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CONTRIBUTIONS TO THE DEVELOPMENT OF SOIL MICROBIOLOGY FROM THE SOUTHEASTERN UNITED STATES[1, 2]

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SOIL microbiology may be defined as that branch of science which treats of the microorganisms in soils, their character, life-history and function *and their relationships to the fertility or crop-producing power of the soil.* It is not enough to isolate microorganisms from the soil, to study them in pure culture, to characterize and classify them to define the science. The relationships of the microorganisms to the crop-producing power of the soil is fundamental in the concept of the science.

It is quite generally known, by the soil microbiologist at least, that productive soils contain greater numbers of microorganisms than unproductive soils and that those soil management practices which have proved to be effective in building soil fertility also stimulate desirable microbiological action in soils. However, to many who make a business of growing plants, even this does not indicate the very close relationship of the soil microorganisms to the growth of plants. To fully appreciate the almost complete de-

[1] Abstract of report presented at the Association of Southern Agricultural Workers, Memphis, Tennessee, February, 1942.

[2] The assistance of the Southeastern Agronomy Research Committee is gratefully acknowledged.

stage, the radio frequency current is fed through condensers into the ultrasound generator.

The generator consists of the crystal and its holder housed in a transparent bakelite container which is filled with transformer oil kept cool by water circulating through copper coils. The entire generator is attached to a universal joint on the end of a flexible extension arm which permits its safe and ready application to living biological material. The design of the crystal holder permits maximum freedom from dampening and torsion effects, the maintenance of an oil-tight air chamber behind the crystal with doubling of ultrasound output, and finally, it permits the operator to vary the position of both crystal and holder with respect to the container and so vary the depth of application of the focused ultrasound. The focused beam of sound passes out of the generator through a Cellophane diaphragm and into any living or dead specimen which has been applied to its outer surface.

RESULTS

Propulsion of oil: The activity of the focused ultrasonic waves was made visible by floating a film of oil on the surface of the diaphragm. When the current was turned on, the oil was driven upward in a conical column, its height being roughly proportional to the radio frequency current applied to the crystal. A large number of experiments of this nature were performed with single curved crystals and mosaics, mounted so as to focus on a common point.

Paraffin wax blocks: Preservation of the conical effect in solid form was obtained by placing cubes of paraffin wax or beeswax of known melting point on the diaphragm over the point of focus. Perfect cones were melted out of the wax blocks if low intensity current was used over a long period of time. The authors were naturally interested in obtaining a maximum melting zone at the point of focus with a minimum effect at the base, since the focal effect would be much more useful biologically. This was obtained by utilizing an ultrasonic beam of maximum intensity applied for a few seconds only.

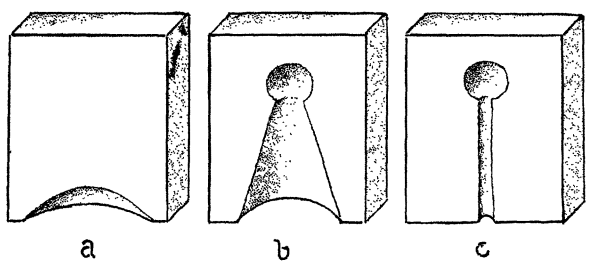

FIG. 1. Melting defects in paraffin blocks produced by focused ultrasound. (a) Low intensity for 30 seconds; (b) medium intensity for 30 seconds; (c) high intensity for 10 seconds.

Animal tissues: Blocks of fresh animal tissue were also treated, and liver was found to give the best results because the heated portion "cooked" whitish-brown, leaving the rest of the liver a deep maroon color. On sectioning, it was easy to see with the naked eye not only the area of basal absorption where the liver was in contact with the diaphragm, but also the more deeply situated focal region of high ultrasonic concentration. Examination of sections under a microscope confirmed the effect of focal destruction of cells.

Living animals: The production of lesions in living animals is made more difficult by the fact that circulating blood absorbs and disperses ultrasonic waves to some extent. The brain of the dog was chosen for the experiment because any destructive effects would be apparent by disturbed motor activity as soon as the animal was allowed to come out from under the anesthetic. In spite of the probability that the focus was not sharp because of refraction from the solid bone and tissue phases of the head, positive results were obtained. By the transcranial application of focused ultrasound to the appropriate areas of the cerebral cortex, disturbances in muscular coordination, some paralysis and in one case blindness were obtained in association with corresponding gross and microscopic brain lesions. Unfortunately, there was always a necrosis of the scalp where the apparatus was applied.

CONCLUSIONS

An apparatus for the production of focused ultrasound has been constructed and applied to biological material. Focal lesions were produced in fresh tissue and living animals.

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BOOKS RECEIVED

GRABER, L. F. and H. L. AHLGREN. *Laboratory Manual for Students of Agronomy.* Third edition. Illustrated. Pp. 155. John S. Swift Co., Inc., St. Louis, Missouri. $2.00.

Highway Research Board: Proceedings of the Twenty-First Annual Meeting—1941. Illustrated. Pp. viii + 561. National Research Council.

Molecular Films, the Cyclotron, and the New Biology. Essays. Illustrated. Pp. 95. Rutgers University Press. $1.25.

RANDALL, MERLE and LEONA ESTHER YOUNG. *Elementary Physical Chemistry.* Illustrated. Pp. xiv + 455. Randall and Sons, Berkeley, Calif. $4.50.

RODGERS, ANDREW DENNY, III. *John Torrey.* Pp. 352. Princeton University Press. $3.75.

SKLÁDAL, J. *The Pleuro-subpleural Zone.* Illustrated. Pp. vii + 103. Cambridge University Press: Macmillan, N. Y. $2.75.

WALLING, S. A. and J. C. HILL. *Aircraft Mathematics.* Pp. 189. Macmillan. $1.25.