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The Making of New Grassland

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A. R. Mcdougal

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ewes, which have had access since harvest to fifty acres of new-sown grass, together with old pasture, are really too fat for successful lambing, with no additional food.

Needless to say, anyone wishing to inspect my grass will be welcome to do so. In conclusion, I would urge a more liberal use of current possibilities as they come along. A few years ago it was good slag. To-day it is cheap nitrogen. To-morrow it will—we hope—be something else to continue the accommodating circle. Extension and stimulation of wild white clover, whilst being good for the individual farmer, carries also an advantage to the nation's real wealth, in that huge stores of nitrogen are assured ready for use in more normal times, or in a national emergency. We do not realize sufficiently that under all old rich pasture there exists more latent than potent fertility. It should be our business, and profit, to cash more of this annually without diminishing the source. Grass that grows in winter can look after itself in summer.

THE MAKING OF NEW GRASSLAND

BY CAPTAIN ARTHUR R. McDOUGAL

Blythe, Lauder

IN 1901 I took over the tenancy of my present farm from my father's trustees. It consisted of about 1000 acres of high, poor arable land, along with a big area of moorland grazings. The arable land had all been reclaimed, out of heather, bog, birch, scrub and bracken, by my father, from 1852 onwards. He had a twenty-six years' lease, and under its security he reclaimed this 1000 acres and made it arable land, and built a steading, and ten cottages, etc., all as a tenant. This was typical of hundreds of others—our forefathers—whose optimism, fanned by high grain prices, led them to drive the plough in Lammermuir higher than anywhere else in the country, right up to the 1200 foot mark in the case of my father.

It was cropped on the five-shift rotation for one or two rotations; then as prices fell, and the virgin turf which was its only wealth was exhausted, it was sown out with the old-fashioned ryegrass mixture and left. The lower areas were retained under regular crop, but the higher and poorer areas were left to revert slowly to *Agrostis* and *Bent*. The problem is to reconvert this into good modern pasture. It had all been drained, and had got about 5 to 6 tons of shell lime per acre. It all lay at an elevation of from 700 feet to 1200 feet. The soil varies from sharp slaty land to stiff blue clay, with peat on top, and it is all very stony.

At the time I took it over we had twelve work horses, and sold

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some grain annually. So my position in 1901 was that I was faced with this 1000 acres of so-called arable land, with 240 acres of oats, 120 acres of turnips, and approximately 640 acres of inferior temporary pasture, which had been of course sown out in the fashion of those days, with a bushel of perennial ryegrass, half-a-bushel of Italian and a few clovers—English red, white and alsike. It kept $1\frac{1}{2}$ twins per acre as young grass, barely one twin per acre at second year's grass, and after that about one single per acre was its limit. These figures refer to half-bred ewes and lambs. After mid-June there was no bottom in the pasture and little but a forest of ryegrass windlestrae. My problem was to produce the maximum number of lambs for sale of as good quality as possible, and clearly the output could be greatly increased if I could only improve the pasture. It is to be clearly understood that my opinions and experience are definitely limited to this high Lammermuir land. I am too well aware of the great differences in land, climate and methods of stocking and types of pasture desired to say this or that is the best grass or mixture for everyone. Every farmer ought to carry out simple experiments on his own farm to find out what suits him. A simple experiment is described later, which I sowed for many years, in almost every field.

I attacked the problem on three main lines, experimentally:

- (a) By top-dressing some of the worst deteriorated pastures with manures and lime.
- (b) By special stocking with cattle to eradicate or check *Agrostis*, and mowing rough bits in the better pastures.
- (c) By plowing out the bad fields, and by lessening the ryegrass in the mixtures and increasing the natural grasses.

After thirty years' experiments I have never seen any advantage from top-dressing pastures on my farm with phosphates and potash, and my experience in this respect is fairly general all through Lammermuir.

The results from liming were more encouraging, and several times I could see very distinct results from it.

