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PRINCIPAL CONTENTS.

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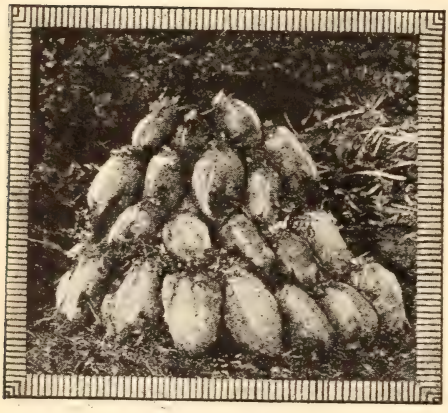

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THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXVIII. No. 5.

AUGUST, 1921.

NOTES FOR THE MONTH.

Corn Production Acts (Repeal) Bill.

At the time of going to press, this Bill has passed the Third Reading Stage in the House of Commons. Further amendments may be introduced in the House of Lords. The Bill as it stands at present provides (a) for the repeal as from 1st October, 1921, of the Corn Production Acts, 1917 and 1920, (b) for the payment in respect of wheat and oats produced in 1921 of grants of £3 per acre in the case of wheat and £4 per acre in the case of oats, and (c) for the payment of a sum of £1,000,000 to be devoted to the promotion of agricultural education and research, of which £850,000 is to be applied in England and Wales and the balance in Scotland.

The repeal of the Corn Production Acts involves the abolition of the Agricultural Wages Board and of the District Wages Committees, together with the existing machinery for fixing a minimum wage for agricultural labour. In place of the existing arrangements, it is proposed to establish voluntary Joint Conciliation Committees composed of representatives of both employers and workmen for the purpose of dealing with wages, hours and conditions of employment. In order that there may be no interval between the cessation of the Agricultural Wages Board machinery and the establishment of the new Conciliation Committees, the Bill provides that the representatives of employers and workmen on the existing District Wages Committees shall in the first instance act as joint conciliation committees in their respective districts. The members of the joint conciliation committees will consist solely of representatives appointed by the employers and employed. The committees may appoint an independent person to act as chairman, with or without a vote as the Committee may decide, or may agree to such appointment being made by any Government Department or other body.

(38106) P6/198. 11,250. 7/21. M. & S.

When any one of these committees has agreed upon a rate of wages for any class of persons employed in agriculture, the agreement may be submitted to the Minister for confirmation. When confirmed, the particulars are to be advertised in the district in order to bring the terms of the agreement to the knowledge of the persons affected. Where a rate of wages has been so agreed, confirmed and advertised, it then becomes an implied term of every contract for employment that the employer shall pay to the workman wages at not less than the rate payable under the agreement, and such contract will be enforceable at law. Where in any proceedings for the recovery of sums due under any such contract it is proved that on account of special circumstances affecting the workman, the employer and workman have agreed to a lower rate of wages, the court may determine that the wages shall be recoverable at the agreed rate or at any rate the court may think fair and reasonable.

In order to assist the agricultural industry to form district conciliation committees on the termination of the Agricultural Wages Board, the Minister of Agriculture and Fisheries has set up a special temporary branch of the Ministry to deal with the matter. Mr. H. J. Wilson, C.B., of the Ministry of Labour, whose services have been lent by the Minister of Labour, has been placed in charge of it.

* * * * * *

Minimum Prices of Wheat and Oats.

REPRESENTATIONS having been made that the time allowed to growers of wheat and oats in which to make their claims under the Corn Production Acts was too short, the Ministry announced on 28th June that claims might be made up to 18th July, but that no further extension of time beyond that date would be granted. No claim can now be received unless the claimant can show that he became the occupier of the land to which the claim relates after 30th June, in which case a claim will be accepted up to 1st September next.

The total number of claims received up to 18th July is approximately 160,000. These have been sent to the County Agricultural Committees, whose officers are engaged in testing their accuracy: special attention is being given to those cases where there is reason to suspect that the land has been negligently cultivated. The work of inspection is being proceeded with rapidly, but in view of the fact that a very large proportion of the claims were not made until July, the work cannot be completed for some weeks.

The Corn Production Acts (Repeal) Bill proposes that the amount payable in respect of this year's crops of wheat and oats shall be £3 and £4 per acre, respectively, and that payment shall be made on 1st January, 1922, or about four months earlier than would be possible if the Corn Production Acts remained in force.

* * * * * *

Corky Scab of Potatoes.

THE Ministry has noted with regret the large number of cases where seed potatoes affected with Corky Scab (*Spongospora subterranea*) have been sold for planting, and in answer to various inquiries has considered the renewal of the Corky Scab Order which was suspended during the War. The whole position has been examined, but in view of the following facts the Ministry feels that it is at present undesirable to revive the Order.

(1) The risk of large new areas becoming infected appears to be slight. From the Plant Disease Survey organised by the Ministry it is clear that Corky Scab may in certain seasons occur in almost every county. Whilst, therefore, it is always inadvisable to plant diseased seed, there are no large tracts of country, at present clean, which would become infected if such seed were used.

(2) The intensity of the disease appears to be largely a matter of seasonal conditions. The Survey shows that during 1920 Corky Scab was very much more prevalent than usual, and in many of the northern counties it occurred in a particularly severe form. Many soils which in normal years give a clean crop, produced last season tubers badly affected with Corky Scab. On the other hand, badly diseased seed may sometimes be planted and an entirely clean crop result. Although it has not been proved by actual experiment, it appears likely that the conditions leading to severe attacks are a cool soil-temperature and a plentiful supply of soil-moisture during the growing season. Excess of lime also is well known to accentuate attack.

(3) There is great difficulty in the administration of the Corky Scab Order. The disease is not always easy to recognise with certainty, even by experts. In inspecting consignments of seed, slight infections would be easily overlooked, and, owing to the similarity of mild cases to attacks of Common or Brown Scab, examination with the microscope is often necessary. This would entail an increase in the number of inspectors and involve extra expense.

For the present, therefore, the Ministry, although deprecating the use of seriously scabbed tubers for seed purposes, feels that the gain which would be derived by the Order would not justify the additional expense. Purchasers are accordingly advised to examine for themselves the seed supplied and reject all that is extensively or seriously diseased.

* * * * * *

National Institute of Agricultural Botany Yield Trials.

ONE of the most urgent needs of modern argiculture is the provision of a system by which the value of new varieties and strains of farm plants may be ascertained before their general distribution.

The National Institute of Agricultural Botany, organised with the object of improving the seed supply of the United Kingdom, is now making arrangements to conduct a comprehensive series of yield and "quality" trials of cereals (wheat, oats and barley) to commence during the season 1921-22. The trials will be carried out on a uniform and scientific system in several parts of the country, and final reports, on which the granting of certificates of merit will be based, will be issued after the harvest of 1924. The trials will be open to all who can show that they have in their exclusive possession new or improved varieties or strains of any of the above cereals, and who undertake to refrain from placing them on the market before the issue of the final report on their merits, except with the consent of the Institute.

The testing fee will be limited to the actual cost of the trial, which will be determined at the time of the issue of the final report.

At the conclusion of the trials, the whole of the seed will be returned to its owner unless the Institute shall consent to take over the stock on terms to be mutually agreed.

All those interested are requested to apply at an early date to the Secretary, National Institute of Agricultural Botany, Huntingdon Road, Cambridge, from whom full particulars may be obtained.

* * * * * *

Autumn Cleaning of Weedy Land.

FARMERS do not want weeds, but weeds will grow in spite of him, and even on occasion unknown to him, with the result that he may fail to recognise their presence until they are in full bloom. When this is the case it is likely to be too late to deal with them without considerable expenditure of time and labour.

There is usually a period between the harvesting of one crop and the planting of another during which a war of extermination against weeds may be waged. This year the drought, however lamentable in other ways, should afford special assistance in such a campaign. The hot, dry weather has had the effect of ripening cereal crops earlier than usual, and the interval between harvesting and planting will, therefore be extended.

Full advantage should be taken of this longer interval to clean the land thoroughly. Ploughing, not too deep, or scarifying should follow close behind the reapers, and if a good tilth can be prepared weed seeds will be encouraged to sprout. Directly this takes place (and the rain, when it comes, will be likely to induce rapid germination) the seedlings can be attacked in the mass with cultivators and harrows. Ploughed in, the young weeds will do some good as green manure. Though, in the war on weeds, actual extermination by cultural methods is hardly possible, still, thorough attention while the land is unsown will go far to reduce the amount of horse-hoeing and hand-hoeing required in the future.

