MINUTES OF PROCEEDINGS.

13TH MAY, 1886.

Walter Shellshear, President, in the Chair.

The following candidates were balloted for and duly elected:—

MEMBERS:

R. P. PARK.

V. RHODES.

E. S. NIXON.

The following Papers were then read:—Mr. Angus Mackay on "The Mechanics of Agriculture," and Mr. H. Selfe, on "Our Colonial-Built Harbour Steamers."

THE MECHANICS OF AGRICULTURE,

BY ANGUS MACKAY, MEMB. FRANKLIN INST.

AGRICULTURE has advanced in two very distinct lines during the hundred and fifty years since the science emerged from the long dark period during which the cultivator of the soil was the drudge of the time, whose main efforts were dependent upon his own manual strength.

Those two lines are chemistry and mechanics. The former has done much for agriculture, tending as it has directly and in the most effectively practical manner, to make clear and plain what, prior to the days of agricultural chemistry, was dark and mysterious, and beneath the consideration of learned men in early times, with but rare exceptions. Chemistry, fortunately for agriculture, was fostered and encouraged by public as well as by the individual efforts of the many grand and noble men who employed their talents in that direction during late years. In the various schools opened for agricultural instruction, chemistry has been recognised as a leading principle, and due attention has been paid to it.

But mechanics, as applied to agriculture, have not fared so well. With the exception of the American agricultural schools, and notably those of New York, California and Illinois, comparatively little has been done for educating the farmer in agricultural mechanics. And the impression has gone abroad that while mechanics and engineering have done so much for the industries generally, agriculture is far behind in that respect. The supposition is not correct. As we shall see while investigating and illustrating this department of agriculture, the aid afforded to the science by mechanical engineering is nothing short of wonderful. And it will be seen further that the skilled agriculturist of the present day should of necessity be an efficient mechanic, or mechanical engineer. The tendency of all agriculture is in that direction very decidedly, and towards further advances. And there is ample scope still for improvement.

So far, the developments of agricultural mechanics are due very largely to private effort, and to the pushing business tact of the many individuals and firms who have made specialties of the agricultural tools and machines manufactured and brought into notice by them. Progress of that kind is not without its advantages; hence the credit given to those who have been the direct me ns of many of the immense advances made in the form and quality of farming tools and machines generally. But the process has its disadvantages. It has led to the palming off upon the classes who cultivate the soil of immense numbers of machines and contrivances which actual work prove to be absolutely unsuitable for the purposes for which they were recommended and pushed into notice. Worry, loss of time and money, and disappointment follow the purchase of bad and unsuitable tools and machines. But, in spite of all drawbacks, the farmer has now the choice of tools and machines equal to the best seen in other countries.

The author's object then in drawing attention to the foregoing facts is twofold:

First, in order to show the effective services already extended to agriculture by mechanical developments in the form and quality of the tools and machines in use.

Secondly, to show further that mechanical skill is absolutely necessary to the agriculturist of every degree, that he may be able, from his own knowledge, to decide whether an implement offered him is suitable in a practical way for the work to be done; that he may be able to use his implements to the best advantage, and to make such repairs, alterations, or improvements upon them as may become necessary. It has been a boon to agriculture that implement makers and others have done so much; it is still better when the agriculturist himself is a skilled mechanic—the two divisions are combined in the one man with great advantage.

The Royal Agricultural Society of England, and the Highland Society of Scotland, have done much for the development of agricultural mechanics and engineering. Those societies offered prizes, not only for such machines as were coming into use, but for special contrivances for doing specified work, and by this means many very desirable improvements have been introduced. Other societies, in Australia as well as in other places, have followed in the wake of the great institutions of the mother land; but the latter have always been most prominent, a circumstance due largely to the exceptional ability of the men the Royal and Highland Societies were able to secure as experts and judges. The most notable case of this kind in Australia as yet, was the very handsome offer of the Government of South Australia for the invention of a harvesting machine that would reap the grain, thresh, winnow, and bag it, all in the field. The author had the privilege of seeing that trial, and, although none of the machines submitted came up to the requirements of the case, he was much taken with the very great skill and enterprise made manifest by the competition.

