tute for Plant Research, Yonkers, New York, dealing with all phases of plant research, which formerly were issued only as reprints from other journals, are now published from the institute only and collected in yearly volumes of not less than five hundred pages. Subscribers will also receive reprints of the professional papers dealing usually with practical applications of the research work. Persons carrying on investigations or teaching along the lines discussed will be placed on a mailing list for notices of publications as issued, and furnished with copies on request. Others may purchase such reprints.

DISCUSSION

GAMBUSIA IN FOREIGN LANDS

IN about 1920, apropos of the successful use of Gambusia for the control of mosquito breeding in the extra cantonment zone of a U. S. Army camp in 1918, the International Red Cross made an appeal through diplomatic channels to the Bureau of Fisheries for broodstocks of this fish for Italy and Spain. The shipment that went forward to Italy was a failure, very probably due to improper care of the fish while en route. However, the fish sent to Spain arrived in fairly good condition. A rapid multiplication appears to have taken place, and within a year or so Italy was able to obtain a broodstock from Spain.

In a paper entitled "Recent Developments in the Control of Malaria"[1] given before the National Malaria Committee (conference on malaria at Louisville, Kentucky, November, 1930) by Dr. L. W. Hackett, of the Rockefeller Foundation, who had been stationed in Italy, collaborating with the Italian National Health Department, stated that the introduction of Gambusia into Italy led to unexpected results. He points out that multiplication was unusually rapid and the density of the Gambusia population in some localities apparently now exceeds that of the most favorable places in our Southern states. Standing water in some sections has become fairly clogged with the fish, so much so that the peasants complain that the cattle refuse to drink the water. To illustrate the density of the fish population, Dr. Hackett says:

> From one lime sink in Istria about an acre in extent we took over four million Gambusia for distribution purposes last year without apparently diminishing the number per unit of area. No horizontal vegetation, however thick, can protect anophelene larvae from the fish, large and small, which constantly patrol every square inch of water surface. In the area of about eight square miles which we have had under observation for five years in Istria, the spleen index in a scattered rural population has gone down from 98 per cent. in 1924 to about 10 per cent. in 1930.

(It may be explained here that malaria causes the spleen to become enlarged and the examination of people, especially school children, for enlarged spleens is a common method of determining the prevalence of malaria in a community.)

In regard to the effectiveness of Gambusia for the control of malaria in the area referred to in the preceding paragraph, Dr. Hackett says:

> Acute epidemic malaria is reduced to sporadic cases, and a tuberculosis preventorium for Viennese children can now be operated throughout the year instead of being closed from June to October. There has been no case of malaria among the 300 children in the last two years. Nothing but Gambusia distribution has been done in this area.

Although Gambusia is very effective in standing water, Dr. Hackett points out that in Italy *Anopheles maculipennis,* an efficient vector of malaria, breeds along the edges of running streams, and for the eradication of this mosquito the fish have not been successful, since Gambusia, as is well known, does not frequent running water.

It is understood that Gambusia has been distributed, from the original introduction into Spain, to nearly all countries of Europe from Germany and Austria southward. The results claimed for Gambusia in southern Europe, and especially in Italy, as an eradicator of mosquito larvae far exceed those secured in this country.

The great value of Gambusia as an eradicator of the aquatic stages of the mosquito was first clearly shown in the wide use made of the fish in the extra cantonement zone of Camp Hancock at Augusta, Georgia, in 1918.[2] Other studies were undertaken after this invesitgation was completed and the results published, and the great value of Gambusia as an agent for the control of mosquitoes and malaria became definitely established. Various prior claims were made for Gambusia and other small fish as eradicators of mosquito larvae, but they were not based on well-founded or extensive evidence. In an effort to secure an enemy of the mosquito which will work every day in the year without cost or care, Gam-

[1] *Journal Southern Medical Association,* xxiv: 5, pp. 426–430, May, 1931.

[2] "Fishes in Relation to Mosquito Control in Ponds," by Samuel F. Hildebrand. U. S. Public Health Reports, May 23, 1919, pp. 1113–1128, 3 double pls., 3 figs. Reprint No. 527. Also Appendix IX, Report, U. S. Commissioner of Fisheries, 1918 (1920), 16 pp. Pls. I–VI, 3 figs. Bureau of Fisheries Document No. 874.

busia has been introduced, not only into southern Europe, but also into Palestine, the Philippine Islands (from whence it is reported to have reached China and Japan), the Hawaiian Islands, the West Indies and the Argentine.