Weeds such as couch, field bindweed and creeping thistle, which spread by means of underground runners, naturally require different treatment from weeds which only live for a year. Regarding such, or indeed any weeds, farmers might find it useful to consult their County Agricultural Organisers, whose names and addresses are given in the Ministry's Leaflet No. 279. In all cases, the main effort should be to prevent weeds from growing at all; it is much more expensive to deal with them when they become established than to keep them down season by season. One of the first conditions for clean crops is the use of clean seed.

* * * * * *

Home-grown Wheat Prices, 1920 Crop.

In the May issue of this *Journal*, particulars were given of the arrangements made as regards home-grown wheat prices of the 1920 crop, and in the issue for July, it was stated that for the month of July the average price properly receivable by growers was 82s. per 504 lb.

The Ministry is now informed that the Royal Commission on wheat supplies calculate that the cost of wheat imported during May, June and July is equivalent to 80s. per qr. of 504 lb. for home-grown wheat of sound milling quality. Until 13th August, therefore, the average price properly receivable by growers for home-grown wheat of sound milling quality of the 1920 crop

will be 80s. per 504 lb. *Farmers are reminded that the arrangements as regards British wheat of the* 1920 *crop come to an end on* 13*th August.*

Taking into account the value of imported wheats of comparable quality on the open market, it is estimated that no refund to millers will be required to ensure on average the receipt of the above price by the grower. The Board of Trade, therefore, will pay no refund in respect of any home-grown wheat, ground after 31st July. Millers are reminded that the undertaking referred to relates solely to wheat of the 1920 crop. Growers who sold their wheat between the 8th November, 1920, and 5th March, 1921, and who have not yet made their claims under the schemes for the fulfilment of the Government's undertaking in regard to the price to be obtained for wheat of the 1920 crop, must make their claims on the prescribed form not later than the 13th August. Claims in respect of wheat sold direct to a miller must be transmitted to the miller for certification, and those relating to wheat sold to a merchant must be certified by the merchant and transmitted by the growers to the local wheat panel not later than the 13th August.

* * * * * *

American Gooseberry Mildew.

As it appears that some misunderstanding still exists as to the present regulations with regard to American Gooseberry Mildew, the following summary of the effect of the Orders now in operation has been prepared for the information of growers and dealers :—

(1) Outbreaks or suspected outbreaks of American Gooseberry Mildew occurring on premises on which gooseberry or currant bushes are grown for sale must be reported to the Ministry. Outbreaks on other premises need not be reported, but the Ministry will be happy to give advice to any grower as to the measures which should be taken for the control of this disease.

(2) Gooseberry bushes affected with American Gooseberry Mildew may not be sold or moved from any premises until all visible traces of the disease have been removed.

(3) There are no restrictions on the sale in England or Wales of any gooseberries (fruit) grown in this country. Berries affected with American Gooseberry Mildew may not, however, be sent to Scotland except under licence from the Board of Agriculture for Scotland.

THE EDUCATION OF THE FARM WORKER.

W. R. SMITH, M.P.

"The present generation would indeed be surprised if they could foresee what science and brains will do for agriculture in the next half-century.

THIS quotation from an official report seems to be so reasonable a statement that I use it as a peg on which to hang all I have to say in this paper on the very difficult subject of education. It is obvious that the vast changes and developments prophesied in the above quotation will mean that agricultural workers will in many respects be different in the future from what they have been in the past. Whatever viewpoint we may have, most of those connected in any way with agriculture want to see the workers on the land as keen, as alert, and as educated as is possible.

If we use the phrase "education of the workers" in its widest sense, the subject will fall naturally into two divisions. There is, firstly, what is usually described as technical education; and secondly, what we may call social education.

I do not think this matter can be usefully discussed unless we are prepared with an answer to what seems an elementary, though important, question: What object is to be pursued in the education of boys and girls? Let me say at once that I do not subscribe to the view widely held that education is merely for the purpose of enabling the workers to keep pace with industrial developments, and to respond efficiently to the increasing demands made on their intelligence by modern organised production. I believe that the workers have a right to culture as such. They should be free to enlarge their minds, and to fit themselves to enjoy the deep happiness hidden away in books, in music, and in art. It is this conception of the function of education that leads me to make my strongest objection to elementary education as we know it to-day.

It imparts a varying quantity of facts, and gives the scholars some idea how to read and write. *It seldom implants in their hearts a real eagerness to know more.* At an age which should coincide with a crucial period in an educational course, the average rural (and town) child leaves, and is "done with schooling." There is no hunger for more knowledge. The books are laid away, and the child turns to "the more serious business of contributing to the family income."

With a "system" of education which stops short at such results we cannot possibly be satisfied; and those who have the interests of child life at heart must work, in season and out of season, to secure for the workers' children some real education during at least those most important years between fourteen and eighteen, when so many wonderful secrets of life begin to reveal themselves.

I have said that education is a difficult subject to discuss. It is difficult because it has become depressing. In the campaign for economy which has been going on in every quarter, one of the first fields for retrenchment has been that of education. The Education Act of 1918 aroused great hopes; but now we find that all schemes for continuation education not already in operation are indefinitely suspended. Even the county agricultural committees, which by arrangement may take over certain duties hitherto performed by the education committees, have been told by the Minister that "while the last thing in which he wished economy to take place was education," he was obliged to ask them to spend less. The worst economy of all is the attempt to save money on the teachers.

It is with this question of the teachers that we get near the heart of the matter. In the *Farmers' Union Year Book, 1921*, it was declared that "It is unsound to have our rural schools indifferent copies of our urban schools. They must find their inspiration from their rural surroundings and instil a real love of the country and of nature." In short, the schools should have a life and power of their own. Yet how can we expect this when we realise the inadequate provision made for teaching in rural areas? I yield to no one in my admiration of the rural teachers' heroic struggle under adverse conditions, but they, I am sure, will be the first to agree that great reforms are necessary. The disparity between the salaries in rural areas and those paid in towns is too great, with the result that the towns attract the best teachers. This does not, of course, mean that no good teachers find their way into the country. The headships of country schools often attract assistant masters from urban areas. The difficulty is that the county councils, which control the country schools, often have a large number of schools under their charge, and are therefore subject to the strong temptation of having cheap supplementary teachers. Although most head teachers in country schools of seventy to eighty children are certificated, the standard is satisfied very often with either an additional uncertificated teacher or supplementary teacher, or both. The number of teachers

employed by county councils in rural schools is about 50,000, and this number includes 10,926 supplementary teachers! This is an indefensible position. Such economy—penny wise and pound foolish—stands utterly condemned. I do not ask that these uncertificated and supplementary teachers be swept summarily off the board; but I would point out that if they were paid better, and more opportunities for self-improvement given, a higher standard could reasonably be expected. In my opinion, all the costs of education, both "general" and, up to a certain point, "technical" also, should be charges on the national exchequer, for they are incurred in the business of making citizens. Only in this way can all the inequalities which exist between one authority and another be eliminated.

I am quite confident that the view taken in the *Farmers' Union Year Book*, quoted above, is the right one. It ought not to be difficult to relate the everyday life and *thought-development* of children in the country to the world of nature which surrounds them. Experience shows that to an unitiated countryman a beautiful valley may be nothing but a "dull place where nothing ever happens." Of country children it can often be said: "Eyes they have, but they see not!" It is not a matter for wonder that, to such as these, towns, with their kaleidoscopic changes in the daily scene, seem a paradise of movement, whilst the magic ebb and flow of life all through the countryside create no wonder. In some subtle way, without doubt, a man's love for his native place, where he has perhaps spent most of his life will sometimes, but not always, hold him to the land. This, however, is not enough. We need to create in the hearts and the minds of growing children in the country a delight in, and an understanding of their environment. Farm life and work must be not merely endured when no town alternative offers, but must attract both those born on the land and those from the congested cities.

All this implies that life on the land must be no "dead-end" occupation. Avenues of advancement must be there, and, as a corollary, education of every grade, even to the highest, must be open to every village boy or girl who is keen and able to take advantage of it.

On paper there is a system of agricultural education which is truly admirable (though of course needing immense development). In a leaflet issued by the Ministry it is thus described:—

> "Briefly, the agricultural education which is now available consists of courses at various colleges extending over three

or four years and leading up to a degree or diploma; shorter courses at the same institutions; short courses varying from a few weeks to several months at farm schools and similar institutions; courses of ten days or a fortnight in dairying at migratory dairy schools which visit a number of different centres each season; and courses of day or evening lectures, accompanied in many cases by practical instruction in agriculture, poultry-keeping, bee-keeping, farriery, horticulture and manual processes. Most county councils offer a number of scholarships, tenable at agricultural institutions, or courses to students resident in the county."

