Throughout Canterbury there is an abundance of farms, which, as a result of a protracted programme of cropping without due attention to a suitable rotation, have gradually become depleted of much of their original soil fertility. Under a continued system of incorrect management, this depletion has inevitably reached the stage at which further cropping has become uneconomic owing to reduced yields. When this regrettable stage has been reached something has had to be done—some alteration in the management has had to be made in an endeavour to rebuild the fertility of the soil.

When this point has been reached different farmers have adopted different methods of attaining the desired end. In a minority of cases, when sufficient capital has been available to permit the owner to neglect temporarily the maintenance of income, the restoration of the soil to good heart has been accelerated. In most instances, however, restoration has been very gradual as the farmer has been forced to maintain a reasonable annual income and at the same time return a small instalment to the "bank of soil fertility." A few farmers, through exceptional methods, have reached the desired end fairly rapidly without the use of capital which has not been produced on the farm, so with the property of 513 acres owned by Mr. E. Rands, of Springbank, North Canterbury. This farm, which is located 8 miles west of Rangiora, on the Oxford Road, has behind it a history of heavy cropping which, though very profitable in the early stages, led gradually to the depletion of soil fertility with a corresponding fall in crop yields. The climax was reached when the average wheat yield fell to the uneconomic figure of 19 bushels per acre, whereas in good seasons some years before yields had averaged 35-40 bushels.

In bringing about this state of affairs, Mr. Rands has adopted very successful and interesting methods of management, and always they have been methods which have maintained a working income. In fact, which could be used by the average farmer under similar soil and climatic conditions. It is with the period of fertility restoration which this paper will deal chiefly, but before doing so it may be of interest to give a brief account of the history of the property, as a background to the present management.

Part of Big Station

Originally the property was part of "Springbank," a station of 23,000 acres. It was taken up in 1851 by Mr. W. Kaye and sold in 1853 to Mr. Robert Chapman. In 1882 Mr. Chapman divided the station among his sons, but it was not until 1912 that the present state of subdivision was brought into being. In 1919 the late Mr. Rands (Mr. E. Rands's father) purchased the property, which he farmed until his retirement, when his son took over the management. With the exception of two paddocks, one of which had been cropped and one sown down with dantonia, the farm at that time was covered with tussocks and matagouri. There were several extensive areas of manuka and blackberry. The 513 acres was divided into 7 paddocks with wire fences and manuka hurdles.
There were several small clumps of trees. The buildings comprised a 4-roomed cottage and thatched stable on the eastern boundary. A water race followed a deviated course through the property.

The late Mr. Rands soon had a man at work with a B-horse team and a plough. Most of his own time during the early period of possession was devoted to the erection of his homestead, farm buildings and yards, and the levelling up of the two belt. The old farmyard and buildings were placed well behind the homestead and shut off. Pastures were thus fenced and hedges. The house was thus removed from the main line of traffic and its location and results of these two factors gave promising results—results which pointed the way to the future development.

Subdivision

The farm was then subdivided into 21 paddocks, which involved the erection of more than 10 miles of fencing and the provision of 9014 ft. gateways. When the water race had been straightened and a new one formed, water flowed through every paddock on the farm.

During the period it was being worked as a mixed farm the property carried 400 half-bred ewes. Southdown rams were used and all lambs that did not go away fat off their mothers were fattened on rape. Ewes were wintered on turnips and, owing perhaps to the fact that hay was not always available, the death rate was fairly high. The flock was maintained by the purchase every year of 4-year-old ewes. The practice was to breed from these ewes for 2 years and then sell as fat.

During the 20 years from 1919 until his retirement in 1939 the late Mr. Rands concentrated his efforts on the production of wheat, wool, and lambs. In addition to the wheat Mr. Rands grew about 30 acres of oats each year for chaff and about 60 acres of turnips, with two crops of wheat following. Half dozen rams were used and all lambs that did not go away fat off their mothers were fattened on rape. Ewes were wintered on turnips and, owing perhaps to the fact that hay was not always available, the death rate was fairly high. The flock was maintained by the purchase every year of 4-year-old ewes. The practice was to breed from these ewes for 2 years and then sell as fat.

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Lucerne Hay for Winter Feed

In 1940 Mr. Rands laid down an 18-acre stand of lucerne on to a sheep grazing property growing only occasional cash crops. This was the point at which it was decided to try to build up fertility by growing lucines and by establishing better grass pastures after the lucerne had been turned under. Continuous cropping over a long period had drawn on fertility to such an extent that the growing of annual cash crops was no longer profitable.

It is necessary to give a short description of the farm in order that its fertility may be better understood. A terrace runs east and west along the full length of the property dividing it roughly into two fairly distinct soil types. The lower area of approximately 200 acres lying between the terrace and the road is light and very stony; the 300 acres above the terrace is fair to medium silt loam on shingle.

The whole farm has a northerly aspect.