Gambusia apparently did not multiply as rapidly or become as numerous in other localities where it was introduced as it did in Italy. However, it generally multiplied and spread. In Palestine alone it appears to have met enemies with which it could not cope successfully. Often Gambusia spread far and wide from the place of introduction, as already indicated, until it has become almost cosmopolitan in the warmer sections of the world.

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THE COMMON EARTHWORM AS A SERIOUS ECONOMIC PROBLEM

ORDINARILY the common earthworm is thought of as being a valuable adjunct to the fertility of the soil. Under ordinary conditions this is generally true. However, a condition has come to my notice in which just the reverse is the case.

A few weeks ago a rancher from one of the lower mountain valleys came into my office with the following story. From the main canal, a ditch about a mile and a third in length leads to his ranch. This supply ditch skirts the base of a hill which is largely clothed with scrub oak. Consequently, conditions bordering the ditch are ideal for earthworms, because the soil contains large quantities of humus. Organic matter is abundant.

The whole problem is that the soil bordering the ditch is so riddled with the burrows of earthworms that it is almost impossible to get water through the ditch with which to irrigate the fields of the ranch. The soil bordering the ditch is so porous that the greater part of the water seeps away and is lost. This is a serious condition; and, in years of a scarcity of water, it becomes doubly serious. The rancher was seeking a remedy, for his ranch threatened to become valueless as a result of this condition.

So far as the writer is aware this problem is unique. No precedent was available upon which to base a definite answer to the rancher. However, it was suggested that the ditch be shut down and copper sulphate be used to poison the worms. Copper sulphate can be dropped, a handful about every three or four feet in the standing water in the ditch. When the water shall have all soaked into the soil, the ditch could be opened up again.

If the worms are to be poisoned they must be poisoned by a method that will be harmless to live-stock, since live-stock use the water of the ditch for drinking purposes. It seems that the copper sulphate method is the least likely to be dangerous. Some work done by the writer in former years[1] seems to indicate that this chemical, over a short period of time, will result in no harm to vertebrates.

In the West, in virgin desert soil, so far as the writer is able to determine, earthworms do not occur. They become established only when dry land is brought under irrigation. In some sections of the West, if not most sections, irrigation has not been practiced for very long, comparatively speaking. Consequently, earthworms are just now beginning to be present in really considerable numbers. In fields and pastures generally they are valuable adjuncts to the fertility of the soil; but, in situations such as the above described, they may be a serious pest. In the future they may become more of a pest and a source of serious economic loss. However, it is believed that copper sulphate, a cheap chemical, may be the solution to such problems.

Another solution would be to concrete the supply ditch; but this is an expensive proposition. To build a wooden flume would also be expensive. As a temporary measure, the rancher in question used tarred roofing paper, folded into the ditch, as a relief measure. This latter worked, but it is obviously only a purely temporary way to solve the problem.

The writer has in his own flower garden a short row of sweet peas that it is impossible to water with the hose from the city water supply, when the hose is allowed to run a fair stream with the nozzle placed in a tin tomato can at the head of the row. This is due to the burrows of earthworms draining away all the water. Consequently all watering of these flowers is now done by surface sprinkling.

Water is all-important in the West. Those that are well informed know the careful attention that is given to reclamation and to conservation of the water supply in the western United States. Any waste of water is serious, and a direct economic issue. With regard to the problem as above stated, further research is to be undertaken by this laboratory and it is hoped that a solution may be reached.

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CONICAL HAILSTONES

Two interesting descriptions of conical snowflakes have recently appeared in SCIENCE[1], one by Mr. A. D. Moore and one by Mr. W. W. Wagener. It is never easy for an author to feel sure that he has examined all the literature, and it may therefore be worth while to call attention to two papers on a similar subject

[1] C. T. Hurst, "The Effects of Solutions of Copper Sulphate on Ducks," *Arch. Path. and Lab. Med.*, 1926.
[1] A. D. Moore, SCIENCE, 73: 642 (June 12, 1931). Willis W. Wagener, SCIENCE, 74: 414 (October 23, 1931).