This is very well for agricultural students, farmers' sons, and, perhaps, in some cases, for smallholders. The farm workers, however, are at present scarcely touched by any part of this system. I think it can be said that there is no ordinary agricultural worker at the moment enjoying any of the scholarships referred to above. With the labourer it is the money difficulty that stands in his way; and this could only be satisfactorily solved by a much more generous grant of scholarships. Even if elementary and continuation education were to be widened out to lead a country lad up to a farm institute, money is still wanted. It may be said: "Where there's a will, there's a way," and that if a boy "has it in him" he can get his education. That may be so; but surely a course of education should *be* a course of education, and not a feat of endurance! Money will help; but none appears to be forthcoming, at any rate in anything like sufficient quantities. That is why the present outlook appears to be black. In the face of it one can only urge those who really are friends of education for the country lad, to keep working, in the hope that this short-sighted policy will soon be completely set aside.

It is perhaps nearly as dangerous in agricultural discussions to bring up the question of "rural bias" in early education as it is to bring up that of small holdings. I do not wish to be disrespectful to any experts in education, but I must confess to my belief that the opponents of "rural bias" run to extremes. There are so many aspects of agricultural education—chemistry, botany, mechanics—which can fairly be regarded as valuable elements in a "general" education that I believe the teaching in an ordinary country school could, with great advantage, lean towards agriculture very much more than it does now. In describing the work of the Welshpool County School, the combination of general and agricultural education has been thus referred to:—

"It was considered that it was not the duty of a secondary school to give definite training in the technical and practical processes of agricultural practice, and consequently, in adapting the school curriculum, only those parts of a physics syllabus were retained that were essential to a boy's general training, and had definite application to agriculture."

In general, that appears to me to be an adequate expression of what should be our aim. I suspect that the question of "rural bias" in elementary education is, or has been, largely a bone of contention between two Government Departments, and, in any case, seeing that the Ministry of Agriculture is responsible for all agricultural education other than in secondary or elementary schools, this Ministry should at least be very extensively consulted as to the latter, if anything like a carefully graduated course of instruction is to be built up.

There is one point at which one sees some possibility for action —without undue expense! Surely the text-books provided in country schools, and the general outlines prepared for the courses of instruction, could be devised with an eye to the children's country surroundings. Certainly this would give meaning and interest to much which must appear to ordinary children as ingenious means for making them wretched when they are not allowed to play. And why must all the joy of life be crowded out of school hours? Why is school not an integral and delightful part of the child's life? There must be more opportunity for the study of the great "out-of-doors." Education with "rural bias" and much outside work appears, in spite of jeremiads to the contrary, to be successful in the few secondary schools where it is tried conscientiously and intelligently. Why then are the experiments in this direction so limited?

One must of course realise that the whole theory of teaching in schools is being challenged and criticised. We must wait to see the result of the thousand present discussions, for only a wider experience in educational work would justify one who is not an educational expert proceeding further. Yet I hope I shall be understood, in view of what has been said above, if I venture the opinion that nowhere is there more room for a new spirit and a new outlook in educational methods than in our rural schools.

What I have called *social* education concerns, for the present at any rate, more immediately the *adult* workers in the agricultural industry. By social education I mean the development of thought concerning the history of the worker's class, his

status in modern society, his relation to the community at large, and his prospects and opportunities. I might also include under this head "health"; for though health and sex education should begin in schools they most decidedly should not end there! In the treatment of these subjects, however, with the exception of most aspects of the health problem, we are on dangerous ground, and cannot expect agreement. It is obvious that in teaching history, for instance, bias is bound to give a trend to instruction. Social topics such as those referred to above cannot be presented for discussion as mere collections of universally accepted facts. Points of view must be given, deductions drawn, probable developments indicated, and the right line of effort based on the knowledge gained must be suggested. Similarly, impartiality in teaching economics is unattainable; sociology and class politics are inextricably mixed.

For these reasons the social education of farm workers (and all other workers) should be left to working class organisations. The teaching of history and economics, which is part of the organisation of the present social system, cannot receive the support of the opponents of that system. This position, pushed to the extreme, has been stated in these words:—

> "The workers must think independently. The workers want not merely more education, but a different education. There is no magic that can transform an industrial or political enemy into an educational friend."

The workers have already made small attempts to provide for themselves these educational facilities. One can recognise the limitations, however, which only time can overcome. At present the workers can only get control over adult education to the extent of choosing their subjects and selecting their tutors from among those approved and paid for by universities and local education authorities. The Workers' Educational Association, through its tutorial classes and summer schools, as well as the co-operative movement, provides education of this character for the workers. This dependence must to some extent continue until more workers are able to pass through all the grades of education now provided, or until facilities for independent education are far more numerous than at present. Meanwhile we must remember that schools are not the only channels of education. Books and newspapers are valuable means, and through these we must continually present the workers' case and viewpoint.

Therefore, although we recognise the class character of modern

education, particularly of the higher grades, we cannot reject it on that account. On the contrary, speaking for myself, I am anxious to encourage youth to make the most of existing opportunities. I want to see the way open for them—to farm institute, to agricultural college, even to the university itself.

Though we cannot go so far as we would, the emphasis of repetition must be laid on the fact that *social* education in rural districts, through week-end schools, courses of lectures, summer schools, and the like, must be under the *control* of the workers' own organisations. I conceive it to be part of the duty of modern trade unions to provide, or to assist in the provision of, these facilities.

This much has been said in order that it may be seen that behind the apparent contradiction which may appear to exist in the education views of different sections of the workers, there is at least an understanding of the real position.

There still remains a vast field, as yet unexplored, for co-operation among the various bodies interested in rural education. Every village having a branch of a rural workers' trade union should be able to organise classes for the coming winter. The existence of a branch would at any rate show that there are people interested in *something!* Such classes would arouse interest in the more ambitious schemes for summer and winter schools. It has been said that facilities for any education demanded by farm workers could be provided; that it is not the supply but the demand which is lacking. The economy campaign throws grave doubts on the first part of this statement; but as to the demand, I am convinced it exists, though it has not as yet found opportunities for expression.

We must make a beginning, and doubtless the beginning will be a small one. Why should not the Ministry, the county agricultural organisers, and the unions work together more closely in getting some "technical" classes going? The first two might organise, and the last might advertise them. There would need to be proper courses of instruction, not isolated lectures such as might be given in a Women's Institute or a Village Club. The co-operation would have to be real and complete on both sides. Other courses on social subjects, and on different occasions, might be offered to the same classes, but these would be planned by the workers' organisations.

I suggest that the need for action is urgent and the time for action is ripe. If all parties, without rigidity, would earnestly consider the problem together, we ought to get something done.

ARTIFICIAL FARMYARD MANURE.

H. B. HUTCHINSON, Ph.D., and E. H. RICHARDS, B.Sc., F.I.C.
Rothamsted Experimental Station.

As a consequence of the campaign for increased food production during the War, and the resulting extension of the area under cereal crops, it was thought that, even after making allowances for disposal through the usual channels, there might still remain a surplus of straw which could not be utilised for feeding or for conversion into manure. It was therefore determined to investigate the possibility of converting straw into manure without the intervention of live stock, and a special grant in aid of the investigation was made to the Rothamsted Experimental Station by the late Food Production Department. Apart from war conditions, the possibility of adding to the supply of organic manure deserves consideration. In the case of market gardens particularly, the difficulty of obtaining adequate supplies of stable manure is increasing. The investigations described below indicate a method by which straw can be converted into a substance having many of the properties of stable manure. Further experiments to test the economic value of the process when conducted on a large scale are in progress at Rothamsted. Lord Elveden has also generously provided assistance and facilities for experimental work on his Pyrford Estate.

Of a considerable number of preliminary experiments to secure obvious breakdown and colour changes in fermenting straw, the most promising results were obtained when straw was subjected to the action of a culture of aerobic cellulose-decomposing organisms (*e.g.*, *Spirochaeta cytophaga*). Further enquiry showed, however, that this effect was not due simply to the provision of an organism capable of breaking down cellulose, but rather to the indirect effect of the mineral substances contained in the culture fluid. From this point on, the question of food supply—as distinct from the addition of any particular species of organism—received special attention, and, as will be seen later, led to results possessing both theoretical and practical importance.

Without entering into a detailed account of the various stages of the investigation, we may state here that the most essential factors making for the production of well-rotted artificial farmyard manure are air supply, suitable temperature, and a suitable supply of soluble nitrogen compounds.