On the whole, results from top-dressing have been so disappointing that I have given up the idea of improving pasture in this way. I have come to the conclusion that, in my experience, on the particular land I have to deal with, heavy doses of phosphate and lime on the turnip crop are very beneficial to the following pasture.

A typical mixture for my turnip crop is either 1 ton 34 per cent. slag plus 1 cwt. nitrate of soda, or 8 to 10 cwt. 65 per cent. mineral phosphate plus 4 cwt. superphosphate plus 1 cwt. sulphate of ammonia. This ensures as good a turnip crop as may be, and leaves plenty over for the following grass.

A neighbour top-dresses his seeds with slag after the corn is led. I have not tried this, and it is possible that top-dressing then may be more effective than on an older pasture.

Most of my experiments with top-dressing pasture have been done

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on old deteriorated pastures and were mostly failures. I am inclined to think that perhaps when one has a good pasture it could be kept good for an indefinite, or at any rate a much longer, time by top-dressing with phosphates, etc.

However, I am in favour of getting the pasture first by resowing and utilizing the old turf as manure, and then, if desired, top-dressing may be effective in some cases. I have tried manuring with nitro-chalk and sulphate of ammonia for an early bite, but it too was a failure.

As the old temporary pastures got older they were overrun with *Agrostis*, and I found that lack of lime favoured the *Agrostis*, and that liming in sufficient quantity will overcome it. Nothing is any use unless the ground is sufficiently drained. *Agrostis* will appear on poorly drained land within two years of sowing down.

As regards (b) I found that by heavy stocking with Galloways or West Highland cattle just before the *Agrostis* came away in summer, and by wintering these on the bad fields, we very greatly diminished the *Agrostis* and encouraged the white clover, etc., and improved the pasture.

I have found that the cutting with the reaper of a grazing that had got too rough in June or July always made a great and lasting improvement, and one could see the places that had been cut for two or three years after. They were better grazed and the wild white clover had increased greatly in them.

My experience with this has mostly been with better pastures, and not on the most inferior. The only drawback to it is that the job should be done when one is fully employed with hay, turnips, singling and clipping, so that it is very difficult to get it done. I have not tried surface cultivation as my land is so stony, and the turf mat is not thick.

(c) *Improved Seeds Mixtures*.—In 1919 I obtained a very long lease and I went right ahead ploughing out all the worst pastures, manuring the turnip plots heavily with phosphates, liming where necessary and sowing out with the best possible mixtures that my experiments¹ had suggested to me.

About 1923 I reduced my horse strength to eight work horses, cropping 60 acres turnips, 80 to 120 acres oats, and the rest (840 acres) in pasture of various ages. I had expected to employ fewer men, but I saw that in order to benefit properly from the changed rotation many improvements were necessary. I have been steadily executing improvements since the war, such as roads, drains, water-supply, sheds, dipper, alterations to steading, liming, etc., so that I am still employing as many men as I did when I had twelve horses—that is, I have put off two pairs, but am employing two extra men who keep the work always well forward, and when any slack occurs we get on with improvements.

My present position now is that I have ploughed up and resown as much of the land over 1000 feet as I thought could be profitably done,

¹ *Scottish Journal of Agriculture*, January 1919 and April 1925.

and have handed about 400 acres of it over to the Blackface sheep hirsels, whose numbers have been increased, and I still keep the same number of half-bred ewes on the land under 1000 feet that I did when they had the extra 400 acres. They have about 440 acres temporary pasture plus 200 acres permanent pasture. I let my temporary pasture lie always four years, and as much longer as possible, and I regret having to plough up good pasture at five or six years old. It may lie ten to fifteen years before reploughing. To avoid this, and to reduce the grain crop as far as possible, I take turnips off lea where the land is sharp and light, making the rotation—turnips, oats, turnips, oats and seeds. Where the land is stiff, and turnips off lea impossible, I sometimes take rape off the lea, sowing 6 lb. plus 10 lb. Italian ryegrass, following with turnips, oats and seeds. In other cases I take oats, turnips, oats, turnips, oats and seeds.

