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GENERAL ASPECTS OF INTERDISCIPLINARY RESEARCH IN EXPERIMENTAL HUMAN BIOLOGY[1]

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INTRODUCTION

MUCH of the recent research in experimental human biology using a "total" interdisciplinary approach has received methodological stimulation from the attempt to predict what will happen, under specified conditions, to the intact human organism. In such a program the experimenter works with one "independent" variable (environmental temperature, caloric intake, vitamins, drugs, anoxia, physical work) and many "dependent" variables covering the whole gamut of biochemical, physiological and psychological responses. This type of research differs fundamentally from much of the earlier work in psychosomatics,[2] such as study of the covariation between morphological characteristics and mental traits in which statistical methods provide the sole method of investigation. The study of the effects of vitamin intake or exposure to heat is amenable to the experimental approach, also such problems are much closer to real life situations and require a more truly interdisciplinary attack.

In applied fields a genuine cooperative approach is indispensable. This is readily understandable if we realize that the emphasis is placed upon analysis and manipulation of a sector of reality, and that this reality is always multifarious. It is significant that, in modern industrial research which is concerned with the materials and the manufacturing processes, "the lone worker is being replaced by a carefully chosen corps whose various talents dovetail together and whose collective knowledge and collective analytical

[1] From the Laboratory of Physiological Hygiene.

[2] D. G. Paterson, "Physique and Intellect," New York, Century, 304 pp., 1930.

penicillinase preparation may successfully be used for inactivating penicillin in such materials, thereby allowing the penicillin sensitive organisms to grow on the culture medium. The procedure is similar to the one using para-amino benzoic acid for the testing of sulfonamides in body fluids.

SUMMARY

(1) Standardization of penicillinase has been made possible by the method for its assay.

(2) A purified, dried and sterile penicillinase has been found to be a penicillin-inactivator superior to Clarase for the penicillin sterility test.

(3) Preliminary studies show this penicillinase preparation may be used for inactivating penicillin in exudates of body fluids.

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PENICILLIN TREATMENT OF CROWN GALL

CRUDE penicillin, produced in this laboratory,[1] has cured crown gall on Bryophyllum. The penicillin assayed 2 to 6 Oxford units per cc and was obtained from an improved strain of *Penicillium notatum* contributed by the Northern Regional Research Laboratory, Peoria, Ill. It was made almost automatically and cheaply through the use of a modification of the apparatus described by Clifton.[2] The galls for study resulted from hypodermic inoculations of Bryophyllum with a pure culture of *Agrobacterium* (*Phytomonas*) *tumefaciens*. They were of the "soft gall" type.

From the first hypodermic injections of crude penicillin, just below the galls, the only effect observed was a checking of growth of the gall above the needle punctures, which resulted in an accentuation of the irregularity of the surface of the gall. That effect was interpreted to mean incomplete lateral diffusion of the penicillin in the gall and to indicate as necessary a different method of application.

Penicillin-soaked antiseptic cotton was wrapped around galls and thereafter frequently wetted with crude penicillin. The result of that procedure was the retarded growth and browning of the minute elevations or "pimples" on the surface of the gall. The protective layers of the surface of the elevations appeared to be sufficiently thin for the inward penetration of the penicillin, but elsewhere the drug obviously was kept out of the internal tissues of the gall.

Next, the gall under the cotton wrapping was punctured in numerous places with a sterile needle and soon the tissues began to die and turn brown. Apparent complete destruction of the gall followed. Normal tissues of the stem were somewhat injured where the penicillin-containing cotton wool remained in contact with the surface of the stem, but internally only the gall tissues were affected.

Crown gall is particularly destructive in the Southwest, where the alkaline reaction of the soil, long-growing season, irrigation and heavy transpiration in an arid atmosphere favor the disease.

Penicillin should prove valuable in treating galls on nursery stock and also on set trees and other plants in which the galls are limited to the crown and aerial parts. Cure of the first infected tree in an irrigated orchard frequently would save the entire planting where irrigation would otherwise carry the bacterium and spread the disease. Galls are often seen first at the crown where they may be treated; later they appear on the roots as a result of the downward spread of the gall bacterium. Cure of the crown gall within reach would save not only further spread of infection to the roots of the same tree but, more important, spread of the germ over the field by irrigation water.

The cost of the crude penicillin used in our experiments has been slight. The medium fed to the fungus costs approximately 2 cents per quart and the galls that were cured required a tablespoonful or two of crude penicillin.

Noteworthy is the fact that penicillin apparently destroys, in the case of the crown-gall bacterium, a gram-negative organism. Gram-negative bacteria, in general, have been reported[3] as relatively resistant to penicillin. Interesting, too, is a comparison of the action of crude penicillin on crown gall (often likened to cancer of animals and man) with the reported[4] ineffectual penicillin injection of mice with sarcoma.

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[1] J. G. Brown and Alice M. Boyle, *Phytopathology*, 34: 760–761, August, 1944.

[2] C. E. Clifton, SCIENCE, 98: 67–70, 1943.

[3] For example, see A. D. Gardner, *Nature*, 146: 837–838, December 28, 1940.

[4] Margaret Reed Lewis, SCIENCE, 100: 314–315, October 6, 1944.

BOOKS RECEIVED

KIRSCHENBAUER, H. G. *Fats and Oils. An Outline of Their Chemistry and Technology.* Illustrated. Pp. 154. Reinhold Publishing Corporation. $2.75. 1944.

SAHYUN, MELVILLE and OTHERS. *Outline of the Amino Acids and Proteins.* Illustrated. Pp. 251. Reinhold Publishing Corporation. $4.00. 1944.

WALLING, S. A., J. C. HILL and C. J. REES. *Nautical Mathematics and Marine Navigation.* Illustrated. Pp. ix + 221. Macmillan Company. $2.00. 1944.

The price quoted for the abridged edition of Organic Chemistry by Louis F. Fieser and Mary Fieser is $4.00 not $6.00, as incorrectly stated in the issue of SCIENCE for November 10.