(1) *Air supply.*—It has been found invariably that characteristic breakdown changes in straw remain suspended when a free supply of air is excluded either by intense consolidation or by immersion of the straw in liquid. The fermentation appears, therefore, to be an essentially aerobic one, at least in its early stages, and the typical disintegration of the straw with the production of dark-coloured plastic material does not take place in the absence of air. Moreover, the colour of aerobically produced manure is rapidly reduced when oxygen is excluded. The great importance of air supply is shown by the following experiment, in which four lots of straw were fermented under aerobic and anaerobic conditions for three months at 37° C. (99° F.).

	Loss of Dry Matter.	
	Straw without Nitrogen.	*Straw with Nitrogen.*
Without Air Supply ...	16·3 per cent.	17·1 per cent.
With Air Supply ...	40·1 „	59·8 „

The data explain what may be seen in the ordinary heap of farmyard manure, viz., that straw submerged in liquid urine, and therefore protected from air, remains in an unchanged state for long periods. On the other hand, the practice of carting manure from the yards and boxes and storing it in heaps in the field, although carried out for other reasons, provides better conditions for rotting than are likely to prevail where the dung is consolidated by trampling and saturated with urine.

(2) *Suitable Temperature.*—Except in those cases where straw is being fermented under otherwise unfavourable conditions, special measures to maintain a favourable temperature for fermentation are not called for. In common with other fresh fermentable materials, moist straw rapidly undergoes a preliminary fermentation during which the temperature may rise to upwards of 65° C. (149° F.). It is, however, in the subsequent stages that the effect of treatment becomes most evident in maintaining the temperature. Experience has shown that a supply of nitrogen, by increasing the energy of fermentation, leads to an increase of 15—20° C. (59—68° F.) in favour of straw which has received a sufficient supply of nitrogen, as compared with untreated straw.

(3) *A Supply of Soluble Nitrogen Compounds in suitable Concentration, and possessing a neutral or slightly alkaline reaction.*—Repeated experiments have shown that the most rapid breakdown of straw occurs when some source of nitrogen in an available or indirectly available form was supplied, and then only in those cases where the re-action of the solution was neutral or

slightly alkaline. Hence the supply of nitrogen in the ammonium sulphate alone fails to lead to definite breakdown since the medium soon becomes markedly acid, while, on the other hand, the supply of an alkaline compound alone, such as caustic soda, is equally ineffective, since a source of nitrogen is lacking. The addition of nitrogen in the form of urine, urea, ammonium carbonate, or peptone within certain concentrations immediately sets in train rapid decomposition changes, and results within the period of a few weeks in the production of dark-coloured, well-disintegrated, structureless material closely resembling well-rotted manure. That this should be the case with urine was perhaps not remarkable, although the factors which operate in the essential dung-making process had not then been individually worked out, but that an essentially characteristic product could be obtained without the use of urine or of the fæcal portion of the manure as ordinarily produced was at once suggestive. On the basis of subsequent work, it may indeed be claimed that, in the production of normally well-rotted farmyard manure, the mass inoculation of the litter with the large bacterial population of the fæces does not exert any marked contributory influence on breakdown changes; that the urine, as such, apart from being the carrier of nitrogen, does not induce any characteristic changes in the straw, while the typical smell and colour of stale urine from the manure heap may be successfully reproduced from straw treated with ammonium salts.

Although it is important that available nitrogen should be present for the rotting process, it is also not less essential that the quantity of nitrogen should not exceed a definite amount both actually as well as in concentration. In other words, if the concentration of ammonium carbonate produced from the decomposition of urine or urea exceeds a definite limit, not only are straw-breakdown changes definitely held up, but they continue to be inoperative until by volatilisation, and consequently loss of nitrogen to the air, the concentration or alkalinity has been reduced to the upper limit of growth of micro-organisms. *This must be regarded as particularly important, since the highest concentration for rapid breakdown is appreciably below that of the weakest undiluted urine.*

It follows that it is quite impossible to produce well-rotted dung by the use of neat urine without considerable losses. This fact may be illustrated by the following table, and, incidentally, is shown by all the investigations that have been carried out

on the making of farmyard manure.* Three equal portions of straw were saturated either with water or urine and allowed to ferment for three months in the laboratory, the two portions with urine being subjected to different temperatures. As will be seen from the following table, these two portions fermented to different degrees—the dry matter losses being 49 and 60 per cent. respectively, *but the final nitrogen content was almost identical*, and practically three-fourths of the nitrogen supplied as urine was lost.

	Temp.	*Loss of Dry Matter. per cent.*	*Nitrogen. Initial.*	*Final.*	*Loss − or Gain +*
			mgrm.	mgrm.	mgrm.
Straw with water ...	(36°C. = 97°F.)	40·1	71	97	+26
Straw „ urine ...	(26°C. = 80°F.)	49·1	507	178	−329
Straw „ „ ...	(36°C. = 97°F.)	59·8	507	176	−331

It would be erroneous, however, to assume that such losses are inevitably connected with a satisfactory breakdown of straw, or that the conditions ordinarily obtaining in the farmyard at all represent optimum proportions between the straw which is to be decomposed, and the concentration of nitrogen in the urine which eventually serves for this decomposition. That equally good rotting may be obtained without loss of nitrogen is shown by the cases given in the table below. In the experiments to which the table refers, straw was incubated with urine in different concentrations for periods up to 86 days. Even after this period the losses that occurred with satisfactory rotting and within the lower concentrations were only about 4 per cent. of the total nitrogen of the final product. The ordinary losses of the manure heap are frequently more than tenfold this amount.

	Number of Experiment.				
At beginning	(1)	(2)	(3)	(4)	(5)
Straw and urine nitrogen	77·5	157·6	*237·6*	317·6	397·6
After 86 days					
Total nitrogen	77·3	153·1	*226·8*	262·1	308·0

In addition to *the two phases already mentioned*, (*a*) in which straw overloaded with nitrogen loses it to a definite degree, and (*b*) in which straw with the requisite amount of nitrogen may undergo rotting without appreciable loss and is therefore in a state of equilibrium, there exists *a third phase* in which under-saturated straw, by the agency of micro-organisms, exhibits a well-marked property of picking up nitrogen, particularly in the

* See, for example, Russell & Richards, *Journ. Agric. Sci.*, 1917, Vol. VIII, p. 495.

form of ammonia, until the same final content of nitrogen in the rotted product is attained. Hence we might expect that in two different but adjacent portions of fermenting straw, the one overloaded with, and the other lacking, nitrogen, the former portion loses and the latter accumulates nitrogen until a common level is approached. That such is actually the case is

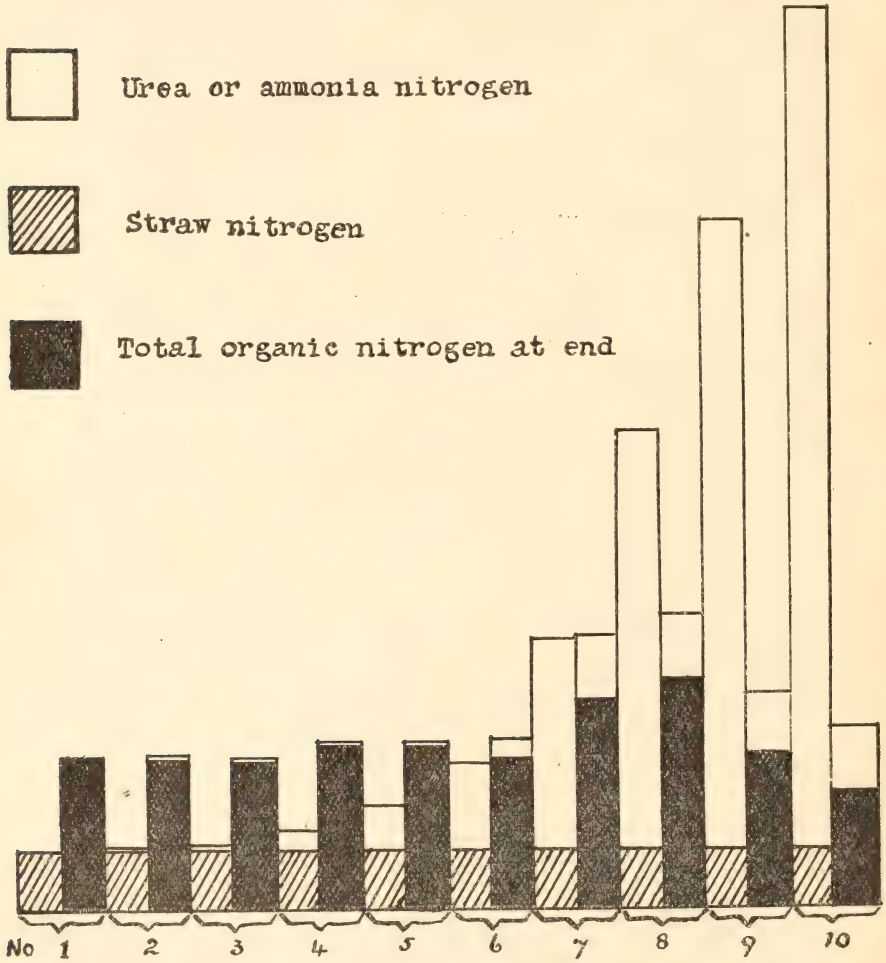

FIG. 1.—The diagram illustrates the power of under-saturated straw to pick up Ammonia lost by super-saturated straw. Ten portions of straw with increasing quantities of nitrogen (as urea) were allowed to ferment for three months.