I find that the heavy manuring (quite double my pre-war standard) plus the lime, and the excellent pasture we have, has resulted in the rather astonishing fact that, I estimate, I am growing almost as big a tonnage of turnips on the 60 acres now as I did on the 100 to 120 acres before, and my yield of oats per acre has increased by at least one-quarter per acre.

This result is also partly attributable to my working a smaller break with the same staff, so that we are always in time and on top of the work. As an instance of the advantage of renovated pasture the case of a sixty-acre field at 1000 feet that I handed over to the Blackfaces in its third year is interesting. They got it in late summer and a big lot were tupped on it and another field. The result was that we had 100 pairs of twins more next year on that hirsels than we ever had before. The extra lambs alone for that year would go far to pay for cost of seed.

Last year I ploughed out a field at 1000 feet which had lain since 1833. I had turves analysed, and it consisted of 98 per cent. *Agrostis* and was almost worthless. It kept 2 ewes or hoggs per acre. I have given it $2\frac{1}{2}$ tons Billingham lime per acre, and sowed it with rape and Italian ryegrass last year. We had an enormous crop, and it is now ploughed for turnips this year. We have drained parts of it and I am confident that in a couple of years or so it will be beautiful pasture, carrying $2\frac{1}{2}$ twins per acre and good for ten years in diminishing ratio. This old land is absolutely clean, and grows enormous turnip crops, and as long as one rests it long enough it will do so. Its wealth lies in the old rotting turf, and it should be sown down to lie and regain a turf before it is ploughed up again. I expect to convert pasture worth 10s. per acre into young grass worth £4 or £5 per acre, diminishing gradually to, say, 20s. in ten years. We graze our young grass always, and take hay off our older fields. The young grass is worth far more for grazing than for hay.

I also have drained, limed and reclaimed a small field which was

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simply a useless water-logged bog. This I sowed out in 1920, and it carried last year over 2 twins per acre. I consider it has repaid me handsomely.

The ninety-three-year-old field above will cost over £8 per acre for seeds, lime and manure alone, but the crops during the rotation mostly pay their way, and the better grass after is real profit. This gives some idea of the cost and value of good pasture.

As regards seeds to sow. A very great deal depends on strain, and it is encouraging to see seedsmen devoting attention to that now. I never care to sow less than about 20,000,000 seeds per acre, and am inclined to think that the mixtures advocated by colleges, etc., are too thin. Of course on good land it is all right, but on poor, rough, high land the survival ratio is sometimes very low. My mixture depends on comparative prices, but the main idea of it is:

- (1) Cut down the ryegrass, as its only merit is that it is sure to grow, but pretty useless as pasture plants.
- (2) Cocksfoot is the staple grass of the mixture.
- (3) Late-flowering red clover is absolutely the most important plant for the first two years.
- (4) Wild white clover is the backbone of the pasture in its later years.

Ordinary red clover is absolutely worthless in Lammermuir, and it was very difficult, in fact impossible, a few years ago to be sure of getting the real late red. However, it is now possible to get it; but one must be careful. Certified Montgomery and Cornish Marl are all right, and if one knows a grower one can get it privately from other counties. Mine comes from Essex and is true to strain. It was not till 1913 that I fully proved to myself the great virtues of late red clover.

Wild white is so well known that no remark is necessary. Personally, I consider late red a better plant in every way, and if we could only get it perennial we would be in luck indeed.

The real New Zealand white is a bigger and better plant than the Kent. I have a nine-year-old field sown with New Zealand ordinary white which has been, and is, as good a white clover field as ever I had. In 1921 it was called New Zealand ordinary, and I daresay it was wild white I got. Now it is mostly called wild white, and some of that is very ordinary. The right strain has done well here.

