Technology, as chairman, and Professor Norris W. Rakestraw, of Brown University, as secretary.

Professors John E. Ricci, of New York University; Vincent du Vigneaud, of Cornell University Medical School, and H. B. Vickery, of the Connecticut Agricultural Experiment Station, were elected to five-year terms as associate editors of the *Journal of the American Chemical Society,* while Professor Linus C. Pauling, of the California Institute of Technology, and Dr. George S. Whitby, of the National Research Council, Ottawa, Canada, were reelected as associate editors. Professor Moses Gomberg, of the University of Michigan, was chosen to fill the vacancy caused by the death of Elmer P. Kohler.

Three reelected as associate editors of *Technological Monographs* were: Dr. Walter A. Schmidt, president of the Western Precipitation Company, Los Angeles; Dr. Edward R. Weidlein, director of the Mellon Institute of Industrial Research, Pittsburgh; Fred C. Zeisberg, of E. I. du Pont de Nemours and Company.

W. A. Noyes, Jr., professor in the University of Rochester, becomes editor-in-chief of *Chemical Reviews* on January 1, succeeding Dr. Gerald L. Wendt, of New York City. Named associate editors were: W. S. Calcott, of the du Pont Company; Professor Wendell M. Latimer, of the University of California; Professor W. Conrad Fernelius, of Ohio State University.

New associate editors of the *Journal of Physical Chemistry* are Professor George S. Parks, of Stanford University, and Professor George Glockler, of the University of Minnesota.

Dr. Beverly L. Clarke, of the Bell Telephone Laboratories, New York City, and Thomas R. Cunningham, of the Union Carbide and Carbon Research Laboratories, Niagara Falls, N. Y., were reelected associate editors of the Analytical Edition of *Industrial and Engineering Chemistry.*

Dr. Walter A. Schmidt, of Los Angeles, was named again to the society's Council Committee on Policy for three years.

SPECIAL ARTICLES

HOST-PARASITE INTERACTIONS WITH BACTERIAL WILT OF MAIZE[1]

IT is commonly believed that bacterial virulence in disease is maintained or enhanced by host passage. The constitution of the host is considered to play little part in the ultimate virulence attained. In conformity with Wellhausen's[2] recent studies I propose to show by another technique that such is not always the case.

Virulent strains of *Bacterium stewartii* (E.F.S.) Stevens, (*Phytomonas stewartii* (E.F.S.) Bergey, *et al.*), a vascular, bacterial wilt disease of maize, are characterized by colonies that are large, smooth, spreading and of a mucoid type; avirulent strains are smaller, slightly rough, raised and of a non-mucoid type. Each strain arising from single-cell isolations is constant for colony type and virulence, so that morphological characters may be used to separate individuals with different physiological potentialities.

Mixtures of virulent and avirulent bacteria of varying but known proportions were inoculated into resistant and susceptible inbred lines of maize by injecting the organisms into the growing points of seven-day-old maize seedlings with a hypodermic syringe and needle. The subsequent proportions of virulent to avirulent types may be followed by isolating at suitable intervals of time from the host. For each isolation, lesions from 10 or more plants were macerated together in a small quantity of sterile water and dilution plates poured from this liquid. In order that colony morphology could be classified, only surface smeared plates were used. In six experiments isolations were made each 4 days after inoculation; in seven other experiments isolations were made only at the end of the experiment. Total passage time varied from 14 to 20 days.

There is a correlation of $r = 0.95 \pm 0.02$ between the ratio of virulent and avirulent bacteria in the inoculating suspension and the ratio obtained by isolating from the first definite lesion. This shows that the bacteria which actually grow and produce a diseased condition are reliably estimated by plating directly from the inoculating medium.

Upon passage through the susceptible host there is a differential selection for the avirulent type of bacteria. For example, beginning with a 50–50 proportion of virulent to avirulent bacteria, the proportion observed after a 15-day passage averaged 39–61. The rate of this change during host passage is dependent upon the initial proportion of virulent to avirulent bacteria in the inoculating medium. The rate of change is slow in a population containing a high proportion of avirulent organisms. When these rates of change are plotted against the initial proportion of avirulent bacteria in the inoculating medium, the slope or regression of these rates is linear and equal to -1.1 (Fig. 1—line A).

Passage through the resistant host results in a differential selection for the virulent type of bacteria, instead

[1] Journal Paper No. J-596 of the Iowa Agricultural Experiment Station, Genetics Section, Project 404.

[2] E. J. Wellhausen, *Phytopath.*, 27: 1070–1089, 1937.