illustrated by the following data, and is diagramatically represented in Fig. 1. Ten portions of straw were moistened to the same extent, and while one received water only, the others received additions of soluble nitrogen in the form of urea in

varying quantities, until the last portion was saturated with a solution similar in concentration of nitrogen to that of horse urine (1 per cent. of nitrogen). The different portions were then kept in an incubator for 3 months, at the end of which time it was evident that, contrary to expectation, the straw, without, or merely with low doses of nitrogen, had passed through a marked rotting process. On analysis, however, it was found that there had been a definite accumulation of nitrogen in the lower members of the series, while the higher members had lost in some cases the greater portion of their original nitrogen.

The Decomposition of Straw in the Presence of Varying Quantities of Nitrogen as Urea.

	Number of Experiment.									
Treatment	1	2	3	4	5	6	7	8	9	10
At beginning										
Straw nitrogen mgrm.	71	71	71	71	71	71	71	71	71	71
Urea nitrogen ,,	—	5	10	24	48	97	243	486	729	973
Total nitrogen ,,	71	76	81	95	119	168	314	557	800	1044
At end of 3 months										
Organic nitrogen mgrm.	180	177	174	190	192	171	245	269	181	134
Ammonia ,, ,,	—	5	2	4	4	29	74	68	71	76
Total ,, ,,	180	182	176	194	196	200	319	337	252	210
Gain or loss— ,,	109	106	95	99	77	32	5	—220	—548	—134
Dry Matter, loss per cent.	49	46	45	49	47	53	51	48	19	14

In seven out of the ten cases the final nitrogen of the fermented straw varied only between 180 and 210 mgrm., irrespective of the nitrogen content of the original mixture. It should also be noted that the extent of the rotting, *i.e.*, the loss of dry matter, in experiments 1—8 was very much greater than in 9 and 10 in which the straw was subjected to the action of solutions closely approaching the concentration of ordinary urine, the high alkalinity of the latter exercising a check on decomposition.

In the main, the nitrogen retained by super-saturated straw, or such as is accumulated by under-saturated straw, as in Nos. 1—6 in the above table, appears to be stored up in an organic or non-ammoniacal form. The maximum retention has been found to occur within the first four weeks, after which time breakdown of this organic nitrogen to ammonia and consequent loss by volatilisation seems to keep pace with loss of dry matter. Finally, the material assumes a "stabilised" condition—the loss of nitrogen becomes greatly diminished or may be absent altogether for long periods. These three phases—accumulative, dispersive and stable—are shown in Fig. 2, which illustrates the type and extent of the changes taking place in a mixture of straw and urine during a period of four months.

Between the 60th and the 120th day little change is found to take place either in the amount of "stabilised" or "fixed" nitrogen or the proportion of this nitrogen and the ammonia which appears to be held by fermented material even at a high temperature (37° C. = 99° F.), and in spite of the frequent handling and exposure associated with sampling operations. In general, it may be stated that when straw has worked from an

FIG. 2.—The diagram illustrates the changes that occur when straw is fermented in the presence of urine. The black discs represent fixed nitrogen, and the white outer circles represent ammonia nitrogen.

unsaturated to a "stable" phase little or no free ammonia is to be found, but straw which commences with a super-abundance of nitrogen appears to hold, when in a fermented state, upwards of 14 per cent. of its nitrogen in the form of ammonia so long as the material is in a moist condition. Desiccation leads almost to complete loss of ammonia, and in this respect as well as in the proportion of ammonia in the moist material, the artificial resembles the natural manure.

From the study of the inter-relations between nitrogen and straw, we have come to the conclusion that the amount of nitrogen necessary for pronounced rotting, and the amount which straw is capable of " fixing " in the form of ammonia are identical, and that, in general, the figure varies only between 0.70 and 0.75 parts of nitrogen per 100 parts of dry straw. Within these limits fermentation proceeds without loss of nitrogen, and it is obvious that, except in so far as the nitrogen content of the original straw varies, the final " stabilised " product obtained when rotting has proceeded to the extent of 40 to 45 per cent. of dry matter must likewise exhibit comparatively slight variation in its nitrogen content. In our experiments the " stabilised " product obtained from the fermentation of straw under a variety of conditions possesses a nitrogen content of about 2 per cent. calculated on the dry material.

It thus becomes possible to estimate fairly accurately what the nitrogen content of any particular sample of fermented straw will be when rotting has proceeded to an appreciable extent. If, for example, the nitrogen content of the original straw is equal to 0.50 per cent., and we assume that the theoretical amount of ammonia nitrogen, equal to 0.72 lb. of nitrogen for 100 lb. of straw, has been fixed, then, with a loss of 40 per cent. of dry matter during fermentation, the resultant rotted straw will contain $(0.50 + 0.72) \times 100 \div 60 = 2.03$ per cent. of organic nitrogen in the dry matter. An additional amount of ammonia nitrogen would probably result in a portion remaining as free ammonia which, as indicated above, would be liable to loss if the fermented straw were allowed to become dry. The data thus obtained enable us to turn to the process of inducing the fermentation of straw on a large scale, and are also capable of application to the conditions operating in the production of ordinary farmyard manure.

Suggested Method for the Preparation of Artificial Manure. * —As regards large scale work, a number of factors have to be taken into account which did not operate in the laboratory experiments. Experience has shown that urea and ammonium carbonate are the most suitable carriers of nitrogen since they ensure a favourable alkaline reaction, and lead to rapid breakdown, provided that they are not present in large excess. They are, however, far too expensive at the present time to admit of general use in farm work, although a reduction in the cost of

* This process, as well as its application to the purification of sewage, has been covered by Letters Patent (British Pat. No. 152387).

manufacturing synthetic urea would create conditions favourable to its extended use. As an alternative source of nitrogen, cyanamide (nitrolim) and sulphate of ammonia have been used with success. Whilst cyanamide already contains sufficient free lime to keep in check any acid compounds formed during fermentation, sulphate of ammonia must be supplemented by the addition of a base, and for this purpose finely-ground chalk, ground limestone, or waste lime from causticising plant at soap works may be used. For general purposes it will be found that upwards of $\frac{3}{4}$ cwt. of sulphate of ammonia and 1 cwt. of finely divided carbonate of lime per ton of straw are sufficient to induce fermentation. The main obstacles to large scale operations at the present time arise from the great tardiness with which raw straw takes up the moisture necessary for fermentation. Where pits are available this difficulty may be overcome by allowing the straw to remain immersed for 2 to 4 days, after which the free liquid may be drained off. In the case of heaps or stacks on open ground no advantage appears to be obtained by continued wetting with large quantities of water, and we suggest, as a more effective method of securing the necessary saturation of the straw, sprinkling the heap comparatively lightly with water and allowing a couple of days to elapse before a second sprinkling is given. During this time a slight fermentation with increase in temperature sets in, rendering the straw more capable of absorbing a second slight application of water than would otherwise be the case. When examination has shown that the interior of the heap has become uniformly moist, the source of nitrogen may be applied in the form of solution, or in the case of cyanamide and other products, this may be broadcasted over the surface of the heap and watered in. The moist convenient method of making the heap, wetting the straw, and supplying the necessary nitrogen for fermentation depends so much on local conditions that much must be left to the initiative of the farmer himself.

General Characteristics of Artificial Farmyard Manure.—Artificial farmyard manure prepared from straw is a well disintegrated plastic material in which the tubular character of the straw has been to a great extent destroyed. There is an almost complete absence of smell, the little there is being slightly fusty or mouldy in character. When prepared through the agency of a compound in the presence of free lime, there is a tendency towards the production of a blackish colour, while if prepared from soluble alkalies such as ammonium carbonate, liquid

ammonia, or compounds giving free ammonia such as urea or peptone, or in the presence of sodium hydroxide or sodium carbonate, the colour is dark brown, and differs only slightly from the natural product. The liquid, which is gradually expressed from the fermenting straw as more and more dry matter is lost by fermentation, has a dark brown colour and a smell which is indistinguishable from stale urine.