Cocksfoot is the best grass we have, and is the backbone of the mixture here. I sow about 15 lb., and have sown up to 25 lb. It is very palatable to sheep.

Cocksfoot and tall fescue are the best weed-suppressors I know. In the pure plots, of all ages, the tall fescue plot is the one which never has a weed in it; no *Holcus*, *Agrostis*, or other vile grass dare grow there.

The palatability of late fescue is in doubt, but I think this is due

to its earliness. It comes away first after cutting and is too old by the time the field is stocked. If stocked early, sheep eat it all right, but if the pure plots were stocked late the tall fescue was never touched.

Last year I sowed a field with 15 lb. tall fescue and 15 lb. cocksfoot, amongst others, with a view to letting it lie six or seven years, and suppressing the couch-grass which is in the field. In a trial on a particularly bad piece of sticky blue clay tall fescue was the best survivor, followed by timothy, cocksfoot and wild red clover. Tall fescue was far the best, and stood out strongly at seven years old when the field was ploughed.

Among the less well-known grasses meadow-foxtail is the best—in fact it is one of our best grasses, but the only seed one can buy is Finnish foxtail, and it is a useless weed. I saved a lot of hand-gathered indigenous foxtail from the roadside one year, and sowed it out in pure strip against Finnish foxtail and other grasses. It was a beautiful strip, whilst the Finnish one was very bad. It is much to be desired that our seedsmen should take up indigenous foxtail. A stock of my foxtail is at the Scotch Plant-breeding Station now.

As regards the merits of Danish, Swedish and New Zealand cocksfoot, my experience in practice is that the Swedish and New Zealand are not worth the extra price. I have sown them in strips, and whilst they were certainly different plants I could not say that one was better than the other. The Danish is the earlier, and that is an advantage, as we want earlier grass. I think that the Danish plant has deteriorated since 1914, and is now seedier and less leafy. The liability of strains of cocksfoot to winterburn here is that Danish is worst, Swedish fair and New Zealand very good, and not liable to burn badly.

As regard crested dog's-tail, it is a poor affair, but better than *Agrostis*, and I find that on poor land the crested dog's-tail appears to be able to squeeze out the *Agrostis*, so it has a use on *Agrostis* land.

I habitually sow yarrow, and am convinced it is a useful plant, though I note that it is classed in the Ministry's *Journal* as a weed.

Perennial ryegrass is in many respects a useless weed here. Its merit is that it will grow the first year, so I sow it solely to act as an insurance against the failure of better natural grasses. I have sown strips of the indigenous ryegrass experimentally, but as far as I observed it was no better pasture than the ordinary, although it was later and a different plant. Ryegrass is disliked by sheep.

The indigenous ryegrass I tried out was, I think, seed saved from the cleaning of wild white clover. It lay for five years before ploughing up, and was carefully observed all the time, along with two ordinary commercial ryegrass strips alongside. The strips were grazed with sheep mostly. Wherever perennial ryegrass is mentioned I mean the commercial strain, unless otherwise stated.

Poa trivialis grows very badly alone, but in mixture it is a very

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good grass, and grows well and strongly, though a small producer. It is a good bottom grass.

I found that meadow-fescue was the best bottom grass and could by itself, pure, make a bottom. When price is reasonable I sow 10 lb. per acre or so. It thrives well here at 1000 feet. The outstanding things I considered in my thirty years' investigations were:

1. Identification of grasses.
2. Palatability of grasses.
3. Productivity of grasses.
4. Longevity and hardihood of grasses.
5. Earliness of grasses.
6. Bottoming qualities.

There is one simple experiment, fully described in my article in the *Scottish Journal of Agriculture* for April 1925, which every farmer wishing more information should make in every field. It is simply to sow strips of pure grasses about five yards wide and twenty yards long into the field and to sow pure clover strips across these. Fence off one half of the grasses and leave the other half for grazing; or, preferably, duplicate the plots and graze one and fence the other. This experiment will give one information as to all the points named above, but one must remember that many grasses, and *Poa trivialis* in particular, thrive better in mixture than by themselves.

