Fish and Mosquito Control.

IN a recent article Dr. B. Prashad and the writer gave a general review of the probable larvivorous fishes of India. In this article the Indian literature on the subject was reviewed and the classification of the probable larvivorous fishes of India was dealt with in a general way. Attention was also directed to the importance of biological control and suggestions were made for future work. One of our suggestions was that "Observations should also be made regarding the natural food of the various types of fishes by an examination of their stomach contents." Fortunately workers interested in the control of mosquitoes had already realised the importance of the above subject and, instead of studying the feeding habits of fishes in aquaria under laboratory conditions, had gone into the field to elucidate the natural food of the species to be utilised in anti-malaria measures. Two such recent attempts have come to the notice of the writer. Dr. Sen has studied the "Food Factors of the So-called Mosquito-Destroying Fishes of Bengal—*Panchax panchax*, *Barbus stigma*, *Esomus danricus* and *Trichogaster fasciatus*", and the data, which he presents, show that under natural conditions these fishes do not feed on mosquito larvæ; in the case of *Panchax panchax*, however, he noticed that "*Anopheles* larvæ were detected in the gut of only about ten per cent. of the total fish examined." Professors N. P. Sokolov and M. A. Chvaliova, on the other hand, in their observations on the "Nutrition of *Gambusia affinis* on the rice fields of Turkestan" remark that

"1. *Anopheles* play an important role in the food of adult *Gambusia* on the rice fields, amounting to 32·8%; Ephemeridæ, 21·9%; Rynchota, 21·5.

"2. *Anopheles* larvæ form the bulk of the food of the young fish, amounting to 64·8%.

"3. *Gambusia affinis* exterminates the *Anopheles* larvæ to about 80-90%. This shows the important role *Gambusia* plays in the ecological method for combating *Anopheles* larvæ on the rice fields."

The results of Dr. Sen and Professors Sokolov and Chvaliova are so widely different that a layman may well feel bewildered in deciding whether fishes could play any part whatsoever in the eradication of mosquitoes. A careful study of Dr. Sen's work, however, leads one to the conclusion that his technique, as detailed below, must have been mainly responsible for the results which differ so materially from those of the Russian workers. The technique employed by him was to remove the "mid-gut"* on a slide and its contents "were then squeezed out from one end on the slide and examined under the microscope". Though the next section is entitled "Analysis of Stomach Contents", in the text reference is only made to "gut" and it is difficult to make out as to which part of the alimentary canal the author refers; it is certainly doubtful whether he uses it as a synonym of stomach in fishes. In the case of fishes the contents of the stomach, which is situated between a short œsophagus and a long or short intestine, have to be studied to determine their natural food. Dr. Sen did not preserve his fishes as they were caught, but usually allowed 2 to 3 hours or longer to lapse before placing them in the preservative. It is no wonder, therefore, that Dr. Sen found the food materials in the "gut" of the fish "in an advance state of digestion".

Professors Sokolov and Chvaliova, on the other hand, record that "The analysis of *Gambusia* food was done by the usual method in ichthyology of examining the stomach contents." They found, however, that even this method proved insufficient to show the entire process of nutrition in fishes, and accordingly carried out some ingenious physiological experiments to elucidate the problem of *Gambusia* nutrition. They found that at a temperature of 30° C. "the process of digestion begins about 2 hours after the larvæ are swallowed. A complete discharge of the stomach takes place in 3-4 hours, except for the chitinous parts which remain in it longer." Low temperatures, however, cause a slowing-down of digestion. They further found that the intensity of digestion remained the same whether the fish were fed on *Daphnia* or on *Anopheles* larvæ. Further they investigated the rate at which *Gambusia* swallows larvæ and found a close correlation between it and the rate of digestion. Though they failed to achieve complete extermination of

* Dr. P. Sen informs me that by "mid-gut" he meant stomach.