Application of Results to the Production of Ordinary Farmyard Manure.—Since it has been possible to produce material identical in physical properties with well-rotted farmyard manure, differing only in chemical composition in so far as the latter contains appreciable quantities of phosphorus and potash derived from foods consumed by the animal, the possibility suggested itself that the results might be applicable to the making of ordinary farmyard manure and led to an inquiry in this direction.

Of the three constituents ordinarily present in manure—urine, fæces and straw—the fæces appears to contribute to the physical character of the product only, since manure can be produced without their presence. Moreover, definite experiments have shown that, chemically, fæcal nitrogen is to a great extent inert and is not capable of contributing to the decomposition of straw to any degree comparable with urine nitrogen. On the contrary, certain methods of feeding farm animals, and particularly of horses, sometimes lead to the production of fæces containing quantities of readily available carbohydrates, and it has been shown* that such fæces are capable of supporting the fixation of atmospheric nitrogen. There is every reason to suppose, therefore, that the fæcal portion of the manure heap inclines slightly in the direction of itself requiring nitrogen rather than acting as a source of nitrogen for the decomposition of straw. With the above exception of some horse fæces, the solid excrements of farm animals may be regarded as having reached a state similar to that observed above in fermented straw, *i.e.*, containing roughly 2 per cent. of nitrogen in the dry matter. This is borne out by the following mean figures which have been obtained from various sources:—

Horse fæces	(mean of	8 records)	= 2·00	per cent.	N.	in dry	matter.
Cow	,, (,,	,, 11 ,,)	= 1·88	,,	,,	,,	,,
Sheep	,, (,,	,, 7 ,,)	= 1·92	,,	..	..	..
	Average of 26 records		= 1·93	,,	,,		

We thus see that during the process of digestion, and also possibly by virture of bacterial action in the intestinal tracts, the

* *Jour. Agric. Sci.*, 1917, Vol. VIII, p. 299.

percentage of organised nitrogen closely agrees with the figure repeatedly found for fermented straw to which purely mineral nitrogen was supplied, and subsequently converted by a bacterial action into organised nitrogen.

Since evidence of this stabilised condition is found in the product of the fermentation of straw and urine, and also in the undigested portion of food passing through the animal, it might be expected that comparable conditions would prevail in the manure heap. Despite the fact that the manure heap usually consists of the liquid and solid excrements of different animals fed with widely different diets, together with litter of various kinds and in variable proportions, and that this mixture is allowed to mature under conditions absolutely lacking in uniformity, the majority of the available data regarding the composition of farmyard manure indicate a striking similarity in the percentage of fixed or "non-ammoniacal" nitrogen. Without giving details of the methods of feeding or of the conditions under which the manure was produced, it may be sufficient to state that the mean content of fixed or organised nitrogen in manure made under controlled conditions in America, on the Continent, and in this country, proves to be 2.09 per cent. as a mean of 43 records. We are now in a position to appreciate more accurately the character of the changes which proceed during the making and storage of manure. Repeated experiments carried out during the last three decades have shown that during this process a very considerable proportion of the nitrogen originally contained in the food and litter is almost invariably lost, and this loss, which may amount to upwards of 40 or 50 per cent. of the whole, appears to fall largely, or even exclusively, on the urine nitrogen, i.e., the most valuable nitrogen, since it is the most readily available constituent of the manure. To prevent or reduce this loss both chemical and physical measures have been suggested, all of which have proved either ineffective or have interfered seriously with the rotting process.

If dung-making be regarded as essentially a straw-rotting process it is possible to obtain some explanation of much of the loss which has been found to occur. We have seen that the nitrogen-fixing power of straw is strictly limited, and that any surplus nitrogen in the form of ammonia is liable to loss by evaporation. It may therefore be assumed that the practice of supplying concentrated feeding stuffs to farm livestock merely

results in an increased production of soluble nitrogen, which, owing to the normally overloaded condition of the litter, is liable to relatively greater loss than where such feeding stuffs are not used.

We have attempted to test the accuracy of this view by computing the amount of nitrogen that ought under ordinary conditions to be recovered in the form of manure from any given system of feeding. For this purpose we have taken:—

(*a*) the total amount of nitrogen contained in the straw used as litter; this is apparently not in a form liable to loss;

(*b*) the amount of indigestible or fæcal nitrogen as calculated from the digestion co-efficients of the foods consumed;

(*c*) the amount of nitrogen which the quantity of litter employed should be theoretically capable of retaining, *i.e.*, 0·72 lb. of nitrogen per 100 lb. of straw; and,

(*d*) the amount of nitrogen present as ammonia at the end of the experiment; this quantity is extremely variable and is determined by the actual conditions, æration, exposure, and the length of the period during which the manure is stored.

The application of this method to the actual results obtained in a number of feeding experiments shows that a fairly close approximation may be obtained.

Two instances may be given, the first relating to Professor T. B. Wood's experiment at Cambridge,* and the second to that of Professor Hendrick† on the feeding of bullocks on roots and straw. The following table gives an extract of Professor Wood's data relating to the amount of total and digestible nitrogen supplied to the respective sets of animals, and the net amount excreted after deduction of the calculated nitrogen due to the live-weight increase of the animals. As the animals were not fed with straw but were able to pick over that supplied as litter, it has been assumed that one-quarter of the whole would be consumed, and due allowance has been made for this. In the two instances, therefore, after making this deduction, 41.15 and 83.85 lb. of nitrogen were supplied to the animals, whilst only 30.9 and 46.70 lb. were recovered in the manure. The totals obtained by calculating the indigestible or fæcal nitrogen, together with that contained in the litter and the amount which this litter is theoretically capable of fixing, closely approach those obtained by actual analysis of the manure, being 33.6 as

* *Jour. Agric. Sci.*, 1907–08, Vol. II, p. 207.
† North Scot. Coll. Agric., 1918, Bull. No. 22.

against 30.9 lb. and 46.51 as compared with 46.70 lb. in the two cases respectively.

	No Cake.		*Cake.*		
	Total Nitrogen.	*Indigest. or Fæcal Nitrogen.*	*Total Nitrogen.*	*Indigest. or Fæcal Nitrogen.*	
	lb.	lb.	lb.	lb.	
Mangolds	17·6	4·0	17·6	4·0	
Hay	21·3	8·5	21·3	8·5	
Straw	9·0	1·7	8·6	1·65	(¼ taken as food)
Cake	—	—	42·8	5·56	
Total Nitrogen minus nitrogen in live-weight increase.	41·15	14·2	83·85	19·71	
			Calculated.		
Fæcal nitrogen	—	14·2	—	19·71	
Straw „	—	7·3	—	7·0	
Nitrogen fixed by litter ...	—	10·2	—	9·8	
Nitrogen found as ammonia...	—	1·9	—	10·0	
Total (calculated)	=	33·6	=	46·51	
Total actually found	=	30·9	=	46·70	

The data referring to Professor Hendrick's experiments are contained in the table below in a somewhat condensed form. The total amount of nitrogen supplied to the animals as food amounted to 613 lb., and of this it has been calculated that 42 lb. were retained by the increase in live-weight of the animals, thus making the total amount which should have been present in the dung equal to 671 lb., whilst only 524 lb. were actually recovered as organic and ammonia nitrogen. For the calculation, we have taken the fæcal nitrogen as given by Professor Hendrick as 276 lb., the nitrogen contained in the litter as 100 lb., and the amount of nitrogen which would be fixed by the litter (equal to 146 cwt. with a dry matter content of 91 per cent., as 107 lb. It will be seen that the sum thus obtained is 537 lb. by calculation, as against 524 lb. by analysis. It should be noted, however, that Professor Hendrick himself calls attention to the fact that the cattle used in the experiment did better than might have been expected from accepted scientific standards of digested litter, and raises the question as to whether the foods actually used were not more digestible and of higher starch value than is allowed in Kellner's tables. If this were the case, it would simply mean that the amount allowed in our calculation as indigestible or fæcal nitrogen is somewhat too high, and would consequently bring the totals of the analytical and the calculated amounts into still closer agreement.