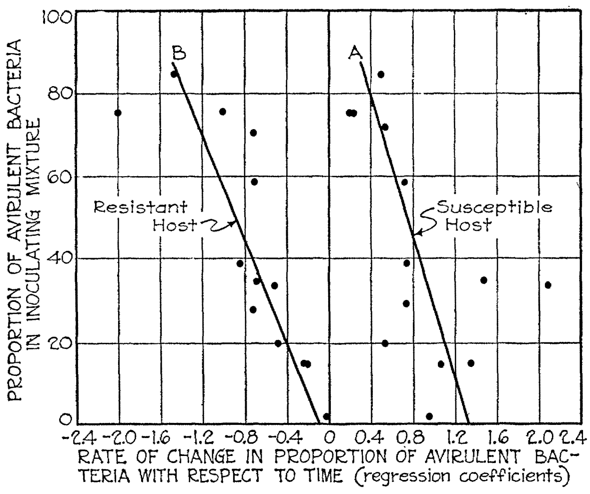

FIG. 1. Rates of change of proportion of avirulent and virulent bacteria when passed through resistant and susceptible hosts. On passage through the susceptible host the change toward a higher proportion of avirulent types is slow in a bacterial mixture composed largely of avirulent types (line A)—passed through the resistant host the change toward a lower proportion of avirulent types is rapid (line B).

of the avirulent as in the experiment above. When the initial proportion of virulent to avirulent bacteria was 50–50, the proportion observed after a 15-day passage averaged 63–37. The inoculum containing a high proportion of virulent organisms changes at a slow rate toward the limit of 100 per cent. virulent organisms. The inoculum containing a low proportion of virulent organism changes rapidly toward one of higher proportions. Again, plotting these rates of change during passage against the initial proportion of avirulent bacteria in the inoculating medium, the slope of these ratios is linear and equal to -1.7 (Fig. 1—line B).

Changes in the proportions of the virulent and avirulent types of bacteria proceed in orderly fashion from the time of inoculation to the death of the host, the direction of the change depending on the host.

Virulent bacteria kill the susceptible host in from 10 to 15 days, but only stunt the resistant host. Avirulent bacteria stunt but do not kill the susceptible host and become limited to the first early lesions in the resistant host. Assuming, as a working hypothesis, that the most advantageous host-parasite relation is one of equilibrium with a virulence sufficient to overcome host resistance, yet not so virulent as to kill the host, then selection within the micro-environment of the host over long periods of time would be towards such equilibrium. This point is approached in the low degree of virulence of bacteria adapted to the susceptible host and in the high degree of virulence in resistant maize.

With the materials used in these experiments, the rate of change in the bacterial population proceeded more rapidly within the resistant host than within the susceptible host as shown by the slope of the general regression lines (Fig. 1). The rate of change in the population is not a constant, but changes as the population changes, being rapid when equilibrium is greatly disturbed, weakening as equilibrium is approached.

The conclusion that intensity and direction of selection are dependent upon host resistance has been verified through using 14 other inbred lines of maize as host.

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A SIMPLE TECHNIQUE FOR CONTROLLING SUBJECTIVE ATTITUDES IN SALIVARY CONDITIONING OF ADULT HUMAN SUBJECTS

IN the last six years the writer has been engaged in a series of experiments on salivary conditioning in adult human subjects. The method used for measuring the saliva consisted of weighing increments in dental cotton rolls (Johnson and Johnson, No. 3, 0.5×1.5 in.) inserted under the subjects' tongues for short periods of time, usually one minute. Since the cotton-in-the-mouth was by no means a totally inactive stimulus, periods of control salivation had to be temporally rotated with experimental periods, and, again, to prevent evaporation, scale-corrosion and absorption, the rolls had to be weighed in small envelopes and reweighed in the envelopes immediately after the removal of the rolls from the subjects' mouths. The method of measuring by itself proved to be quite satisfactory and reliable—the magnitudes of the S.D.'s of the salivations in 20 to 30 trials under uniform conditions being seldom greater than one eighth of the magnitudes of the means—but the conditioning was irregular and rather unsuccessful, despite the fact that the writer followed closely the general methodology of Russian investigators with animals.[1, 2] A statistical analysis of the data and an introspective check clearly revealed that the disturbing factors in the writer's[3, 4, 5] conditioning experiments were the subjects' sets and attitudes, their "catching on" after a few trials to "what is expected" or "what is not expected" of them. These attitudes

[1] I. P. Pavlov, "Conditioned Reflexes." Oxford University Press, 1927. Pp. xv + 430.

[2] N. A. Podkopaev, "The Methodology of Investigating Conditioned Reflexes." Moscow: GIZ, 1926. Pp. 64.

[3] G. H. S. Razran, *Arch. Psychol.*, 28: 191, 124, 1935.

[4] G. H. S. Razran, *Jour. Psychol.*, 2: 327–337, 1936.

[5] G. H. S. Razran, Studies in configural conditioning. I. Historical and preliminary experimentation. (In press, *Jour. Gen. Psychol.*) II. The effects of task-sets and subjects attitudes upon configural conditioning, *Jour. Exp. Psychol.*, 24: 95–105, 1939. III. The factors of similarity,