		s.	d.		£	s	d.
Local Collection...	at	0	3	...	1,875	0	0
Freight and Charges	„	4	6	...	33,750	0	0
London Salesmen, &c.	„	2	3	...	16,875	0	0
For Orchard Rent, Cultivation, Gathering, Packing and Cases	„	3	0	...	22,500	0	0
Total		10	0		75,000	0	0

It would appear that there was no redress for the shipper —not even returned freight when produce was spoilt. Thus it certainly did look as if he should have a little more consideration given to the care of his produce than it received at present. If by radiation from cold surfaces every part of a cold store could on shore be kept at the desired temperature, surely the same could be done at sea. But how could food be expected to be kept at 30 to 40 deg. uniform throughout the hold when a few match boards as were nailed together under the deck on each side of the ship and air 60 deg. colder than required was brought in on one side and taken out on the other side by these crude boxes, having rough slides, to regulate the distribution of the air in the shallow plane governed by the openings they covered, and without any device to cause perfect circulation and ventilation? When frozen or chilled meat was carried in the same vessel, a few metallic air trunks through the more perishable cargo would abstract all the heat necessary without carrying in moisture at all.

A most important point, that could only just be touched upon now, but which he (the speaker) went very fully into at the Hobart Conference, was the hygrometric condition of the atmosphere in cold storage chambers. It had been proved beyond doubt, that the bacteria of decay and putrefaction did nothing towards its destruction so long as heat and moisture were being given off from food, but the moment that heat and moisture were transferred to such food, the work of these destructive agents began. Therefore, when we cooled any food

many degrees lower than was required and afterwards allowed it to rise in temperature by the admission of warmer air when the chamber was opened, we were only courting destruction. This was a very wide subject, deserving more exact attention than it had yet received, and afforded scope for a separate paper. Very few cold stores registered the readings of both wet and dry bulb thermometers. They ought to do so, however, and note the effects in changes of saturation as well as temperature. When the fitting up of ships' holds and cold stores to carry chilled or frozen food was carried out on a more scientific basis, records would be kept of humidity as well as of temperatures during storage. With proper attention to chilling before, and thawing after, storage the amount of food lost by refrigeration will be practically nil.

From what had been shown, it was evident that, partly owing to her special requirements, and through the enterprise of her citizens, Australia had been years before the old country in the design, construction and use of refrigerating machinery, accumulating experience all the time. And yet Australian graziers, dairymen, and orchardists shipped hundreds of thousands of tons of Australian produce in English vessels without taking any steps to have the arrangements for cold storage as perfect as they might be. For over 30 years New South Wales had been producing machinery for artificial refrigeration, often superior to that which had been imported, and was doing so still. The proportion of the total receipts realised for Australian produce which was paid for freight was so extremely large that nothing but the most scientific and perfect arrangements should be accepted for the safe carriage by cold storage of any class of food products. Such crude and makeshift appliances as were now adopted in the carriage of butter, cheese, fruit, &c., should be no longer tolerated.

What had been nearly everybody's business had, of course, been nobody's, justifying the proverb to that effect. But, surely, when the interest of every one in the State was con-

cerned, the State should take the matter up, as it did others of infinitely less importance. There was one institution in the colony which had already made its influence felt in the dissemination of useful, practical, and scientific teaching—the Technical College. That institution should be the focus where the rays of technical experience gained in all branches of Australian industry meet, and whence they should be again dispersed to enlighten the minds, strengthen the hands, and increase the wealth of the Australian producer. The Technical College had many excellent appliances, but it had, unfortunately, no experimental refrigerating chamber. He ventured the assertion that if the Government, through the Minister for Public Instruction or the Minister for Agriculture, would expend the trifle of, say £500, in fitting up some small experimental cold storage chambers, so that absolute data could be established concerning the chilling, storage, and thawing of food, the money value would be returned to the colony tenfold within a year. Such chambers should be at the disposal of any competent persons to conduct experiments with food on condition that the results were public property. In a very short time incalculable good would be done, and many bogeys which now frighten producers would be laid to sleep, the result being increased production and increased prosperity with the whole community.