The general result of the temporary pastures I have made here—about 800 acres in all—is that I have increased my sheep output greatly, and increased the yield of other crops per acre.

I consume all my own grain at home, and buy anything up to 90 tons of cake and feeding-stuffs per annum as well.

I have looked on cattle as a necessary evil to graze rough fields and to break down one's straw, and have not bothered to keep more than could easily be handled.

I have looked on labour in the light that the more labour one employed the more one prospered, and similarly with manures, drains and improvements.

In brief, my experience has been that the best, cheapest in the long run, and most effective way to improve poor arable land pastures is to plough them out, treat them well during the rotation, and sow down with good seeds, avoiding ryegrass. It also is a sound paying position.

[Herewith

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Herewith are some mixtures I have been sowing, amongst others :

<i>Mixtures in lb.</i>				
	<i>a</i>	<i>b</i>	<i>c</i>	
Perennial Ryegrass, Ayr	4	8	8	
Italian Ryegrass, French	2	3	3	
Cocksfoot, Danish	15	15	15	
Tall Fescue, Dutch	15	
Meadow-Fescue, American	6	6	10	
Timothy, American	3	6	6	
Poa trivialis, Danish	2	3	$\frac{1}{4}$	
Crested Dog's-tail, Irish	1	$\frac{1}{4}$	$\frac{1}{8}$	
Yarrow, Dutch	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{8}$	
Late Red Clover, Essex	4	5	5	
Late Red Clover, Montgomery	1	
Alsike, Canadian	1	1	1	
White Clover, New Zealand (ordinary)	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	
Wild White, Kent	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	
Wild White, Essex	$\frac{1}{2}$	$\frac{1}{2}$..	
Sweet Vernal, Dutch	1	..	
Poa pratensis, American	$\frac{1}{4}$	
	<hr style="width: 100%;"/>	<hr style="width: 100%;"/>	<hr style="width: 100%;"/>	
	<u>55$\frac{3}{4}$</u>	<u>50</u>	<u>49$\frac{3}{4}$</u>	

On the better fields at lower elevations these temporary pastures stabilize into good permanent pasture at about five or six years old, and continue without deterioration indefinitely, according to treatment. Laying down turnips on them in winter and box-feeding sheep on them helps, and manuring and haying also keeps them good. I hayed one field continuously for ten years, and its botanical composition varied little from its original. It was manured every year. The fields over 1000 feet are thinner and poorer and more acid, and deteriorate steadily up to about ten years, when they stabilize for a long time at a level considerably above the original. Whether regular manuring would prevent this deterioration I do not know. I think the limiting factors are (1) the continual sheep-grazing, (2) thinness of the soil and (3) want of lime. However, the winter grazing with sheep is hard on cocksfoot (and better grasses), and I find plenty of cocksfoot plants eaten out to the heart, and some pulled right up by the Blackface sheep in winter.

On the lower fields under 1000 feet, and stocked by half-bred sheep, the grass gets a rest for three months every spring, which helps greatly. The sheep is a highly selective grazer, which is bad for pastures. I have failed to get good pasture to remain more than a year or two on muirband, with peat over it, or on clay with peat over it. The failure is, I think, due to three causes in varying degree—viz.

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- (1) Deficiency in lime. The requirement on one peat experiment was 6 tons shell lime on land that had received 6 tons sixty years ago;
- (2) Bad aeration of subsoil;
- (3) Water-logging, owing to impervious pan of muirband clay. These always reverted to *Agrostis*.

I have found barley the best nurse crop, strong-strawed Tartarian type oats next, but rape a bad nurse crop. With all the care in the world the fate of the pasture depends a great deal on the weather for eight weeks after sowing. There are vintage years for pastures as well as wine, and one has had disappointing takes due solely to bad after-sowing weather.