South Australia is peculiarly adapted for wheat farming on an immense scale, and upon a system in which mechanical engineering is all important. The only parallel to South Australia is seen in parts of California and in Colorado. The South Australian wheat soils, with but rare exceptions, are very light. The soil is loose in texture, and very rich in lime. It overlies immense beds of limestone. By the aid of gang ploughs—a series of two or more light plough bodies in a frame—the soil is turned over four or five inches deep, each furrow being from 8in. to 10in. wide, a team, with two men and four to six horses, going over from four to ten or more acres daily. Seed is at once sown by centrifugal seed sowing machines, doing from 50 to 100 acres daily, and in very excellent style. The crops grown are light in quantity, from six to ten bushels per acre being about the average; and the harvesting is done by stripping machines, reaping 200 to 400 bushels daily. The grain is threshed, winnowed, and bagged in the field by different machines. Altogether the system is peculiar, and would not be rated as high-class farming in either Europe or America. But it is adapted to the light, open treeless lands of South Australia, and sections of Victoria and New South Wales. The results, per man, that is, the number of bushels produced per man and horse engaged, are not low by any means. The whole process offers excellent illustration of what mechanical aids are doing for wheat farming. It is very safe to say that, without their peculiar ploughs, their seed sowers (the author had the privilege of introducing them to Australian farmers), and their harvesting appliances, it could not pay, possibly, to reap 10 bushels of wheat per acre. But by the South Australian system, six bushels pay. The author has not a doubt that, with further mechanical aids for ploughing deeper, and when manuring or soiling enters into their system, much larger returns will be got for about the same outlay.

The principles of agricultural mechanics are identical with the science of mechanics. The lever, wedge and screw, have all their outlets in agricultural engineering, in the same manner, precisely as in the other branches of mechanics. In the plough, in seed sowing machines, in mowers, reapers, hay cutters, baling presses, and the other machines used in agriculture, the knowledge, the practice and theory of mechanics is as useful as in shipbuilding, railroad engineering, or other branches of the art.

In the spade, mattock, pick, trenching, draining, and other tools of that type, we have the very first principles of the lever and wedge. To be effective, to move soil with the least exertion to the worker, and to enable him to get the best results, the tools should not weigh an ounce more than is necessary for the strain put upon them. Quality of material, steel, iron, and wood, and substance where required only, rather than weight and bulk, should guide in the choice of tools of that kind, even more than in those used for horse, steam, or other mechanical power.

The plough is a combination of the wedge, screw, and lever, and just in proportion to the skill of the maker in developing those principles of mechanics in the plough, each in the right proportion and in the right place for the work to be done, and these in combination with the quality of material used, go to make the most suitable plough. But different soils require differently arranged implements, whether the work be breaking up new land, ploughing where stumps and roots cannot be got rid of for a time—then the stump-jumping plough of South Australia is a boon—ploughing for ordinary crops, subsoiling, draining, ditching, tank-making, and other ploughing, for each class of work special adaptation of the implement is necessary. And in these days it is better and cheaper, to an absolute certainty, to provide suitable tools than to worry men and horses, and waste time and money trying to get along with tools that are not suitable.

In stump-extracting and tree-falling machines, sometimes termed "forest devils," we have most excellent results from the application of lever power. By a combination of levers and chains, or by the use of the screw, trees and stumps are taken down, or raised out of the ground by one or two men—or horses can be used—these contrivances are able to tear out of the ground stumps, roots, stones, &c., that could not be moved by a 10-horse power engine without the aid of the lever or screw.

Seed sowers combine the the screw, lever, and centrifugal force in such a manner as to sow, with mathematical regularity, from 50 to 100 acres of wheat daily, one man and a horse doing the work.

Mowing, reaping, binding, stripping, threshing, winnowing, and other machines of that type, are all built upon the recognised mechanical principles followed in other classes of engineering, The rule for quality and suitability of the materials in the machine apply in these with even greater force than in ploughs. Every pound of unnecessary weight, every unnecessary combination or increase of parts all tell against complicated machines of this kind. Steel and iron (now-a-days capable of endless applications in mechanics) are decidedly better than wood in all machines in which jolting, dust, and risks of wear from friction of the parts are combined with very rapid speed. Machines of this kind have been improved immensely since their first introduction in Australia, nine years ago, and improvements still go on steadily. The results already are that the white man, with their aid, is able, even in these depressed times for grain, to hold his own in the market in competition with grain from Russia, India, and other cheap labour countries.

