content are evaluated in the Beckman spectrophotometer at their respectively maximal absorption. The transfer of the mono-layer makes it impossible that protein which is dissolved in the substrate during the process of spreading, is measured additionally. This constitutes the first appliance for separating the surface for spreading and the surface where reactions of the surface-chemical type take place. From the extent of binding of the different dyestuffs by serum albumin and fibrinogen, it can be deduced that their dispersion is the determining factor, so that it is a colloid-chemical reaction which governs the affinity between protein monolayer and azodyestuff.

Model Experiments for the Production of Gastric Hydrochloric Acid

Recent experimental investigations concerning the secretion of hydrochloric acid by gastric mucosa, especially those of DAVIES *et al.*[1], have made important statements with respect to this process. Relations have been established between Q_{O_2}, Q_{CO_2} and Q_{HCl} respectively. The quantitative data of these investigations, however, characterize only the initial and final state and do not interpret the more detailed mechanism of this process.

Undoubtedly, the hydrolysis of the sodium chloride, or the liberation of hydrochloric acid by means of a weaker acid, can only take place at ordinary temperatures by means of substances which have specific affinity for certain ions. These substances must be—to put it perhaps more comprehensibly if not very precisely—permeable for certain ions and not for others. For the reaction concerned we believe that it is possible to find such a model in the ion exchange substances. Ion exchange resins were employed.

The production of hydrochloric acid from sodium chloride and a weak acid can be written as follows:

[1] R. E. DAVIES, Biochem. J. *42*, 609; *43*, 321, 336 (1948).

(1) Using cation exchange resin:—

(*a*) $R \cdot H + Na^+ + Cl^- = R \cdot Na + H^+ + Cl^-$.

The regeneration of the sodium resin by means of a weak acid, e. g. with succinic acid, proceeds:

(*b*) $R \cdot Na + H^+ + (\text{succinate})^-$
$= R \cdot H + Na^+ + (\text{succinate})^-$.

(2) Using anion exchange resin:

(*a*) $R \cdot Cl + H^+ + (\text{succinate})^-$
$= R \cdot \text{succinate} + H^+ + Cl^-$.

The resin succinate will be treated:

(*b*) $R \cdot \text{succinate} + Na^+ + Cl^-$
$= R \cdot Cl + Na^+ + (\text{succinate})^-$.

As the processes (*a*) and (*b*) can be carried out separately one after another, we can see that there is a possibility for the production of hydrochloric acid from sodium chloride by means of weak acids.

In our experiments the cation exchange resin was brought into the form $R \cdot H$, the anion exchange resin into $R \cdot Cl$ and washed until of neutral reaction. Then the solution containing the ion to be exchanged was poured into the column. In the case of cation exchange this was a sodium chloride solution; in the case of anion exchange it was succinic acid. The extent of the exchange was measured by titration of the hydrogen ions in the dropping down liquid. Indication was made either with methyl-orange, or by pH-measurements.

Our expectation was fulfilled in both cases. The cation exchange resin, treated with succinic acid, gave with sodium chloride solution hydrochloric acid; on the other hand, the anion exchange resin regenerated by sodium chloride brought a considerable amount of hydrochloric acid into the succinic acid solution.

After these experiments the regeneration of the cation exchange, as well as the treatment of the anion exchange resins by means of a still weaker acid, carbonic acid, was attempted. As the following tables show it was successful:

Table I

Anion exchange

Experiments with CO_2

Amberlite IR-4B transferred with HCl into $R \cdot Cl$, washed with distilled water until of neutral reaction:

	(0)	100 ml water saturated with CO_2	pH = 4·20
$R \cdot Cl$	(I)	10×10 ml water saturated with CO_2 until	pH = 3·52 consumed 12·2 ml 0·1 *n* NaOH
	(II)	5×10 ml water saturated with CO_2 until	pH = 3·50 consumed 4·5 ml 0·1 *n* NaOH
	(III)	5×10 ml water saturated with CO_2 until	pH = 3·78 consumed 3·9 ml 0·1 *n* NaOH
	Liberated HCl:		20·6 ml 0·1 *n* NaOH

Table II

Cation exchange

Amberlite IR-105 (commercial form) transferred with 30×10 ml water saturated with CO_2 into $R \cdot H$, washed with 5×10 ml distilled water until of neutral reaction:

$H \cdot R$	10 ml 2% NaCl consumed (until 3·60 pH)	1·38 ml 0·1 *n* NaOH
	10 ml 2% NaCl consumed (until 3·60 pH)	1·76 ml 0·1 *n* NaOH
	10 ml 2% NaCl consumed (until 3·60 pH)	0·88 ml 0·1 *n* NaOH
	10 ml 2% NaCl consumed (until 3·60 pH)	0·40 ml 0·1 *n* NaOH
	10 ml 2% NaCl consumed (until 3·60 pH)	0·12 ml 0·1 *n* NaOH $R \cdot Na$
	Liberated HCl:	4·56 ml 0·1 *n* NaOH

Table III

The R-Na form of the resin is treated with 20×10 ml 0·1 n succinic acid, washed with 10×10 ml distilled water until of neutral reaction:

