Table 1. Production of colicines by colicinogenic strains in Simmons's Citrate agar

Type of colicine produced	No. of colicinogenic strains	No. of strains producing colicine in Simmons's citrate agar
I	30	0
E	12	5
E+*I*	11	5
V	4	4
K	4	4
X	3	3
B	1	1
D	1	1
A	1	1
F	1	1
G	1	0
C	1	1
H	1	1
S_3+*I*	1	1
S_5	1	0
Total	73	28

colicines *B*, *D*, *A*, *F*, *G*, *C*, *H*, S_3+I and S_5; finally, a very strong, non-typed colicine, produced by the strain *Mutaflor* of Prof. Nissle, largely produced in Germany by the A. G. Hageda for the treatment of 'Dysbakterie'[6], is defined as colicine *X*.

Strains producing colicine *I*, a part of strains producing colicine *E*, or colicines $E+I$ simultaneously, and type cultures producing colicines *G*, *H*, and S_5 did not produce any inhibition zones on the strain sensitive to the indicator (Table 1).

Strains producing colicines *V* and *K*, some of the strains producing colicines *E* or $E+I$, and type cultures producing colicines *B*, *A*, *C* and S_3+I, gave smaller inhibition zones of the indicator in Simmons's citrate than in nutrient agar.

Finally, the type cultures producing colicines *D* and *F*, and the cultures producing colicine *X* gave very large inhibition zones in the synthetic medium.

This observation can be of practical value in the typing of the colicinogenic strains. This typing was found to be important in epidemiological studies of infantile diarrhœa due to *Escherichia coli*[7]. A large number of colicinogenic *E. coli* isolated from epidemics produce colicine *I*[8] or colicine *I* together with another colicine (unpublished results).

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Lysogeny in the Genus *Proteus*

A lysogenic strain of *Proteus* species was detected by Fejgin in 1924[1] but no systematic attempt has ever been made to ascertain the prevalence of such strains. We have investigated the incidence of lysogeny using 23 *Proteus* strains for which we have previously isolated lytic phages from sewage[2]; media used have been previously described[2,3].

The Fisk technique[4] using overnight broth cultures gave uniformly negative results, and other methods of induction were then used. The 3 methods used, details of which will be published elsewhere were: (1) individual cultures of the 23 strains were grown in broth for 10 days at 37°C.; (2) ultra-violet irradiation according to the method of Gots and Hunt[5]; (3) all possible combinations of pairs of the 23 strains were grown together in broth for 10 days according to the Scholtens' method[6].

Cultures thus obtained were centrifuged to clarity, kept at 56°C. for 45 min. to inactivate remaining bacteria, and then tested for phage activity by a modification of the agar layer technique[2]. Using 49 different *Proteus* strains as indicators, 12 of the 23 strains were found to be lysogenic. The three induction methods apparently possess a degree of species specificity, in that not all lysogenic strains were induced by all three methods, and the strains induced by method (3) were all *mirabilis* species, while 4 of 5 induced by method (2) were *vulgaris* species. In only one instance did a phage derived from a *vulgaris* act on a *mirabilis* species. The host range of most temperate phages isolated was restricted to one strain, in contradistinction to the sewage phages isolated[2].

Some phage suspensions appeared to contain mixtures of phages. This is being investigated. It is possible that if a greater variety of methods of induction and a wider range of indicator strains had been used more lysogenic *Proteus* strains would have been detected.

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Influence of Carotenoids on the Infra-Red Spectrum of Bacteriochlorophyll in *Chromatium*

Although it is well known that the infra-red maxima in the absorption spectrum of *Chromatium* exhibit considerable variability, the basis of this phenomenon has remained obscure. Wassink *et al.*[1] described in detail the variations which they observed in the infra-red spectrum of both the organisms and colloidal extracts. After considering several explanations, these authors took the view that all these infra-red maxima represent one pigment, namely, bacteriochlorophyll bound to different proteins. More recently, Duysens[2] also has claimed that each of the infra-red peaks represents bacteriochlorophyll; however, he has not tried to explain the existence of more than one peak. Work in this laboratory has led to a hypothesis of the ultra-structure of the bacterial chromatophore[3]. It was posulated from this model that the transfer of energy from carotenoids to bacteriochlorophyll has spatial requirements which are met only when the chromatophore is in a suitable environment and further that the complexity of the infra-red spectrum is related to the interaction between these two pigment systems. At this time both postulates have received experimental support. Variation in the concentration of inert solute in the suspension medium has pronounced effects upon the efficiency with which quanta absorbed by the carotenoids are used for photophosphorylation by isolated chromatophores[4]. The loss of the ability to transfer energy is also correlated with specific changes which appear in the infra-red spectrum. These changes which appear in the infra-red spectrum of isolated chromatophores are comparable to the differences which are observed in organisms with differing carotenoid content.

In Fig. 1 the changes in light absorption which accompany the 'uncoupling' between the carotenoids