threshold effect. Biological thresholds are much higher.

When a case of pneumonia approaches the crisis the physician in attendance may visualize the psyche perched precariously on a very high threshold. It will either tumble back into the weary body or glide forth into the Great Beyond. Micromathematics does not reach the threshold and does not help in the treatment or prognosis.

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[1] Holmyard, E. J., *Biology for Everyman* by the Late Sir J. Arthur Thomson (J. M. Dent & Sons, Ltd., London), 1934.

[2] Ride, L., *Genetics and the Clinician* (John Wright & Sons, Ltd., Bristol), 1938.

[3] Hewlett, R. T. and McIntosh, J., *A Manual of Bacteriology* (J. & A. Churchill, London), 1932.

A PRELIMINARY NOTE ON THE SEVERE MEXICAN EARTHQUAKE OF APRIL 15, 1941

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AN earthquake shock of severe intensity rocked Mexico at $19^h\ 29^m$ Greenwich Mean Time (roughly about 13^h Mexican Standard Time) on Tuesday, the 15th April 1941. It is too early to get complete reports of the extent of area affected and the amount of damage caused; but the reports so far available from Mexico City state that the number of persons killed there exceeds 250 and that two towns, *viz.*, Tecatelan and Tuxpan in the State of Jabisco, have been wiped out. Many persons are reported to have been killed in the villages along the coast. Nearly three-fourths of the houses in Colima City have been either damaged or destroyed. A report from Vichy, supposed to be based on a message from Mexico City, states that most of the 15,000 inhabitants of the city of Colig are believed to have been either killed or injured. The volcanic group near Colima is reported to be in eruption and a tidal wave along the Jabisco coast has caused destruction to life and property in many villages. It would naturally take some days before the final casualty list will be available to us, but it is expected to be fairly heavy, judging from the nature of destruction.

Past history shows that the Mexican region is liable to experience severe earthquakes occasionally. During the last 13 years this region has felt as many as seven shocks of severe intensity including the present one. The extent of damage to life and property during these shocks varied to different degrees. The dates of occurrences of these shocks together with a brief description of the extent of damage done are given in Table I.

According to Milne's Catalogue[1] of Destructive Earthquakes, the total number of destructive earthquakes of intensity III (those that destroy towns and desolate districts) during the 17th, 18th and 19th centuries were 11, 8 and 16 respectively.

Epicentre of the Earthquake.—The seismographs at all the Seismic Stations of the India Meteorological Department, namely Bombay, Calcutta, Agra and Kodaikanal, as also those of the Nizamiah Observatory at Begumpet and the Haig Observatory at Dehra Dun have recorded this shock as one of great intensity. All the four departmental Seismic Centres have recorded P' as the first movement and that with an 'emersio'. SS is clearly recorded with an 'impetus' at all the four stations; the calculation of the