Though Mr. Rands realise the detrimental effects of such cropping on the soil, he continued to grow wheat through the war years, until the average yield over 150 acres dropped from 19 bushels per acre. He then tried to maintain production by growing barley and peas for 2 years, but met with little success. Since then it has been fed regularly, being fenced in breaks to prevent over-grazing and, after several years of this type of treatment, the stand is still quite good.

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Use of Lupins

The basis for the improvement of the farm was the growing of lupins. These built up soil fertility and as a result newly-sown pastures had the vigour which ensured good establishment. Mr. Rands's practice is to sow 89lb. of lupins with a bushel of cocksfoot the fall in production. Others would take up the running in early December when the lucerne and cocksfoot made a good recovery. The paddock is then closed for the feed required during winter and spring. The paddock is then ploughed in early spring, summer fallowed, and sown to pasture about the end of January.

The fattening of lambs during the dry summer period always creates a serious problem on the light land. Mr. Rands soon realised that to increase carrying capacity he must prolong the growing season by the judicious use of the various high-producing pasture species. It was therefore decided to establish special-purpose pastures each fulfilling a definite role in the grazing programme. Some such pastures would take up lucerne and cocksfoot pasture about the end of January. Other paddocks were then carry on for varying periods until the ryegrass-subterranean clover paddocks came into production again. The feed supply would thus be maintained at a fairly steady level during the greater part of the year.

With this plan in view, Mr. Rands decided to sow down the whole of the lower area in such permanent pasture as would be not only resistant to grass-grub but would serve the main object—that of producing good grazing during early spring and summer. His reason for choosing the lower area of the farm for sowing down in permanent pasture was to avoid the high cost of frequent cultivation of stony land. In a few years he had 3 well-established paddocks of cocksfoot, perennial ryegrass, and subterranean clover. Each one was sown after a summer fallow following rape or turnips. One ton of lime was applied before sowing and a light of superphosphate was drilled with the seed. These areas have given consistent good production. In the recent provincial pasture competition the oldest area was placed first in its class.

The rate of seeding was cocksfoot 1lb., perennial ryegrass 16lb., and subterranean clover 3lb. A cocksfoot-lucerne pasture was laid down 4 years ago with 6lb. of cocksfoot, 1lb. of lucerne, and 1lb. of white clover per acre. Subterranean clover was not included as the pasture was spring sown. Drilled in on limed ground after harvest, a dense crop of self-sown lupins is available for winter feed. The lupin paddock is then ploughed and, in early spring, summer fallowed, and sown to pasture about the end of January.

As a cocksfoot-lucerne pasture was not successful. The area was summer fallowed and sown with cocksfoot (7lb.), lucerne (13lb.), subterranean clover (2lb.), and white clover (1lb.). The cocksfoot and subterranean clover dominated the pasture along with 6lb. of lucerne that failed to establish. However, the pasture is still a very useful one. One paddock is being fallowed preparatory to its being sown down to cocksfoot and lucerne pasture next autumn. The whole of this light stony area will then go in cocksfoot in association with lucerne. In some paddocks and subterranean clover in others. Growth in all these pastures is strong and vigorous, giving high production and maintaining growth in dry periods.

Special-purpose pastures

On the better land above the terrace some paddocks have been sown in short-rotation ryegrass and white clover, some in perennial ryegrass and white clover, and others in a mixture of perennial ryegrass-Montgomery red clover and white clover. Each of these pastures, together with those on the lower area, provides good grazing during various periods and all combine to maintain production at a high level throughout the greater part of the year.

Every care has been taken in the laying down of pastures. Thorough preparation of the seed-bed after a summer fallow, the sowing of appropriate pedigree seed, and subsequent controlled grazing have, in all cases, ensured good production. The short-rotation ryegrass-white clover pastures sown at the end of January produce well from April to September. During October, November, and early December the perennial
ryegrass-white clover pastures are at their best. From mid-December to March the Montgomery red clover paddocks, together with the cocksfoot-lucerne pastures, carry the stock well through this critical period. In addition to these pastures, which produce well in succession, the whole feed position can be changed and the whole economy of the farm upset. With this cocksfoot and lucerne and cocksfoot and subterranean clover pastures well established, Mr. Rands feels that he is well insured against such periods of acute feed shortage.

Mr. Rands's success in establishing the various pastures has been largely due to:
1. Growing lupins, usually two crops in succession, to build up fertility.
2. Summer fallow and careful preparation of the seed-bed.
3. Sowing of pedigree seed.
4. Controlled grazing, suited to the characteristics of the various species. (Topdressing then helps to maintain production.)

Lime and Fertiliser
One ton of lime is applied before final cultivation; then 1 ton is applied every fourth year or, alternatively, 4 tons yearly. When it is available, light superphosphate is applied, usually in February or March. A 7-ton roller has been used on all pastures to bury stones and consolidate the ground; its use has made top-p ping and haymaking possible and top-dressing easier.