Anopheles larvæ even at a density of 2·3 Gambusæ per sq. mile, they found on the rice fields that the average extermination extended to 93·1 per cent. From their experiments and observations Sokolov and Chvaliova conclude that "*Gambusia* may be regarded as a sufficient agent of repression with the *Anopheles* larvæ, without applying any other methods."

The writer has for long been of the opinion that biological control of mosquito larvæ by the use of fish will prove very effective in India, but considerable work on *proper lines* remains to be done to determine the utility of the different species under field conditions; and in this connection the methods adopted by Professors Sokolov and Chvaliova should prove very helpful.

S. L. HORA.

Prashad, B., and Hora, S. L., "A General Review of the Probable Larvivorous Fishes of India," *Rec. Malaria Surv. Ind.*, **1936, 6,** 631–648.

Sen, P., "On the Food Factors of the So-called Mosquito Destroying Fishes of Bengal—*Panchax panchax*, *Barbus stigma*, *Esomus danricus* and *Trichogaster fasciatus*," *Curr. Sci.*, **1937, 5,** 357–361.

Sokolov, N. P., and Chvaliova, M. A., "Nutrition of *Gambusia affinis* on the Rice Fields of Turkestan," *Journ. Animal. Ecol.*, **1936, 5,** 390–395.

ASTRONOMICAL NOTES.

1. Comets.—The first Comet of the year was observed by Mr. Simizu in Japan. The object has been identified as Daniel's Comet 1909 IV which has not been seen since discovery in 1909. The computed period is about 6·8 years.

Comet 1937*b* was discovered on February 7, by Dr. Whipple of the Harvard Observatory. The estimated magnitude at the time was 12 and it had a short tail several minutes of arc in length. From the ephemeris based on the orbit calculated by Dr. Whipple, it is noted that the Comet will be in favourable position for observation during the next two months.

2. Transit of Mercury.—On May 11 the planet Mercury will be in inferior conjunction with the Sun and will partially transit over the Sun's disc. The phenomenon will be generally visible in Southern Asia and the central and southern parts of Africa. At Madras the ingress will occur at $2^h\ 14^m$ P.M. and egress at $2^h\ 46^m$ P.M. Indian Standard Time, and at Bombay the times are $2^h\ 18^m$ and $2^h\ 42^m$ P.M. respectively. The maximum ingress will be 7″·3, the true diameter of the planet being 12″·02.

3. Planets in May 1937.—The planet Venus will be a morning star throughout the month and will attain greatest brilliancy on May 24. Mars is a bright object rising in the early part of the night; it will be in opposition to the Sun on May 20 and will approach nearest the earth on May 28. The planet will be found a little to the west of the bright star Antares (α Scorpii). The two objects, being nearly of the same colour, present a noteworthy appearance in the evening sky. Jupiter rises about midnight and will be almost overhead early in the morning before sunrise. Saturn will also be a morning star, rising about two and a half hours after midnight in the middle of the month. The rings are gradually widening and can be seen with telescopes of moderate size.

4. The System of Capella.—The star α Aurigæ (Capella) was found by Campbell to be a spectroscopic binary with a period of 104·022 days. Later measures at Mount Wilson with an interferometer have confirmed the period. The star has a faint companion (magnitude 10·6) about 12′ distant, having the same proper motion. In *Astronomical Journal*, 1048, C. L. Stearus remarks that on photographs obtained by him, the image of this companion shows a distinct elongation and suspects, that it is also a double star. Kuiper, observing with the 40″ Yerkes' refractor, has confirmed (*Ap. J.*, Oct. 1936) the star being a close double, so that Capella appears to be a quadruple system of the ε Lyræ type.

5. New Stars.—The four Novæ which were observable about the end of 1936 are still fairly bright and can be seen even with small telescopes. Nova Herculis—the star that had its outburst in Dec. 1934—appears to be steady at the eighth magnitude with only some small fluctuations in brightness. The two Novæ in Aquilæ are slowly declining, the magnitudes of both on March 11 were estimated to be 9·7.