entitled, "The Geology of Tasmania." No doubt the Government would recognise the importance of this work as they did with that of Mr. Johnston, and make provision for its publication.

The part of the work prepared by Mr. Rodway was remitted to the Council of the Society for their consideration.

TASMANIAN APPLES IN LONDON.

Mr. W. E. SHOOBRIDGE read a paper entitled "Tasmanian Apples in London." He said :—The export of Tasmanian apples to London opens up a wide and interesting field of inquiry to the student of physical science, as well as a source of profit to Tasmanian growers, and pleasure to consumers in England, and being intimately acquainted with the subject from the beginning, he had thought some account of its history would be interesting to this Society, and form a record of the initial steps taken to establish what now appears likely to be of colonial, if not national, importance. The soil and climate of Southern Tasmania have long been noted for their suitability for growing and maturing all the fruits of a temperate climate in perfection; and as the industry gradually extended from Hobart, southwards to the Huon, and north-westerly up the Derwent Valley, a distinct difference was discovered in the growth, and consequent treatment necessary in the two districts. In the Huon the heavy rainfall and damp climate, and fertility of virgin soil fresh won from the dense forests produced a luxuriant growth of large sized fruit, and orchards quickly spread along the narrow valleys and crept up the steep hillsides until it became the staple industry of a great part of the district, and the main dependence of a number of small settlers. The Derwent Valley extending inland, and gradually widening in a north-westerly direction out of the line of the great mountain ranges of the west that cause the moist climate of the Huon, is dry and arid, and the system of fruit growing, especially that of apples, that had been so successful in the Huon, failed when applied to the Upper Derwent. But small patches of the river flats near New Norfolk that received the drainage from the hills, and some that were irrigated for hops, were found to produce excellent fruit; through information about irrigation and its effect on growing and maturing fruit was difficult to obtain, and such knowledge as could be gained by fragmentary description of Indian and Italian irrigation, needed adapting to the special wants of our own soil and climate. Besides a strong though unreasoning prejudice existed against fruit grown by artificial watering, as it was said to be soft and green, though large, and destitute of flavour and keeping qualities, and at the same time irrigation appliances were costly and hard to get. But the indomitable energy of the Anglo-Saxon, when once fairly applied to the problem, slowly but surely overcame the difficulties, and brought success out of seeming failure. The first step was to get an accurate knowledge of the climate, and this was obtained by a careful series of observations, extending over many years, by which it was found that the average rainfall at New Norfolk for the year was 23·22in., and the spontaneous evaporation 45·36in.; and for the summer months of December, January, and February the mean average rainfall was 5in., and evaporation 15in., the mean temperature of three daily registers, 62·36deg., the mean of maximum solar intensity 134·88deg., of minimum terrestrial radiation 41·51deg., and humidity of air ·68 per cent.; of course this means an exceptionally dry summer climate for cultivation, and explained the reason of the failure of the Huon system when applied to the Derwent, but the mean amount of cloud of three daily registers (7·30 a.m., 4.30 p.m., and sunset) was only 4·20 of scale 0—10. He gave these and other figures in order that those who may wish to investigate the subject, either as a matter of inquiry, or for the purpose of establishing the industry in other places, may have some reliable

data to go on. The next step was to find out the effect of water on the growth and maturing of the fruit, and after a patient and extensive series of trials, with nearly 100 varieties of apples, on different soils and situations, and varying amounts of water, applied at all stages of growth, as well as the effect of many systems of pruning, manuring and cultivation it was found that the water principally acted as a carrier or medium, by means of which the plant was fed, and the action of growth, consisting as it does of a constant absorption of water by the roots, carried up to be exposed to the sun and air, and by the action of the chlorophyll cells, the hydrogen of the water combining with the carbon dioxide in the air, forms the series of hydrocarbons, that are the basis of all plant life, and by the addition of the salts and acids held in suspension by the water from the soil, and acted on by heat and light, causing the chemical changes and combinations that build up the different parts of the plant, and mature the seeds and their covering, that is, the fruit. It was found, that given a sufficiency of moisture in the soil to dissolve the chemical matters contained in it either naturally or artificially supplied when wanting, the essential point was to ensure a free circulation of air and access to light, of every part of the tree and fruit, and also to aerate the soil by constant moving, so that the roots could have air as well as water. The amount of water required to do this in the friable loam of most parts of the Derwent Valley, was found to be 30in. for the three summer months, and as the absence of cloud meant more sunshine, the dryness of the air was a positive advantage in maturing and colouring the fruit, as when a free growth was kept up by the constant artificial supply of water, the maturing was hastened, and as the fruit was more fully developed, the flavour and keeping qualities were vastly improved. The accuracy of these observations is confirmed by the researches of Dr. Julius Von Sachs on the transpiration of plants, which show that when it is increased by light and heat in a dry air, the passage of water from the soil is hastened, and by its evaporation in the stomata of the leaves, more of the salts in suspension are left in the chlorophyll cells, and consequently there is a rapid increase of the substance of the plant. The effect of this system, varied with the sort of apple and method of pruning, and finally the sturmer pippin, scarlet nonpareils and French crab were selected as the most suitable varieties, as well as being the healthiest trees and heaviest, and most regular croppers, and by their firmness of flesh and toughness of skin, best adapted for the rough usage of travelling. Of these the sturmer pippin is most improved by watering. It is satisfactory to find that these three sorts are pronounced by experts in the London fruit trade to be the best in flavour and appearance to please English customers. The style of preserving known as the inverted pyramid, formed by a number of branches radiating from the stem, a short distance from the ground, was found the best shape to allow free access of light and air to every part, as well as easiest to pick and prune, and least liable to damage from wind. Having selected the apples and learnt the best method of growing, the next difficulty was in transport. A six or seven weeks' journey, part of which was through a climate absolutely destructive to the apple, seemed at first an insuperable obstacle, but by the same method of patient observation and experiment, aided at last by the co-operation of growers, the dangers to avoid were gradually found out, and a knowledge was gained of the conditions necessary for the successful transport of fruit to London. First of all experiments were made ot the amount of heat apples could stand without injury, and it was found that 70deg. was about the limit of safety, but the heat of the tropics, both in water and air, averages about 90deg. for 10 to 14 days of the voyage, so artificial cooling was a necessity. The success of the dry air refrigerating process for carrying meat naturally led to inquiries to see how far it