Turning now to the system of management. The whole of the cultivation is primarily to produce winter keep for the sheep stock. The grass is grazed from lambing time onwards till spaneing time, and the sale of the ewes and lambs. The twins all get extra box-feed, being mostly run off their mothers for it. The young grass, if the late red is good, can keep $2\frac{1}{2}$ twins per acre, and the older grasses in diminishing ratio. The late red is very good mostly for two years, and thereafter a sporadic sprinkling of plants remains, and the wild white takes its place. On the better land the cocksfoot persists indefinitely, but on the worse land it disappears considerably.

The problem one has is that the best grazing fields are the best croppers also, and yet one wishes to plough up the bad grass to renovate it. One has to compromise in this, for one cannot get, by any economic process, really good permanent pasture on the poorer land, but by lifting at longish intervals one does get a vastly better pasture that pays its way. However, I have given up one field as hopeless—a blue sticky clay with little soil at all.

As far as I can form an opinion, the proper course for the future is for farmers on the poorer land to improve their pastures. There are plenty of reasons for pasture, but none for bad pasture. The better-land farmers should change part of their grain crop to silage and go in for intensive stock arable farming.

We are yearly adding greatly to our technical knowledge, thanks to Professor Stapledon and others.

In answer to the query as to what is the line of research most likely to be beneficial I would without reservation say that it is that of *developing our own indigenous grasses*.

I am convinced that in the wild strains of the natural grasses we have far better pasture plants than we can at present buy from the seedsmen. The timothy varieties isolated at the Scotch Plant-breeding Station are extraordinary examples of what I mean.

If the farmer who is willing to pay the extra cost, as many are, could buy definite strains of natural grasses, as one buys different kinds of oats, etc., and be sure of their genuineness, it would mark a great

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step towards better pastures on our inferior lands. Timothy, cocksfoot, foxtail, ryegrass, permanent late red clover, etc., are all types that exist wild, and are better grazing plants than the cultivated ones. One gets permanent red amongst the late red. Personally, if I had a drier climate, I would grow much of my own seed, but our high rainfall makes it very difficult.

I have twice saved my own cocksfoot seed, and have now a seven-year-old pasture sown with home-saved cocksfoot which is very good. The seed was from a field sown in 1914 with New Zealand cocksfoot, and the present cocksfoot in it is very permanent-looking, and is a nice leafy type. I have more hope of good results from selected strains from old pastures than from artificially cross-bred plants. Of course different districts would require different strains, and I imagine that as many strains of a grass would be required as there are strains of sheep, to suit different localities.

Here then is a very wide field for research. A good deal has been done already by enterprising seedsmen and farmers, and by Research Stations, such as Aberystwyth and the Scotch Station. Professor Stapledon's work seems to run on very useful and practical lines. We are fortunate in having many public-spirited and enterprising seedsmen who are doing good work in producing and marketing selected strains, and who can be relied on not to ruin a good plant, as has been done in the past. Much has been done, but far more remains to do, as the selection of indigenous strains is still in its infancy.

When one compares the pastures of twenty years ago with now one sees a great advance. The good land seems about as good as one can hope for, and it is in plants suitable for inferior land that the room for research lies.

Manurial and cultivation matters seem to be about fully elucidated, and the remaining weak link is the plant itself, and its suitability for the different areas and jobs.

LEAFY INDIGENOUS STRAINS OF GRASSES

BY M. JONES

Imperial Chemical Industries

THE need of securing high production from grassland over a number of years is bound up with the nutritive value of the produce and the persistency of the plants. The recent work on the nutritive value of leaf and of stem in plants has shown that leaf is far richer than stem in the useful constituents. It therefore behoves us to consider leafiness as well as persistency in our pasture plants, but luckily the two factors