bands are the silk glands. The Malpighian tubules are shown pure white, indicating that they contain chemical elements of comparatively high atomic weight. Excretion of ingested inorganic salts may be indicated, inasmuch as radiographs of different specimens show various degrees of opacity, from no delineation to complete whiteness of the image.

The digestive system and the tracheal tubes are usually the most pronounced structures seen in the

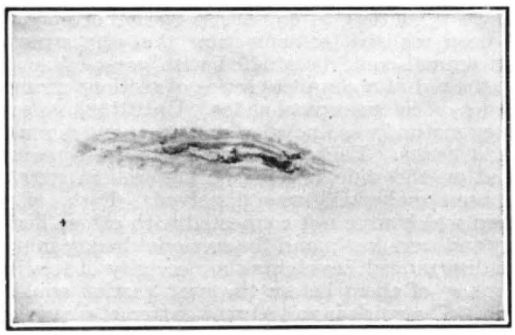

FIG. 1.—Radiograph of *Hydropsyche* larva. ×3.

radiographs. The digestive tract often contains opaque food matter. In insects having a complicated digestive tract, such as the cricket, the detailed structure of the fore and hind gut stands out distinctly. The musculature and the architecture of the chitinous exoskeleton are well brought out. The fat body often exhibits a granular structure, due presumably to the storage of insoluble excretory products containing a chemical element of comparatively high atomic weight. The reproductive organs are not shown well, except that the male accessory reproductive apparatus and, occasionally, the testes themselves and their ducts are visible (water strider). The venation may be brought out beautifully. As an aid to morphological work in the classification of insects, certain details may be brought out which would obviate the dissection of the insect. An important usage may be in physiological studies, especially of digestion and excretion.

We have received invaluable assistance from Dr. S. I. Kornhauser, of the University of Louisville, during this work, for which we express our gratitude.

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[1] Other reproductions of our radiographs will be found in the September-October number of *Radiography and Clinical Photography*, published by the Eastman Kodak Company.

Petroleum Bacteria and the Nutrition of *Psilopa petrolei*

IN a recent letter to NATURE,[1] Messrs. Lipman and Greenberg have described a coccus or cocco-bacillus occurring in petroleum obtained from a Californian oil well 8700 ft. in depth, and have stated that it has the power of oxidising petroleum with the production of carbon dioxide. This is an interesting addition to the list of micro-organisms which have been recorded as capable of decomposing paraffin hydrocarbons.[2]

The record is, however, of particular interest by reason of its possible connexion with the nutrition of the petroleum fly, *Psilopa petrolei* (Diptera, Ephydridæ). In 1930, I published[3] an account of the biology of this extraordinary insect, in which I described and illustrated the mid and hind gut of the larva as containing great numbers of a cocco-bacillus. My experiments showed that the fly larvæ, which had previously been supposed to feed on the paraffin itself, were unable to go through their development in the absence of extraneous animal matter such as the bodies of small insects; these being frequently trapped in the pools of crude oil where the larvæ live. The experiments did not, however, prove that the larvæ were incapable of deriving *any* nourishment from the oil, which is constantly swallowed, and it was indeed suggested that the bacteria in the proctodæum might be concerned in nutrition, either serving directly as food or by the production of some available substance from the petroleum. This hypothesis appeared all the more probable in view of the great abundance of larvæ in some of the pools contrasted with the apparent scarcity of trapped insects which could be used as food.

In 1931, I obtained some specimens of oil from the Santa Fe Oil Field of southern California, some samples being taken from exposed oil pools, others direct from the wells. These specimens were kindly examined by Mr. J. H. V. Charles of the Division of Biochemistry of the London School of Hygiene and Tropical Medicine. Large numbers of bacteria-like bodies were observed in all samples, although more abundant in those from the exposed pools. First attempts to culture these organisms in pure paraffin hydrocarbons were unsuccessful, but it has now been found possible to grow them in Söhngen's hydrocarbon-ammonium chloride medium at 32° C. The organism first obtained differs from that found in the alimentary canal of *Psilopa*, and from that desoribed by Lipman and Greenberg, in that the bodies are rod-shaped (or fusiform) rather than cocco-bacillary in form. However, Mr. Charles now informs me that, after continued incubation, the cultures show numerous bodies cocco-bacillary in form and exactly similar in appearance to the organism found in the gut of *Psilopa*, although the original larger fusiform bodies are still present in abundance. As yet, nothing has been ascertained as to the metabolism of these bacteria, but work on the subject is being continued, and it is hoped that before long some knowledge as to their mode of life will be forthcoming.

It appears that such organisms are by no means universally present in natural oils, although, according to Söhngen, organisms (bacterium, mycobacterium, micrococcus) capable of oxidising paraffin are easily obtainable from soil. While in Trinidad recently, I obtained a number of fresh petroleum samples from oil wells of varying depth in the neighbourhood of Apex, San Fernando, but in no case were any bacteria or other organisms found.

The abundance of micro-organisms in Californian oil fields may conceivably have some connexion with the ability of an insect to colonise this particular environment—an achievement, so far as is known, unparalleled elsewhere.

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Zoological Laboratory,
Cambridge,
Aug. 23.

[1] **129**, 204, Feb. 6, 1932.
[2] See Söhngen, N. L., 1913, "Benzin, Petroleum, Paraffinol und Paraffin als Kohlenstoff- und Energiequelle für Mikroben", *Centbl. Bakt.*, **37**, 595-608, and Tausz, J., and Peter, M., 1919, "Neue Methode der Kohlenwasserstoffanalyse mit Hilfe von Bakterien", *Centbl. Bakt.*, **49**, 497-554.
[3] Thorpe, W. H., "The Biology of the Petroleum Fly, *Psilopa petrolei*". *Trans. Entom. Soc. Lond.*, **78**, 331-344; 1930.