Mr. JOHN WILDRIDGE said that the first portion of the author's paper was confined to work he had done in the matter of refrigerating installations, and, although open to much criticism from a mechanical point of view, should form no basis for a discussion on the prospects and abilities of these colonies in export of products, which should find employment for thousands of our working men and a fair profit to our highly deserving, and too little appreciated, graziers, dairymen, and farmers; and only by the introduction of mechanical systems for the production of cold air had this been made possible.

To the introducers of the means whereby our products could be preserved for an indefinite time, we and the world in general should be thankful: and amongst the first we had the honoured name of Mr. T. S. Mort, who not only gave his time, ability, and means to this important enterprise, but was also heart and soul in the whole matter, and had left us an inheritance which we would do well to follow, noting the failures and increasing the successes, until we should at least command the markets of Great Britain, and in time, by a fair trade policy, that of other nations. But resources had scarcely been tapped, and we could not anticipate a sound business until our exports were continuous, and of a superior, or at least equal, quality to that of other exporting nations; and this without a doubt we could do by careful supervision, whether on the part of Governments or mutually selected experts by producers as graders, it being quite impossible to anticipate a uniform quality in any one product; but we should under any condition have only three grades, and that of good, better, best; an inferior quality being sufficient to damn a whole cargo; or until the consumer could say this was Australian, and could rely upon it.

Granting that the graziers and dairies, fruit-growers and others would do their utmost in this respect, engineers must follow in providing the means for economically freezing, chilling, or cooling these products to such temperature as might be best suited to their safe preservation, and remain sound and nutritious for human consumption. The author advocated radiation as the best means of extracting heat for all conditions. In this he (the speaker) differed from him, having gained, through the experience of both systems, that each article of produce should be treated specially according to its own requirements. Meat chilled or frozen by exposure to the open air according to the temperature existing in cold latitudes could not be compared by any mechanical application, and in this respect the Linde system of dry air circulation was the nearest

approach to the natural we had at present any knowledge of. Butter, being in an insulated box of its own, with waterproof paper inside, did not require air circulation, therefore radiation suited equally well. Cheese could be treated both by dry air and radiation, and both were suitable for this purpose. Fruit required a constant supply of fresh cold air to carry off the gases arising from same. That we had not all these elements on board ship as required according to requirements was not surprising, inasmuch as compressed air machines were made first on account of their freedom from injurious effects arising from leakage of joints as compared with other gases, and, secondly, they were fitted entirely for the carriage of frozen meat, dairy products and fruit being an export which had arisen within the last three years, and only tacked on to the meat export trade. Under these conditions, it could not be expected that shipowners were likely to fill their ships with machinery suitable to the several exports and maintain an equitable freight.

The author stated that the manufacturers of compressed air machines were the opponents to any other improved system of refrigeration. This was an assertion without foundation, as there was not an original manufacturer of compressed air machines in England who did not manufacture machines using other gases as refrigerating agents, and who supplied either according to demand. Mr. Selfe's remarks that the dense ignorance of many in the old country were at least imprudent, as it was not so long ago since this Society had the pleasure of inspecting a compressed air machine made from his designs. That we were advancing rapidly in the matter of refrigeration and carriage of perishable products was undoubted, and to meet these advancements the new systems were also being introduced on board ship, of which we had already many examples, with carbonic anhydride as the refrigerating agent, with the result that the coal consumption was materially reduced, and the products carried in a better

condition, both by radiation and direct contact; and unless it was proved a certainty that other gases could be used safely on board ship, owners were not likely to stand a coal bill of four times the cost of either of these gases when by the use of new machinery they could repay the cost in a short time; and we might reasonably expect an advancement which would not only benefit themselves, but also meet all the requirements of exporters.

At the present time the safe carriage of chilled meat was a most important factor if we were to compete with America, and although the trial in the s.s. "*Port Pirie*" with which we were connected, proved a failure only through the carelessness of one of our own cloth, he was pleased to see in this day's cable news the report that the "*Gothic*" had arrived in London with her chilled meat in good condition. This news was of great importance, as it meant at least doubling the profit to the grower by the increased consumption and cutting out of the American supplies, whilst our existing freezing establishments would also increase their profits by doubling their output, and shipowners would be equally benefited, inasmuch as they would now have certain employment for their vessels.

