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THE ECONOMIC APPLICATION OF SCIENCE.

The following is the presidential address delivered by Dr. Rennie at the annual meeting of the Royal Society of South Australia:—

After some deliberation I have decided to say a few words on the present state of some of those industries of these colonies in which chemical science is more or less involved, and in some cases to suggest what seems to me to be the possibilities of economy and development in the future. I do not claim originality, nor do I claim to be in a position to discuss fully all the circumstances of each case, but simply venture to hope that by drawing attention to certain facts some will be induced to think over the possibilities of future improvement, and, perchance, to take steps to bring about practical advances in our industrial processes. If some of the suggestions should be proven to be impracticable owing to local circumstances at least no harm can be done by having them under discussion.

AGRICULTURAL AND PASTORAL.

What is the condition of affairs in this colony? Is the yield of wheat anything like what it used to be? On all sides we hear statements of the great differences between the yields of earlier and later years. It goes without saying that a great deal depends upon the rainfall. Nothing can be done without water, and it is a matter of satisfaction that the settlers in the colonies are gradually becoming alive to the absolute necessity for better water conservation. But given fair average seasons, how is the falling-off in the crops to be accounted for? The obvious answer is—Exhaustion of the soil. But what are its causes, and are there any remedies? Every year sees the export from this colony of thousands of tons of wheat, to say nothing of other cereals. Now every ton of wheat contains on an average about 18 lb. of phosphorous oxide and 7 lb. of potash. Both of these substances in certain forms of combination are essential elements in a fertile soil; but they are only present in very small quantities even in the best land. Besides this a not inconsiderable quantity of potash is carried off with all the unwashed wool that leaves our shores. If this is to go on without some compensation the yield of cereals, grasses, &c., must inevitably become smaller and smaller, and the crops will be rendered more liable to be attacked by parasitic diseases. Deeper ploughing will do something for a time, but only for a time; something more is necessary. In many cases, I fear in most cases, nothing is being done to make up for the loss. Nothing in fact can be done, except by the addition of natural or artificial manures and systematic farming. This of course involves careful preservation of all materials which can in any way be applied to manurial purposes. In this last respect there is great want of care. If anything successful is to be done with working men's blocks and such comparatively small tracts of land as are likely to be benefited by the Beetaloo irrigation scheme, careful cultivation is absolutely necessary, for water alone will not supply all that is needful for the growth of crops. What are the facts in most cases? Little or no care is taken to utilise farmyard manure to the best advantage, yet this is a form of manure eminently adapted for most purposes, containing as it does nitrogen compounds

and phosphates in a form especially suitable for assimilation by plants. Wood ashes, which contain a considerable proportion of potash salts, and of which a not inconsiderable quantity is produced every year in every farmhouse, are thrown out anywhere and everywhere. The same is true of bones. With a little trouble they could be all burnt, adding thereby very materially to the value of the ashes; or, better still, by a cheap mill they could be ground to bonedust and so give nitrogen as well as phosphate to the soil. The quantities of phosphate, nitrogen, and potash salts obtainable from the above sources would not be sufficient to replace the loss on a large farm, but they would do something towards it and would certainly be of considerable use in increasing the produce of the orchard or vegetable garden. Quantities of bones, bonedust, and superphosphate are being from time to time exported from the colony. Surely this is a needless sending away of valuable manure. It seems to me there must be something very seriously wrong somewhere when such valuable materials can be exported from such a colony as this at a profit. Then, again, there is sulphate of ammonia, a most valuable manure in some cases. There is so little sale for this now the Mauritius market has failed that the gas company are hesitating whether to continue the manufacture. Yet it is obtainable at a reasonable price, and not a pound of it should be allowed to leave the colony. There is strong evidence of want of thrift and economy among a large proportion of our rural population. The days are gone in which crops could be obtained by merely scratching the surface of the soil. Every day it is becoming more manifest that careful and economical treatment is necessary to make the land yield any kind of produce. The much persecuted Chinaman is certainly a pattern in this subject. He has come from a country where the very existence of the population depends to a very large extent upon the proper treatment of the land, and he has learnt the lesson well. He takes good care that nothing is wasted, and he obtains results accordingly. Possibly something may be done by training the children in our schools, country schools in agricultural districts especially, in such a way as to make them practically acquainted with such matters, and by endeavoring to foster in them a liking for agricultural pursuits. Is it not desirable that experiments should be undertaken with a view of discovering what are the best methods of farming in this colony under varying conditions? In England, in various parts of Europe, and in America, there are large experimental farms, established either by the Government or by private enterprise, in which such experiments can be carried out on scientific principles. The results obtained by years of painstaking investigation at the experimental station carried on by Messrs. Lawes & Gilbert at Rothamstead have proved invaluable all over the world. Associated with these stations in many cases are well equipped agricultural colleges. What have we here? An Agricultural College, it is true, but very insufficiently equipped internally as regards the appliances for proper scientific teaching of even an elementary character, to say nothing of investigation, and externally with one of the worst pieces of land in the whole district, and besides all that with an endowment utterly inadequate for effectively carrying out experiments such as have been alluded to. Reference has already been made to the fact that potash salts are carried off with all the unwashed wool that leaves our ports; but apart from this no effort is made, so far as I know, to preserve for manurial purposes the potash salts which find their way into the water in which wool is washed. Professor Tate drew attention to this matter some 10 years ago. The greasy matter of