			Initial pH
H·R	10 ml 2% NaCl consumed (until 3·60 pH)	4·23 ml 0·1 n NaOH	1,54
	10 ml 2% NaCl consumed (until 3·60 pH)	6·63 ml 0·1 n NaOH	1,23
	10 ml 2% NaCl consumed (until 3·60 pH)	4·60 ml 0·1 n NaOH	1,30
	10 ml 2% NaCl consumed (until 3·60 pH)	2·20 ml 0·1 n NaOH	1·60
	10 ml 2% NaCl consumed (until 3·60 pH)	0·81 ml 0·1 n NaOH	2·00
	10 ml 2% NaCl consumed (until 3·60 pH)	0·38 ml 0·1 n NaOH	2·45 R·Na
	Liberated HCl	20·82 ml 0·1 n NaOH	

The results of our experiments do not contradict those of DAVIES; our data even explain and complete them in detail. Thus they elucidate the remark of DAVIES concerning the process of HCO_3^- formation $-OH^- + CO_2 = HCO_3^-$. We believe that this picture can help to throw light on some observations of DAVENPORT[1] which could not be brought into agreement with his general considerations, e. g. the absence of the effect on the acid production of some substances inhibiting the action of carboanhydrase. If the steps of the whole process are separated, as they must be separated, then these contradictions do not exist any more.

The question might still arise whether our model could be applied to gastric secretion. The literature referring to the ion exchange substances does not mention until 1949 that substances of similar function occur in human organs. This, however, does not seem improbable. The anion exchange resins are amines of high molecular weight and it is probable that other amino groups can also exert similar functions. In our laboratory experiments are in progress for the study of ion exchange functions of some proteins. According to the data hitherto available, these processes—corresponding to the manifold functions of the proteins—are very complex and the observed exchanges must be proved in long series of experiments.

We believe that the permeabilities in the organ can only be observed if a peculiar affinity exists between the transferring and the transferred substances when the permeability can be reduced to a continuous ion exchange.

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Department of Chemistry University of Szeged, Hungary, March 1, 1951.

Zusammenfassung

Da einerseits Kationaustauschharze, die mit schwachen Säuren in die Form $H \cdot R$ übergeführt worden waren, mit Kochsalzlösung Salzsäure ergaben; und andererseits Anionaustauschharze, die mit Kochsalzlösung behandelt worden waren ($R \cdot Cl$), Salzsäure in den Zustand einer Lösung einer schwachen Säure überführten, so glauben die Autoren, daß der Ionenaustausch an Harzen als Modell für die Magensäuresekretion gelten könne. Die Permeabilitäten können auch als fortwährende Ionenaustauschvorgänge beteiligt sein.

[1] H. W. DAVENPORT, Physiol. Rev. *26*, 560 (1946).

Possible Immature Forms of Bacteriophage

Though it has not been hard to obtain electron micrographs showing bacteria in many stages of the lysis they undergo when attacked by bacteriophage, these photographs have contained surprisingly little unequivocal evidence as to how new bacteriophage particles are produced during this process. In the usual preparations[1] new particles are commonly seen in clumps and strings distributed through the remains of a bacterium; and often these groups, especially in the case of such tailless bacteriophages as T_3 or T_7 against *Escherichia coli*, have had the appearance of microcolonies[2]. Nevertheless, they have not contained particles which could be recognized as being in course of division. This has stimulated a continuing search for objects that may be incompletely formed, or immature, particles of bacteriophage. A year ago HERČÍK[3] and the writer[4] independently found segmented filaments having the diameter of bacteriophage heads in certain lysates of *Escherichia coli*; but the conditions under which these have appeared suggest that they are not steps in the usual process of bacteriophage proliferation. This note describes other objects in cultures of *Escherichia coli* infected with T_2 and T_4 bacteriophages which are connected with the lytic process and may be forms of bacteriophage in course of development.

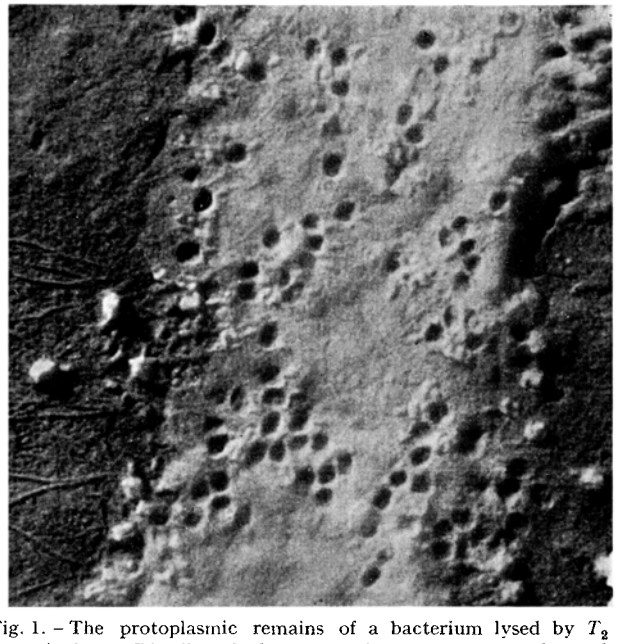

Fig. 1. – The protoplasmic remains of a bacterium lysed by T_2 bacteriophage. Distributed throughout it are some granules and many "holes" with the short "tails" referred to in the text. Magnification = 38,000 ×.

Many "holes" having the diameter of bacteriophage heads (fig. 1) have already[1] been seen in lysed bacteria. At first these were thought to be protoplasmic sites from

[1] R. W. G. WYCKOFF, Biochim. et biophys. acta *2*, 27, 246 (1948).
[2] R. W. G. WYCKOFF, Proc. Soc. Exp. Biol. Med. *71*, 144 (1949).
[3] F. HERČÍK, Exper. *6*, 64 (1950).
[4] R. W. G. WYCKOFF, Exper. *6*, 66 (1950).