could be utilised for carrying fruit. A serious difficulty existed in the fact that the fruit season lasting so short a time meant that only a single trip of each steamer in the year was available for the trade, and the fruit being so susceptible to taking up foreign flavours, as well as liable to damage other things, no other article could be carried in the same hold, so freight could only be secured by guaranteeing to fill the whole of the cool chamber in each boat carrying fruit at the high rate of 90s. to 100s. per ton freight, growers taking all risks. The knowledge gained by so many years of patient inquiry and experiment had established the following facts:—1st. That at least three kinds of apples of excellent flavour, appearance and keeping qualities could be produced in greatest abundance and perfection, especially in the Derwent Valley district, and that the supply could soon exceed the demand of colonial markets. 2nd. That an almost unlimited market existed in England for this class of fruit, and owing to the difference in season, could be landed in London at a time of year when it would not have the competition of either home grown or American growth, and consequently good prices might be expected for the quality of fruit produced here. 3rd. That the fruit would keep in good order for at least double the time required for the voyage, provided the right condition of temperature and ventilation could be secured. 4th. That the yearly increasing number of ocean steamers fitted with cooling apparatus provided the means whereby a very large quantity of fruit could be carried. It now became necessary to secure the co-operation of growers, so that a sufficient number of cases could be collected to fill the cool chambers of some of the ocean steamers. By this time growers had so much confidence in the knowledge gained as to induce them to risk enough fruit to make the experiment. Accordingly in 1888 the first shipments on a large scale were made, although small experiments in shipping had been made for many years with varying success, and it was thought if they could only be kept cool enough through the tropics, there would be little danger in the venture. These first large shipments, however, only served to show the number and magnitude of the difficulties. In the first place the refrigerating machinery was designed for carrying meat, the essential condition of which was that it should be kept below freezing; but freezing was ruinous to apples, and some cargoes were nearly all spoilt by this cause and even when saved from frost the great amount of condensation of cold air from machine coming in contact with the damp air in the hold was very injurious, and in addition to this the want of proper ventilation in parts of the hold favoured a fungoid growth that spoilt the flavour even when it did not cause rot, and the rough handling of the fruit by stevedores unaccustomed to such easily bruised articles, was, and still is a serious loss, as the short time allowed for the loading makes careful handling very difficult. Improvements are gradually being made in tempering the air entering the cool chambers to prevent freezing and excessive condensation, and in thoroughly ventilating every part of the hold to prevent mould; and a new system has been proposed, adapted for ordinary holds, by fixing an exhaust fan to draw the air from every part of the hold by a reticulation of fixed pipes, and passing the inlet air through a chamber (supplied with cold air from the refrigerating machine) by a series of small pipes, so as to cool the air in passing through, and also to condense the moisture in the air before coming in contact with the fruit. It appears probable that the fungoid growth found in the holds on some of the fruit is anaerobic, and therefore fresh air should be constantly passed through all parts of the fruit to prevent its growth. It is found that the fruit when landed in London is very much riper than similar fruit kept till the same time in Tasmania; this cannot be caused by temperature alone, as the records of temperature of holds are almost identical with recorded observations in Tasmania for