Analytical Data.		lb.	*Calculated Data.*		lb.
Nitrogen supplied in food	=	613	Indig. (fæcal) nitrogen...	=	276
Nitrogen „ „ litter	=	100	Nitrogen in litter ...	=	100
Total nitrogen	=	713	Nitrogen fixed by litter (16·352 lb. @ 91 per cent. dry matter × 0·72, *i.e.*, fixation constant)	=	107
			Nitrogen as ammonia ...	=	54
Total nitrogen recovered in dung	=	524	Total calculated	=	537

Similar calculations have been made in the case of other feeding experiments, but these two instances will probably suffice to show that the amount of nitrogen which we found straw to be capable of fixing in the laboratory, is also most probably built up into organic form and to the same extent under ordinary farm conditions. It is, perhaps, outside the scope of this paper to suggest means by which the observed losses which occur in the making of manure may be minimised, but rational practice would appear to lie in the direction of a more liberal use of litter in order to increase the amount of ammonia that can be fixed, with the further result of a considerable increase in the dung-making capacity of a given number of stock.

THE CLAYING OF FEN SOILS.

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THE true fen soils of East Anglia, or "Blacklands" as they are called, are light soils, black in colour, containing a very high percentage of organic matter, the mineral matter present being mainly coarse and fine sand, only a very small percentage of the finer particles being present. Even the top soil may contain over 50 per cent. of organic matter, and in the subsoil the high organic content is even more marked, until a layer of unadulterated peat is struck, sometimes within a foot of the surface. This layer of peat may be only a few inches in thickness, in which case the local name of "Bears' Muck" is given it, or it may continue to a depth of several feet. Under this peat is either sand and gravel, or clay, and on this the value of the land depends. Blackland overlying clay is superior in every way to that overlying sand and gravel, and if the clay is within four feet of the surface, then the process of claying the top soil is rendered cheaper and the land has an increased value.

Historical.—The practice of claying fenland is undoubtedly an ancient one, though exactly when and where it had its origin it is impossible to say. Arthur Young, in his *Lincolnshire*, written in 1799, does not mention it, from which it may perhaps be assumed that it was not then a common practice. Samuel Wells in his *History of the Drainage of the Great Level of the Fens*, 1830, gives an interesting note on this subject in which he says: "This mode of management is so very modern, that the author finds some difficulty in giving an accurate description of its singular process." He continues, "The object is to give solidity to the land; but it is for experience to prove whether the heavier soil will not force itself back before the industrious owner can reap the reward of the expense he has thus unavoidably incurred. One beneficial effect, undoubtedly, arises from the measure—the employment of the poor."

In 1841 Mr. Morton, writing in the *Journal of the Royal Agricultural Society*, says: "This mode of improving peaty soils

extends over a very large district, indeed it is equal in extent to the extent of the fens, for, although the whole of the Fenland in Lincolnshire, Northamptonshire, Huntingdonshire and Cambridgeshire has not been so treated, there is scarcely a farmer but what has, and is now proceeding with this most important improvement. I have witnessed this operation for the last 15 years; and I believe it was begun long before." Skertchly in his *Fenland*, 1878, refers to the practice as having been in much favour for the past 20 years.

As the cost in 1841 was estimated by Mr. George Cooke, manager of Lord Harrowby's Lincolnshire estate, at only 54s. per acre, the increase in yield of wheat obtained being 10 bushels per acre of 10 per cent. heavier grain, the improvement to last 15 years, it is hardly to be wondered at that the practice increased rapidly. As the price of corn rose, so claying grew in popularity, for the increased cost of labour was small in comparison.

With the decline in agriculture the practice was gradually discontinued by the smaller tenant farmers, but it was kept alive by the larger farmers, many of whom owned their holdings. For some years before the War it was again growing in favour. With the extreme scarcity of labour during the War all operations of this nature were of necessity stopped, and it was only during the winter of 1919—1920 that it was recommenced to any extent. Indeed, with the very high cost of labour, and the uncertainty of the outlook, the wonder is that it was recommenced at all, and it argues well of the practice that it should be those men who had had most experience of it in the past who were the first to restart.

Objects.—Claying is usually done in the winter months, when other work on the farm is slack, and the field selected has generally carried corn the previous year. The objects aimed at are :—

1. To apply a maximum amount of clay to the surface soil with a minimum of labour.
2. To avoid burying any of the "made" top soil, but to conserve it on the surface.
3. To replace the clay removed, refilling the trenches with inert peat, material which it is useless to incorporate with the top soil (which already contains excess of organic matter), but which, being of a porous nature, will assist drainage.

Method of Claying.—Operations are begun by opening furrows with a horse plough 13 yards apart and parallel to each other. It is usual to plough 2 furrows 10 to 12 in. in width, leaving 12 in. of unploughed land in the centre, thus making the trenches roughly 3 ft. wide at the top. The workman begins at one end of a furrow by sinking a hole about 5 ft. long and 3 ft. wide. The top soil is laid on one side of the hole; the peat from the first hole is piled at the end of the furrow. The clay, which lies directly under the peat, is struck at various depths from 2 to 6 feet. If the clay is deeper than 6 feet, then the operation becomes difficult and expensive, and will not as a rule be attempted. From three to four spits of clay (3 to 4 feet) are then thrown out into heaps, half on one side of the hole and half on the other. The sides of the hole are undercut to some extent, so that the maximum amount of clay may be obtained from each hole. Holes are then sunk all up the furrow, about 1 foot apart, the space being left to shore up the sides of the trench and keep them from caving in; also to act as a dam to prevent the water, which rapidly accumulates in each hole as it is dug, from filling the trench. In digging the second hole the top soil is laid on one side as before, but the peat is thrown into the first hole, and thus the useless material dug from each hole helps to fill up the preceding one.

It is the custom among some farmers to cut away the partition left between each hole after the clay has been removed and the partition has served its purpose. In this way a continuous trench is made across the field, so that as it is filled with porous peat it acts as a drain, which discharges its water at either end into the dykes surrounding every field. This practice seems to be thoroughly sound and may be commended to the notice of those who are not at present in the habit of carrying it out.

Having completed several holes, the workman goes back and spreads the heaps of clay evenly over the land to a distance of 6 yards on each side of the trench.

The tools used are an ordinary spade for clearing away the top soil and peat, a fork for spreading the clay, a small light wooden shovel or spoon with a thin sharp cutting edge and about 12 to 14 in. deep, for digging the clay, and a large wooden scoop for throwing out the water as it accumulates in each hole back into the preceding one. The amount of water

Fig. 1.—Digging the Clay, which is 4 ft. below the surface.

Fig. 2.—The Clay spread, and Trench ready for filling in.

met with varies greatly; where there is much to be contended with it renders the operation difficult and expensive.

The clay having been excavated and spread over the whole field, the work of filling in the trenches is begun. Three furrows are ploughed round each trench, usually with a digging plough, to a depth of 8 or 10 inches. After the third furrow has been turned the plough is followed by a gang of men with spades, who remove about 12 inches of subsoil and peat from the bottom of the furrow, and throw it into the open trench. The plough follows and turns a fourth furrow, the bottom of which is dug out and thrown into the trench as before. This process is continued until the trench is filled in. By this ingenious method, known locally as subsoiling, the top soil remains on the surface, and the trench is filled with peat. The whole field is then ploughed, the clay being buried to a depth of 6 inches. The cultivator follows, and the land is prepared for a crop of potatoes or mangolds in the usual way, roots being usually the crop chosen to follow an application of clay.

Cost.—The digging of the holes and the excavation and spreading of the clay is done by skilled "Toolmen" by piece-work. The cost varies with the depth of the clay and the amount of water present in the soil. Prices ascertained in the winter of 1919—1920 varied from 11s. to 15s. per chain of trench dug. The cost of claying per acre in that particular season was approximately as follows, clay being struck at a depth of 4 feet, and water not being excessive:—

	£	s.	d.
Setting out work with plough	0	6	0
Cost of digging holes, excavating and spreading clay, trenches 13 yd. apart, @ 12s. per chain, *i.e.*, 17 chains @ 12s.	10	4	0
Cost of filling in (subsoiling), including plough	2	10	0
	£13	0	0

The work is hard and requires a good deal of skill, and the "Toolmen" earn from 9s. to 10s. per day of 7½ hours. Wages are always rather higher in the fen country than in the surrounding districts, but most of the work is done by the piece. In fact, the amount of piece work is a characteristic of fen farming, the result being a more efficient and better type of labour, as under thi system men earn what they are individually worth. A "Toolman," that is a skilled man, in the

prime of life is nearly always at piece work either dyking, claying, manure carting and spreading, hoeing, or harvest work, the horses being worked mainly by lads.

Duration of the Claying.—For the purpose of valuations of Tenant Right, claying is valued on a seven-year basis, but this is generally admitted to be a very conservative estimate. George Cooke, already mentioned above, estimated claying to last for 15 years, and provided it has been well done, there is no doubt that its effects may be seen for 20 years. The full benefit is not felt until the second year, by which time the clay has become thoroughly incorporated with the soil. During the first year much of the clay may be observed lying on the surface in small lumps.

