of *Fusarium oxysporum*, this strain being different from that isolated from necrosed vascular strands[2].

These observations give me an opportunity of saying that, broadly speaking, the major plantation problems are common to the whole oil palm region of West and Central Africa. Accordingly, it is to be hoped that the closest co-operation will be maintained by all bodies interested in the welfare of this important industry.

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[1] Wardlaw, C. W., *Nature*, **158**, 56 (1946).
[2] Wardlaw, C. W., *Nature*, **158**, 712 (1946).

Bacteriophage Typing of Untypable *Salmonella typhi* Organisms

STRAINS of *S. typhi* reported as being untypable by bacteriophage figure largely in previous reports and vary between 30 and 8 per cent of the total[1].

Using a modification of the method described by Craigie for typing, the group of untypables can be divided into three more or less distinct sub-groups. The first is characterized by all specimens from the same source of infection giving a standard pattern throughout with certain Type II bacteriophages. This pattern reaction identifies the close relationship of the strains to one focus, but does not allow the strains to be classified into any one of the recognized twenty-four groups. The second subgroup, and the larger in my series, are strains which give no reaction with Type II 'phages, but react to pooled Types I and IV 'phages with clear, complete, confluent lysis. These types may easily be considered to be new types; but with the technique to be described, most can be classified into the existing ones. The third group are those in which Types I and IV 'phages have little or no reaction, although the organisms may or may not have a *Vi* antigen content.

From a series of symptomless carriers in one area there were isolated 'rough' typhoid organisms, suggested by the biochemical findings, for they were auto-agglutinable in both normal and 0·2 per cent saline solution. Observation of the cultures showed them to be heavily contaminated with a naturally occurring anti/*O* 'phage. When the 'phage content was reduced in amount, the agglutinations were characteristic, and the organisms reacted with confluent lysis to I and IV 'phages and also were all lysed by specific Type II *G* 'phage. This series was presumed to be an example of excessively 'phage-contaminated Type *G S. typhi*, which had spread from one person to another in the roughened form.

This technique of growth in anti-phage serum was applied to a series of previously untypable strains, and most of them have now been assigned to known 'phage types. Most difficulty arises with the sub-group characterized by its pattern reaction, for although these strains can be altered to the second group (that is, lysis only with pooled I and IV 'phages), so far it has not been easy to classify them further.

These three subgroups would seem to be due to the same biological process in action. The groups are not clear cut and merge into one another. The individual variation of *V* — *VW* — *W* seems to run parallel to the colonial population change of smooth to rough in that the roughness is due to the same process acting on smooth organisms.

It would seem that bacteria contaminated with bacteriophage show the phenomenon of partial and complete interference to specific 'phage action. The loss or lowering of bacterial resistance to concomitant 'phage is responsible for the change from *V*—*VW*—*W* and even to *rho* forms. Outbreaks of typhoid fever have occurred, where the *S. typhi* isolated gave partial or complete interference to specific 'phages and rendered the organisms untypable, in that they could not be assigned to group I—24. It is of interest to note that untypable forms occur towards the end of outbreaks caused by specific 'phage types. When these previously untypable strains are rendered typable by the above method, they are found to be of the same 'phage type as the outbreak. As with communities, so with individuals, it is not infrequent that in a clinical relapse the organism isolated is of the untypable group. Examples of these untypable *S. typhi* from relapses have been identified as being of the same 'phage type as the initial infection.

Bacteriophage is widely distributed in Nature. Among the Gram-negative bacilli, 'phages have been isolated here from *S. typhi*, paratyphi *A*, *B* and *C*, various other members of the *Salmonella* group, most strains of dysentery, *Proteus*, *Pyocyaneus* and Coliforms, and they are especially numerous on Paracolon organisms. It would seem as if most of these organisms have the weakness whereby they lose their resistance to 'phage and become contaminated. From this point of view, it is not happy symbiosis, for the contamination alters the organism.

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[1] Craigie and Yen, *Brit. Med. J.*, ii, 1293 (1937). Felix, A., *Brit. Med. J.*, i, 435 (1943). Wilson, J. F., *J. R.A.M.C.*, **4**, 186 (1947).

Distribution of Shell Porphyrins in Mollusca

RED fluorescence due to porphyrins in molluscan shells has been known for some years (Furreg and Querner, 1929; Fischer, 1930, 1934, 1937; Waldenstrom, 1937; Tixier, 1945); but its exact distribution has not been described. In an investigation of the phylogenetic relationships of shell pigments, I have examined some three thousand species from many gastropod and pelecypod genera by ultra-violet fluoroscopy. Detailed findings in this investigation, together with data on the chemistry of shell porphyrins and other acid-soluble pigments, will appear in due course in the *Biochemical Journal*.

The distribution of porphyrins follows the known anatomical affinities of molluscs very closely. They occur widely in the Archæogastropoda, but disappear among the Turbinidæ, in which Krukenberg (1883) and Tixier (1947) have demonstrated a predominance of linear tetrapyrroles, and are absent from the Mesogastropoda as far as the Lamellariacea. A focus of porphyrin deposition covers this section and overlaps into the Cypræacea. The characteristic fluorescence recurs in the tectibranch opisthobranchs and in *Umbraculum*. Isolated species of *Marginella*, and one species of *Torinia*, also deposit porphyrins. Among the pelecypods, I found them in the Anomiidæ, Pinnidæ and Pteriidæ, and in *Venus* (*Clausinella*) *fasciata*, *Gafrarium divaricatum* and *Sunetta solanderi*.