wool is composed of certain peculiar fatty substances, some fatty acids, and potash salts in the form of soaps. These latter find their way into the washwater, and and here are simply wasted ; but in Europe the water is evaporated, the residue calcined in gas retorts, yielding by that treatment considerable quantities of ammonia and illuminating gas, and the charred product washed to extract the potash salts, which are obtained in a form readily convertible into valuable manure. A process has recently been patented in this colony, of which a trial took place some time ago, for extracting the potash salts from wool by water, and the greasy matter by carbon disulphide. The patentees have proceeded to England with a view of perfecting certain parts of the apparatus, which cannot be obtained here. The use of carbon disulphide for extracting greasy matters is not new, but has been tried more than once and abandoned owing to various difficulties connected with its use. Possibly, however, the new process involves improvements which will render the process workable and profitable. The value of the greasy extract depends mainly on one of its constituents, a substance known as cholesterin, which is found in human gall-stones, in feathers, hair, whalebone, &c, and which possesses the peculiar property not possessed by ordinary fats of absorbing more than 100 per cent. of water. Mixed with a certain proportion of water it is known as lanolin, and this substance is stated to be much more valuable for making plasters, ointments, &c., than vaseline, paraffine, or lard, being much more readily absorbed by the skin, and carrying with the various medicaments with which it may be mixed. Potash salts are sometimes carried off in some quantity in the 'argol' or 'tartar' which separates from grape juice during fermentation. This substance is known chemically as potassium bitartrate, and is in many cases sold to chemists for the manufacture of cream of tartar and for other purposes. It is not impossible, however, nay, it is highly probable, that a continual draining off of this compound from the soils of our vineyards without corresponding replacement may produce damaging effects hereafter. We may safely take it for granted that the invariable presence of considerable quantities of the substance in the fruit has some intimate connection with the healthy growth of the vine.

FOREST CONSERVATION.

In the matter of forest conservation we are well off in this colony, and our energetic Conservator of Forests has achieved great successes in this direction. You will have noticed that he is proposing to supply a large quantity of charcoal for use at Broken Hill. This means a large waste of by-products if it is to be made by the old method of burning. Mr. Brown informs me, however, that he is thinking of introducing the system of carbonising in retorts, and so preserving the liquid products, which are of considerable value, containing as they do creosote, pyroligneous acid and wood spirit. For all of these there is some demand. There is great need of a supply of the latter article of good quality for methylating purposes, the material imported for that purpose being wretched stuff, containing a considerable quantity of hydrocarbons, which are immediately precipitated on dilution with water. The conservator also contemplates the production of turpentine from the pine forests, which are growing successfully in some of the northern parts of the interior. I am sure you will welcome these advances in utilisation of our own products.

Another subject connected with one of the products of the colony is the production of tannin from the bark of the various species of acacia. This scarcely seems to be attracting the attention it deserves. A great deal remains to be done in the direction of ascertaining the best varieties of wattles which will flourish under different conditions, and above all of ascertaining at what stage of growth it is most advantageous to strip the tree, or cut it up into fragments, as is now done at Messrs Barrow and Haycraft's establishment at Willunga. There has, however, been needless waste in the ruthless destruction of young trees which would have yielded much more tannin had they been allowed to grow for a year or two longer. If the demand increases, as it is certain to do (unless indeed some cheap substitute for tannin be found), there will probably be a difficulty in supplying the demand. Putting in a few wattle seeds now and again on spare land does not involve a large amount of time or labor, and many a landholder might add to his income in the future by a judicious and systematic planting of this useful tree.

OIL YIELDING PLANTS.

The cultivation of certain oil-yielding plants may yet yield good results. Olive oil has for some years been successfully produced in South Australia. It is a splendid article, and is deservedly commanding an increased sale. There is, I am told, some prospect of a trial being made with castor oil. For this oil there is a considerable demand, and, judging from the facility with which the tree grows, there seems no reason why it should not be successfully cultivated. There were some good specimens of sesame and peanut oil from the Northern Territory shown at the Exhibition last year. From this I gather that the plants yielding those oils grow well in that district. There again there are doubtless many indigenous trees capable of yielding valuable products, medical or otherwise, but the investigation of such matters requires long and patient labor, and there few workers in the field.

METALLURGY.

So long as metallurgical processes are conducted on a small scale, as they are at present, little can be done that has not already been done in the matter of economy. In older countries large metallurgical works, such as those at Freiberg, include a large number of different processes, yielding different products, and all help to contribute to their success. Here the great difficulty seems to be to obtain a market for many of the products. For example, in connection with the extraction of gold from pyrites, pyrites can be buried in suitably-constructed kilns, and the sulphur dioxide so produced utilised in the manufacture of sulphuric acid, the residue being in a condition suitable for extraction of gold by amalgamation. But most samples of pyrites contain arsenic, which can only be partially condensed, though it often is condensed in Europe and preserved for various purposes. The sulphuric acid from the pyrites therefore becomes contaminated with arsenic, and would not command such a ready sale for some purposes as the purer article, though it might be applied in many

cases just as well as the purer acid. The great difficulty is that more acid would be produced than there is a market for. But may it not be possible in some instances to combine with the manufacture of sulphuric acid from this source other processes in which the sulphuric acid could be utilised? At Mount Morgan I am credibly informed that it is intended to make the sulphuric acid and chloride of lime used