Because of the attractive returns that have been received from growing small seeds in recent years, Mr. Rands has often been tempted to close some surplus feed to be utilised to advantage. Whenever necessary, pastures are grazed in breaks.

The ever-present possibility of grass-grub or porina attack is a serious concern of farmers, especially of those on light land. As a result of the ravages of grass-grub or porina, the whole feed position can be changed and the whole economy of the farm upset. With his cocksfoot and lucerne and cocksfoot and subterranean clover pastures well established, Mr. Rands feels that he is well insured against such periods of acute feed shortage.

Mr. Rands appreciates the value of small paddocks and has subdivided 9 of his larger ones. Heavy stocking for short periods is possible on these smaller areas. This facilitates effective control of grazing, the close of paddocks together with the autumn, provide good out-of-season grazing during winter.

The establishment of these special-purpose pastures has been the key to success. Carrying capacity partly depends on manure but doubtless and everywhere there is evidence of increased fertility.
result of exceptional growth, a total area of 110 acres of white clover, perennial ryegrass, and Montgomery red clover was harvested.

Stock
When Mr. Rands took over the farm in 1939 the carrying capacity was 400 half-bred ewes and dry sheep. By 1947 he had increased this to 1000 ewes but, on account of ill health, considered it wise to reduce his flock to 800 Romney cross breeding ewes and 200 dry sheep. Judging from the present feed position 1000 ewes would still cause no worry.

Mr. Rands changed over from half-breds to Romney cross ewes when better pastures had been established. He felt that with the Romney cross he would be better able to control his pastures, have a better lambing, and have lambs that would be more easily handled. Each year sufficient 2-tooth ewes are bought from hill country to replace the cast-for-age ewes, which are sold fat. Southdown rams are used. Half the total crop of lambs usually go away off the mothers by the end of January, averaging 33-35 lb. Owing to the fact that nor'-westers can soon alter the whole feed position, lambs are usually sold when prime rather than held on with a view to increasing their weights. It is not the practice to buy in lambs, though 400 were purchased last year and attended on surplus feed.

Realising that carrying capacity is governed by the amount of feed available during the summer period, Mr. Rands plans to have the minimum of stock on the farm at the driest time. To achieve this he arranged the lambing so that full advantage is taken of the high spring production to fatten lambs and cast-for-age ewes. This practice also enables him to get into good order the ewes he intends to put to the ram in early autumn. Approximately 200 of the older ewes lamb in June. Greenfeed (oats and lupins) is provided for these ewes in addition to the short-rotation ryegrass pasture, which is specially reserved, and a cocksfoot and subterranean clover paddock which has been nursed during the autumn for this purpose. Over a period of 4 years, including some bad winters, this practice has proved profitable.

The main flock starts to lamb late in July so it is possible to have the puk of the lambs off their mothers before production falls away with the dry weather. As lambing at the end of February, which is early, does not allow time for flushing ewes bought in autumn, 2-tooth ewes have latterly been added to the flock each year.

Though there have been periodic bouts of foot-rot, it has been found practicable by early treatment and isolation to keep infection to the minimum. No trouble is experienced with internal parasites, as the older sheep are a good improvement of every year and replaced by full-country sheep, pastures are kept clean, and lambs are handled very well. A hay crop is usually taken off the cocksfoot-lucerne paddock and the weak pasture are put on the aftermath, which provides a clean pasture year round. From the cocksfoot-lucerne paddock the lambs go on to rape. As they are in good condition by the time they go on to rape, a smaller area of the crop is required than would be the case when lambs lacked condition.

The 20 h.p. tractor used on the farm which was bought in 1938 is still working efficiently. A lighter one has recently purchased for use at rush periods, and in addition a power mower, tedder, and new 3-furrow plough have been added to the range of implements. Very often heading, toping, hay-making, and cultivation have to be done at the same time. The header is regarded as a very necessary part of the farm equipment.

The policy throughout has been to pay for all equipment and improvements out of revenue. Mr. Rands has erected 70 chains of fencing, planted and fenced 30 chains of shelter belts, built a hay shed, and improved his dip yards.

Crutching, shearing, lime spreading, hay baling, and carting of hay to the shed is done by contract. During the war years a boy was employed. Help for seasonal work is secured as required.

Mr. Rands intends to lay down a stand of 30 acres of lucerne next autumn, but he has not yet decided hay for 1000 ewes. He also intends to sow down another cocksfoot-lucerne area in the autumn and is considering the establishment of an area of Phalaris tuberosa for winter greenfeed.

The main flock is being well farmed. A few years ago soil fertility was depleted to such an extent that the growing of white crops was no longer payable and stock-carrying capacity was poor. To-day the fertility of the soil has been restored. Legumes for use as a green feed.

There is no doubt that this property is being well farmed. A few years ago soil fertility was depleted to such an extent that the growing of white crops was no longer payable and stock-carrying capacity was poor. To-day the fertility of the soil has been restored. Legumes for use as a green feed.