Draining has developed an immense variety of tools of the spade, or wedge and lever type, to every one of which the features apply of quality and weight of material dealt with in the treatment of spades and digging tools generally. In no department is improvement in these respects more marked than in draining tools. Draining itself has opened out other developments in the science of agriculture. Prior to 1750 it seems to have been scarcely known that water in the soil is only beneficial to agriculture while it is in a state of movement. Stagnant water is now known to be injurious to vegetation, to crops, grasses, and the animals upon or near where water stagnates. When this fact became evident to the advanced British agriculturist of 130 years ago—and there were some advanced men in those times—open ditches were made to carry off the stagnating water, and during some sixty years open drains and ditches were supposed to answer all the purpose. Then another advance was made by laying stones, wood, &c., in the lower part of the drains, filling in the soil, and cultivating the surface. The effect was surprising. The land about the drains was found to be easier to work, it became warmer in winter, and cooler in summer, and gave much better returns.

1836 saw the first tile drains laid. Pipe drains followed soon after. Now it is known that not only does draining carry off stagnating and undesirable water, but the soil is deepened, and the drained land withstands drought, while undrained land becomes parched and bakes hard as bricks. The ordinary spirit level and a length of straight-edged batten are ample levelling instruments for ordinary draining, and so well is the work done that capable drainers can open a pipe track 6ft. deep, 4in. at bottom, and 22in. at top, and lay in the pipes without a speck of loose earth about them, until the work is ready for filling in.

Irrigation can be successful only where the soil is thoroughly drained, either naturally, by having an open sub-soil, or artifically by means of pipe drains. California, Colorado, Utah, and other States of the Union, with climate very much like that of Australia, have advanced rapidly with irrigation. Victoria, our neighbour, is also moving ahead, as are a few enterprising men both in New South Wales and in Queensland. Irrigation is applied successfully for grain crops, grass, orcharding, &c. The mechanical engineering principles involved are easily understood, and with care are not difficult to work out. From lake, river, or dam, water is led in open ditches with a batter of about 45 degrees, where the fall does not exceed 6ft. per mile. Where the fall is greater, or gullies, &c., have to be crossed, flumes made V shape, and of timber, or close pipes of wrought iron or steel (made up to 40in. diameter) are used. Ploughs and scoops are employed with good effect in opening out the ditches. When the water is got to the place where it is to be used, it is brought upon the land with as little run or fall as possible, otherwise it would quickly cut the land into gullies, wash away the soil, and be worse than useless. What is termed terracing is used where steep land has to be crossed. The terraces are made by putting boards or bags across the ditch, so as to raise the water a foot or so. The water from each terrace flows out from an opening in the centre of the board, which is really a dam. Efficient levelling when water can be run upon land, is done by the water itself, always being careful not to allow it to run too fast, nor cut away the land. This is a special branch of our subject to be dealt with separately. Here it is necessary to add that, in practice, it is found the best course to saturate the soil say two, three, or more times during a season, rather than to wet the surface oftener. For wheat and other grains, two saturations are found ample to secure crops; once after the seed is in, and again when the crop is in flower. But much depends upon the soil and the season. There is no hard and fast rule for guidance.

At a strawberry farm in Santa Clara, California, the author saw the effects of irrigation from artesian wells, and the necessity that exists for using water only after it has been exposed to the air. Indeed, it is doubtful whether water applied direct from wells could be profitable for irrigation. In the case under notice an immense tank of concrete has been raised some 10ft. above the level of the cultivated land, which is level plain of great extent. In this tank the well water is aerated, and the elevation is sufficient to give water pressure sufficient all over the cultivation land.

The sugar business is much indebted to engineering. The improvement made during the last twelve years, both in the speed of doing the work and the cost of production, is nothing short of wonderful. The quality of the product is also vastly improved. Yet there are many openings for farther advances. The author will mention one only on this occasion—the want of a machine to cut down cane in the field. There is a fortune for the man who perfects a contrivance of that kind. The difficulties in the way are all of the mechanical kind, and they are to be overcome by the man who studies the subject carefully, but it must be in the field, and while the crop is being harvested.