same time, viz., 35deg. to 65deg., and is probably due to a certain fermentation set up in the fruit by the natural process of decay, induced or at least accelerated by the fungoid growth found in the holds, and it is on these points that further information is required, viz., 1st. The amount of fresh air required daily by the fruit. 2nd. The range of temperature necessary for safe carriage. 3rd. The cause of fungoid growth in holds. 4th. The cause of premature ripening. 5th. The means by which these fungoid growths and fermentation may be prevented, and ripening of fruit in holds be retarded. It is known in a general way that fruit will not keep as well in a close room as when it is freely exposed to fresh air ; that it will endure a range of from 35deg. to 70deg., if changes are not too sudden ; that fungoid growths are promoted by a close, damp air ; and that when kept in a close room at an even temperature of, say 45deg. to 55deg., it ripens and rots far quicker than in the open. As yet, however, we have not sufficiently accurate information on these points to say definitely how much fresh air and how low a temperature is necessary to carry fruit in the best possible condition, and it is a slow and costly process to acquire it, because, as stated before, only one trip in the year can be taken by each steamer and the experiments have to be made on such a large scale to be of any value; for instance, to test the cool ventilation in ordinary hold will require from 15,000 to 20,000 cases in a single vessel, and it is only by carefully noting the cause of failure that we can find out and apply a remedy. This was notably the case with ventilation. Experiments on a large scale were made in storing fruit in cellars and specially constructed stores, and it was found that the quantity stored in one bulk materially altered the results, and the conditions on the voyage were so different from those in Tasmania, that fresh precautions were needed on shipboard to those on shore. By the willing aid and co-operation of the chief engineers of the different steamers, much has been learnt. For instance by a careful register of thermometers in all parts of the holds it was found that through want of ventilation great differences existed, as much as 28deg. in a distance of 7ft. 6in. apart, and by carefully watching the condition of the fruit as it was unloaded from the different parts, it was found that at the inlet pipes of cold air to hold the fruit was mostly damp and sometimes frozen, and near the outlet pipes it was dry and in excellent condition, whilst in places round the bottoms a damp and mouldy appearance proved the stagnant state of the air. In this latter case the fruit had lost its fine flavour, and although clean and bright in appearance, was comparatively valueless. In spite of all failures and difficulties, it is satisfactory to note that a large amount of success has attended the venture ; out of 130,000 cases sent in 1891 to London, at least 110,000 cases of excellent fruit were landed in good order, and was duly appreciated by English consumers of all classes, from Her Majesty the Queen—who was graciously pleased to accept a sample—to the humble customers of Whitecross-street costermongers. Although not of strictly scientific interest, it is yet important to notice the method of sale and distribution, about which much misconception appears to exist. It must be remembered that in this trade we cannot have everything our own way ; as it is only comparatively small and intermittent, we cannot have ships specially fitted with machinery and appliances solely for fruit, but must make use of what is already provided with such alterations and modifications as our experience may suggest, and we can persuade steamship companies to adopt ; so in the sale and distribution of fruit in England. We find an immense organisation reaching to every part of the country in active work, controlled by a few large firms of brokers in London. It would be quite impossible, for so short a time as we require it, and for a single article, to organise any system that could attempt to deal with the business as it can be done by the existing method ; but, as in

the case of transport, we may, by careful observation and experiment, see how far we can make use of this organisation to dispose of our fruit with the best results to ourselves. With this object we have established an agency in London, to reduce expenses, to control sales, to find out so as to prevent or make claims for all damages, and generally to exercise a supervision on behalf of growers.

Discussion on this paper was postponed till next meeting.

The Secretary read a paper contributed by Mr. J. Shirley, B.Sc., of Queensland, a corresponding member, on "A list of the known lichens of Tasmania," and one by Mr. A. T. Urquhart on "Some Tasmanian spiders," from a collection supplied by Mr. A. Morton, curator of the Tasmanian Museum. The other papers on the agenda were held over till next meeting.

The CHAIRMAN proposed a vote of thanks to the gentlemen who had contributed papers, which terminated the proceedings.

MAY, 1892.

The monthly meeting of the Royal Society of Tasmania was held at the Museum on Tuesday, May 11. His Excellency the Governor Sir R. G. C. Hamilton, K.C.B., LL.D., presided. There was a good attendance of Fellows.

His EXCELLENCY expressed his regret at being absent from the last meeting. This was the first time he had been with them since the late Science Congress had met, and he congratulated them upon the success which had attended their labours in this respect. This was, he was sure, largely due to the exertions of Mr. A. Morton, the General Secretary, who had been indefatigable in his efforts to make the affair a success. Mr. Ogilvy had thrown out a very valuable suggestion, to which reference was made in his address at the meeting of the Science Association. The idea was that they should have corresponding members stationed in various places. The country should be mapped out into districts, and each separate district be recognised as being under certain persons' observations, who would undertake to forward anything of any importance which might come under their notice in their particular districts. They might also be communicated with at will upon the subject, and inquiries instituted. He would like the matter to be discussed at the next meeting of the Society. Perhaps they might think the matter over, and make preparations for the discussion in the meantime. He then invited discussion upon the paper of Mr. W. E. Shoobridge.

Mr. A. MORTON said that the suggestion of Mr. Ogilvy was bearing fruit already. He had received a number of specimens from different parts of the island. One was a specimen of a very large crane (*Ardea pacifica*) seldom found in Tasmania, although common in Australia. Another was a white crane (*Herodias alba*) also scarce here. A duck, hitherto unrecorded in Tasmania, called the "blue bill" (*Erismatura australis*) was also sent. The Australian coot was another species of bird rather scarce in Tasmania, and recently found here in some plenitude. He was at a loss to account for the influx of these birds into the island at this period.

His EXCELLENCY stated that he had observed that the crane species were unusually plentiful this year.