The sudden failure of starter cultures, whether mixed or single strains, still proved as great a source of trouble as ever. It had been shown in past years that failure was connected with aeration of the milk in which the culture was to be grown, but there was no indication of the manner in which air produced this effect. A chance observation in February, 1935, gave a clue to the problem and led eventually to a complete explanation of the mechanism of the phenomenon. It was shown that many cultures of lactic streptococci are infected with "bacteriophage," a virus-like agent which preys upon the bacteria. The existence of bacteriophage has been recognized among medical bacteriologists since 1915, but its occurrence in starter cultures has been hitherto unsuspected. The bacteriophage is apparently stimulated by aeration of the milk; it "flares up" and actually dissolves the bacteria in the starter.

The difficulty of dealing with this agent in such a way as to circumvent its action still has to be faced; but now that the mechanism of the reaction is known there is much greater hope of being able to cope with the problem successfully. It may be possible to immunize bacteria to the bacteriophage or to render conditions unsuitable for development of the phage. These lines are being investigated.

(*b*) *Cheese-ripening.*—Work in past years showed that neither starter bacteria nor rennet played a direct part in the development of cheese-flavour, and, further, that flavour did not develop in the absence of bacterial action. Attention was therefore directed to the group of bacteria known as "lacto-bacilli," which grow in the ripening cheese after the first week or two and subsequently reach enormous numbers. It appeared likely that they had some connection with flavour. Various strains of lacto-bacilli were isolated from samples of Cheddar cheese and pure cultures were added to cheese-vats. Control vats of the same milk were similarly made into cheese. As the cheese ripened it was found that the strains of lacto-bacilli added produced distinctive characteristic flavours. Certain strains imparted a mild aromatic flavour reminiscent of ripened cream-butter; others led to the development of a strong fruity fermented flavour, which has in the past suggested an infection with yeasts. All the results supported the theory that the flavour of Cheddar cheese is normally produced by lacto-bacilli which are present by chance in small numbers in the cheese-milk. The types present in the milk may vary from day to day, and hence the flavour of the cheese exhibits chance variations. It remains to be seen whether the deliberate development of distinctive flavours in cheese has commercial possibilities. There are still many technical details to work out in connection with the methods of adding such cultures to cheese-milk, but it is quite evident that here is a method of modifying flavours in cheese should this prove desirable.

(*c*) *Chemistry of Cheesemaking.*—Further investigations have been made of the possible causes of the anomalous whey-acidity readings during the later stages of the cheesemaking process, and an attempt has been made to obtain some more definite information on the nature of the acidity changes in the whey during the making process, and the type of cheese obtained. The factors studied included the mineral and lactose content of the milk, the rate of development of acidity during the making process, and the acidity at which the vat was run. It was shown that a high acidity at the "whey-running" stage caused an increased loss of minerals in the whey and a corresponding reduction in the mineral-content of the curd and cheese. Since the minerals in the curd are chiefly responsible for the neutralization of the lactic acid formed, this depletion of the minerals results in a less complete neutralization, and the whey acidities later in the process are consequently higher than in a corresponding vat run at a lower acidity. Low-test milk, which usually has a lower mineral-content than high-test milk, was found to give higher whey acidities for the same reason. The other factors investigated were found to be of little importance in affecting the significance of whey acidities. The knowledge of mineral losses has thrown considerable light on the relationship between the type of milk and the running acidity on the one hand and the quality of the resultant cheese on the other.

The effect of an artificial increase in the lactose-content of cheese was also studied, and it was found that only a part of the added lactose was fermented, so that, although a larger amount of lactic acid was formed in the cheese and a distinctly acid flavour produced, the acidity did not rise high enough to produce an objectionable effect on either the body or flavour of the cheese.

(*d*) *Payment for Cheese-milk.*—The problem of devising a suitable system of payment for milk for cheesemaking resolves itself into three parts:—

(1) The development of a suitable test for casein which can be carried out in the factory at little cost and which will give reliable results on composite samples of milk:
(2) The establishment of a general average relationship between the values for fat and casein content of the milk and the yield of cheese obtained under commercial conditions:
(3) The choice of a simple and equitable system of apportioning the proceeds to the suppliers.

Work has been carried out at the Institute on this question during the past three years with the following results:—

(1) The Walker test, modified and improved, gives sufficiently reliable results on preservatized composite samples of mixed milk, both in the laboratory and in the hands of the factory-manager.

(2) The Walker test, in conjunction with the fat test, gives equally as reliable an indication of the cheese-yielding capacity of mixed milk as does the laboratory test for casein; and results have been collected from eighteen factories showing that there is a general average relationship in New Zealand commercial factories between fat and casein content of the milk and cheese yield. On the basis of the results a table has been drawn up showing the yield of cheese per 100 lb. milk for milks of varying fat and casein contents.