With regard to the matter of insulation, an important point in connection with the cost of freezing establishments, he might state that he never used charcoal which weighed over 18 lbs. per cubic foot. At this weight it contained much more air than hardwood charcoals weighing 24 lbs., and was therefore a better insulator than either pumice or infusorial earth. A new material had been shown us by Messrs. Parke and Lacy, a sample of which he had pleasure in exhibiting. He also begged to hand in a new catalogue by the Linde Company, showing the number of machines made by this firm up to the present, and for many varied purposes which might be of interest to members, as showing what we should also be able to do in the matter of preserving our products in these colonies.

In conclusion, he desired to thank the author for bringing forward his paper, and hoped members would seriously consider this new element in their profession.

Mr. R. D. Postle (visitor) considered that meat should be deprived of as little moisture as possible during the process of freezing. Therefore the most perfect system of freezing would be that in which the meat was made to retain its full weight without the addition of any condensed moisture frozen on its surface. Commercially, the complement of freezing meat was the thawing of it. Apparently, thawing frozen meat would seem to be a very simple matter, as it would merely mean undoing the usual work effected during freezing; it, however, meant something more than this, as perfect thawing required both the restoration to the meat after thawing of the qualities and appearance it had prior to freezing.

The process of freezing might be described as follows:—

(*a*) Reducing the meat temperature to 32 deg. F.

(*b*) Then converting the water contained in the meat into ice.

The first part of the process (*a*), usually termed "chilling," involved comparatively little work, as it simply meant the abstraction of the sensible heat of the mass from the initial temperature to the freezing point. The principal work began when the water of the meat was converted into ice; any subsequent reduction in temperature below the freezing point was similar to process (*a*).

In thawing, the heat communicated to the frozen meat equalled that extracted from it, plus that necessary to produce the requisite evaporation from the meat surface.

When frozen meat was exposed to the ordinary atmosphere at a higher temperature than itself, it acted as a condenser, the moisture of the air being condensed on its surface; in addition to this, any frozen moisture condensed on its surface during freezing melted. The water from these sources loosened the

surface tissues of the meat, impaired its general flavour and appearance, and favoured decomposition.

In this connection it might be remembered that the hygrometrical and thermal conditions of the atmosphere were constantly varying; sometimes the moisture in the air was excessive, and sometimes the reverse. Occasionally the natural conditions were such that thawing in the open air could be effected without the deposition of much moisture if what might be termed the hoar frost was previously wiped off it and the moisture condensed on the meat's surface occasionally removed. These conditions, however, rarely occurred, hence the necessity for a process under control that would enable the importers of frozen meat to thaw it under any atmospheric vicissitudes, and on a large scale.

Briefly the necessities of the case were as follows:—

(1.) The communication of sufficient heat to the meat to liquify the ice in and on it.

(2.) The circulation of air more or less warm and dry round the meat.

(3.) Economy of process.

Heat (1) could be communicated to the meat by direct radiation or by hot air in motion (2). The latter method was to be preferred, as it was practically the only way of communicating heat to closely-hung frozen carcases.

A moist, hot atmosphere, it was well known, hastened decomposition, whilst, on the other hand, the absence of moisture in it retarded decay. Hence, the dryness of the circulating hot or warm thawing air was an important factor in the process. This would be recognised at once when it was remembered that as soon as the surface rigidity of the meat was removed decomposition commenced, and proceeded with more or less progress, varying with the thermal and hygrometrical conditions of the atmosphere surrounding it. It would, therefore, be readily seen that, under certain conditions

favourable to decomposition, the thawed surface of meat might decay before the internal portion of it was thawed.

Economy of Process.—This was next to complete efficiency of process. The leading features in the detail methods of his thawing process conserve all waste, heat, and cold. Thus the hot dry air after passing over the meat, and being still hot, was made, before being reduced in temperature, to give all its heat to a fresh body of dry air, and if the air was dried by the application of cold for the purpose of condensing the moisture, the resulting cold air was made to give up its cold to the next body of air to be operated on. By these expedients, technically known as exchangers, the heat and cold required was reduced comparatively to a minimum, and the working expenses proportionately.