After a period of 15 years the operation may generally be repeated with profit. By that time most of the clay will have been washed through the top soil. Indeed, the writer has known fields which have been clayed 3 and 4 times at intervals of from 15 to 20 years.

Benefits of Claying.—As regards the benefits derived by various crops from claying, exact figures are wanting, but it is safe to say that both quantity and quality are affected. It is a fact that originally, when these lands were first reclaimed and brought into cultivation, the first improvement carried out after draining was the application of large quantities of clay. Without such an application it was found impossible to grow wheat at all, while oats yielded but a poor, light crop. Practitioners have declared to the writer that their potato crops were increased by 2 tons an acre after claying, and mangolds considerably more. Heavy crops of corn will stand better on land which has been recently clayed, and this point is of first importance in a district where the greatest bugbear to the farmer is a laid crop.

It is by no means easy altogether to account for the great benefit derived by fenland from a heavy application of clay. There is no doubt that several factors are involved. That the action is neither entirely chemical nor entirely mechanical is certain. It has been held by some writers that the clay supplies lime, in which the top soil is deficient. A glance at the analyses given below of two typical blackland soils, with their underlying clays, will show that the top soil already contains plenty of lime, and that the clay contains only a very small percentage. In exceptional cases where the top

soil is acid, the small amount of lime in the clay will have a beneficial effect, yet, generally speaking, there is no deficiency of lime in the top soil to make up.

The potash supplied by the clay is a factor which must be considered. In experiments on the manuring of blackland

Mechanical.	I. *Top.*	I. *Sub.*	I. *Clay.*	II. *Top.*	II. *Sub.*	II. *Clay.*	II*a*. *Clay.*
Fine Gravel			·35			1·9	6·5
Coarse Sand			1·87			41·7	10·0
Fine Sand			18·37			35·2	16·0
Coarse Silt			25·50			6·9	6·0
Fine Silt			9·8			4·2	17·3
Clay			19·6			4·2	30·9
Loss on Ignition ...	57·30	73·6	12·9	50·3	61·5	3·8	9.1
Moisture	11·0	4·4	3·8	9·0	11·6	1·0	3·16
Chemical.							
CaO	5·8	6·2	3·2	18·7	12·4	·3	3·5
M_2O	·31	·02	·34	·36	·15	·05	·63
K_2O	·44	·44	·75	·65	·48	·41	·71
P_2O_5	·19	·10	·22	·21	·11	·14	·10
Insoluble Residues ...	23·75	16·80	76·50	25·5	15·65	91·95	

carried out between 1898 and 1907 by the Cambridge University Department of Agriculture, it was found that no benefit was gained by the potato crop from the addition of sulphate of potash to other artificial manures. This is borne out by experience, for the almost universal dressing for potatoes

on this land consists simply of from 8 to 10 cwt. per acre of superphosphate, no potash manure being used.

Of all the benefits, however, the most important seem to be consolidation and drainage. With soils containing only 20 to 25 per cent. of mineral matter, and from 50 to over 70 per cent. of humus, the consolidation effected by an application of upwards of 100 tons of clay per acre is obvious.

It may be noted here that Clay No. II in the analysis is really not clay and contains over 70 per cent. of coarse and fine sand. This is realised by the farmer to be very inferior material, but running through it are veins of Clay No. II *a*, which, as may be seen by the analysis, is a very superior clay, containing over 50 per cent. of the finer fractions.

The solidity given to these blackland soils by a dressing of clay is quite remarkable. As Mr. Pusey says, in the *Journal of the Royal Agricultural Society*,* "In wet weather, even on a stubble, a horse will often sink in to the fetlocks; yet where so slight a dressing of clay as 40 cartloads per acre has been applied in the previous winter, he will find a firm footing."

In the opinion of the writer the much improved drainage resulting from the modern method of claying already described, is one of the greatest benefits derived from it. In sinking a dyke across a field it will be found that the water table in the centre of the field is very much nearer the surface than it is at either side, where it is lowered by the proximity of the open drains which surround every field. It is clear that a series of trenches 13 yards apart, 6 ft. deep, filled with a porous material such as peat, and discharging into open drains at each end, will assist the free movement of water through the soil and improve the drainage. This point should be borne in mind by those who contemplate carrying out work of this nature.

Owing to the very high percentages of humus it was found impossible to make mechanical analyses of the top and subsoils.

Jour. Royal Agric. Soc., Vol. II, p. 409.

THE EFFECT OF CHALK ON THE CULTIVATION OF HEAVY LAND.

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IT has long been known in a general way that chalk or lime facilitates the cultivation of land, but so far as we are aware no field measurements are on record to show the magnitude of the effect. In the winter of 1912-13 large plots of land were chalked at Rothamsted, but strips of unchalked land were left in each field for purposes of comparison. Records have been kept of the crops; these are given in Table I and show as a result of chalking an increased yield of clover, which reacts on

TABLE I.—*Effect of Chalking on Yield of Crop. Chalk applied November,* 1912, *to March,* 1913.

	Sawpit Field.				*Gt. Harpenden Field.*		
Year.	Crop.	*Yield per acre on*			Crop.	*Yield per acre on*	
		Un-chalked.	Chalked 20 loads per acre.	Chalked 50 loads per acre.		Un-chalked.	Chalked 20 loads per acre.
1914	Oats, bush. ...	44·6	37·3	41·1	Potatoes, tons	9·3	8·8
1915	Clover, cwt. ...	19·4	35·8	39·2	Barley, bush.	36·2	33·9
					Straw, cwt. ...	19·1	18·9
					Wheat, bush.	20·9	19·6
					Straw, cwt. ...	21·4	20·5
1916	Wheat, bush.	27·8	33·8	30·2	Wheat, bush.	31·7	27·3
	Straw, cwt. ...	33·0	40·3	35·0	Straw, cwt. ...	39·7	37·3
					Oats, bush. ...	31·4	38·5
					Straw, cwt. ..	20·0	25·6
1917	Oats, bush. ...	25·8	29·7	27·1	Wheat, bush.	24·5	27·7
	Straw, cwt. ...	23·4	22·8	22·9	Straw, cwt. ...	18·5	20·1
1918	Wheat ..	Plots not separated.					
1919	Wheat ...						
1920	Oats						
1921	Potatoes ...						

subsequent crops, but there is no increase in wheat, oats or potatoes, apart from that due to the growth of clover. On the

old four-course rotation the gain would have been obvious, but now that the rotation is widened to one of six courses or more, it is less evident.

The ploughman always declares, however, that he can tell by the ease of working where the chalk is applied, and during the past six years attempts have been made to devise some means of measuring the benefit obtained. So long, however, as we were working with horse implements no success resulted. Recently a tractor has been substituted for horses in the main work of cultivation, and among its advantages is the fact that its work can be exactly measured and recorded. These measurements are of great economic importance because the farmer pays direct for every additional pound on the drawbar pull. The Rothamsted Experimental Station is endeavouring to secure its own dynamometer, but so far no satisfactory implement is on the market. For the present purpose, however, we were fortunate in interesting the Hyatt Roller Bearing Co., and in borrowing from them, not only their high class dynamometer, but also the services of their Engineer, Mr. J. L. Bent, who took the measurements and calculated the results.

The particular field on which the measurements were made is Pastures Field (also called Sawpit Field), which had been ploughed in October, 1920, immediately after the oat crop was removed. It was cross-ploughed in March last to a depth of 7 in., using an Austin tractor, and for part of the work a Ransome three-furrow plough, for the remainder a Cockshutt three-furrow plough. The measurements recorded in Table II were taken during this cross-ploughing.

The figures show that chalking not only increases the speed of ploughing but considerably reduces the drawbar pull, so that the cultivation is effected by the expenditure of less work and therefore of less petrol and less wear and tear on the tractor and implements. The increase in speed in the case of the Cockshutt plough is from an average of 2.18 to one of 2.23 miles per hour: in the case of the Ransome plough from 1.98 to 2.21 miles. The drawbar pull fell from 1,538 lb. to 1,358 lb. for three furrows with the Cockshutt, and from 1,610 to 1,425 lb. for three furrows with the Ransome plough.

The average of all results is a saving of 180 *lb. drawbar pull and an additional mile of ploughing in every* 9 *hours work as a consequence of chalking. The practical importance of this result needs no emphasis. There can be little doubt that all other cultivations are facilitated by chalking.* Seeing that the chalk

has already been applied 9 years and is still lightening the work to this extent it has obviously saved a considerable amount

TABLE II.—*Measurements for cross-ploughing Land already ploughed in Autumn. