

or elongated dorsal fins, but the author does not allude to the slow lumpsucker, which has none of these characteristics.

Lastly, M. Fage refers to positive and negative heliotropism in the larvæ, the former being illustrated by the capture of the young *Capros aper* much nearer the surface by day than by night, and the latter by the

passage of *Paracentropristis hepatus* from considerable depths by day to a more superficial area by night. The study of this subject, however, is still in its infancy. Many other interesting features are instanced by the author, whose memoir forms an important contribution to the subject of the larval forms of shore-fishes.

W. C. M.

## The Lac and Shellac Industry in India.<sup>1</sup>

By DR. A. D. IMMS.

AT the present time India holds what is virtually a monopoly of lac production, and no satisfactory substitute has yet appeared on the world's markets. This monopoly cannot, however, be regarded as a sinecure; other countries are likely to be found suitable for lac cultivation, and the present high value of lac and its importance to many Western industries render it urgent that the production of this substance should be encouraged along improved scientific and economic lines. The propagation of lac is still very carelessly carried out, and its methods of collection need much improvement. The crop varies from year to year, prices fluctuate seasonally, and there is much injurious market speculation. The bulk of the world's lac comes from Chota Nagpur, Orissa, the north-eastern half of the Central Provinces, some western districts of Bengal, and from part of the Mirzapur district of the United Provinces. Out of the ninety or more trees which have been recorded as hosts for the lac insect (*Tachardia lacca*), the most important include *Schleicheria trijuga*, *Butea frondosa*, *Zizyphus jujuba* and *xylopyrus*, together with species of *Acacia*, *Ficus*, etc. These plants contain much gummy or resinous matter or are rich in latex.

The problems concerning lac production are manifold, and may be roughly divided into (1) botanical, (2) entomological, (3) chemical, (4) cultural, and (5) technological. On the botanical side we need more especially to determine the optimum conditions which conduce to the food-plants yielding a heavy crop of lac. It also needs to be ascertained how far it is possible by cultural treatment to stimulate the plant's production of those substances which are utilised by the insect in lac secretion. On the entomological side the most important problem is to deal with the enormous number of parasitic and other insects which annually destroy a prodigious amount of lac, either directly or indirectly. It is extremely unlikely that any marked improvement in lac culture will result until this complex problem has been thoroughly gone into. On the chemical side we need to know what plant substances are essential as food or raw material for the lac insect. Once the biochemistry of this problem is understood, it will pave the way for a better understanding of the requirements of the insect and open up a whole field of research into the cultural conditions necessary.

Under the latter heading are many other problems.

<sup>1</sup> H. A. F. Lindsay and C. M. Harlow: "Report on Lac and Shellac." Indian Forest Records, vol. viii., part 1, 1921. Pp. x+162+4 plates+10 charts+1 map.

Pruning and pollarding are highly desirable, for the lac insect is dependent upon the existence of young shoots in the right physiological condition. The extent and frequency with which the trees can be safely infected to yield the optimum crop need to be ascertained. It is also necessary to acquire definite information whether the best results are likely to be obtained from the establishment of lac nurseries composed of young trees of convenient size under careful cultivation, or whether little benefit is likely to be derived, as compared with the present system of relying solely upon existing trees growing wild and distributed over wide areas. On the technological side much improvement is possible; we need to ascertain the best and most economic methods of dealing with lac in all stages of its treatment—from the condition when it is received as stick-lac up to the final products of shellac, lac-wax, and lac-dye. The present system is primitive and often uneconomic, and adulteration is frequent.

The problems are highly complex and involved, and this fact is fully appreciated by Messrs. Lindsay and Harlow in recommending that a central lac laboratory be established in India. Under the existing system most of what research has been done at all has been carried out partly by the Forestry Department at Dehra Dun and partly by the Agricultural Department at Pusa. Neither of the research institutes located in the above places has the necessary staff available for the work. The choice of a site for such a laboratory is likely to prove difficult, as there are many factors to be considered. The *sine qua non* is that it must be located in an important area of lac production, where the problems can be studied on the spot. Such a laboratory would be devoted primarily to the study of the growing crop in relation to its environment. Its first aim presumably would be to obtain exact and trustworthy information bearing upon the many problems involved. At the present time we need new ideas and trustworthy knowledge. Much that is published is largely a repetition of what has appeared previously; the same statements, and often the same errors, have reappeared with perennial regularity, and little or no real progress has resulted. Messrs. Lindsay and Harlow's bulletin is a useful *résumé* of the present position of the problems concerned, and the suggestions which they bring forward will, it is to be hoped, receive the fullest consideration by those whose duty it is to develop and influence our means of utilising the natural resources of India.

## Flight of Flying-fishes.

DR. E. H. HANKIN has made some interesting observations on the "flight" of flying-fishes (Proc. Zool. Soc. London, 1920, pp. 467-74, 2 figs.). He concludes that much depends on the atmospheric conditions. On a very still evening in the Arabian Sea he noticed that the length of a glide after leaving the water was only about a metre, and the fishes

showed much lateral instability. During the same voyage, but in sunshine and with a light wind, the longer flights attained to between 200 and 400 metres in length. The pectoral fins are usually in the "flat" position, *i.e.* extended in the horizontal plane. Sometimes the wings are slightly inclined upwards, with the outer part of the fin at a higher level than its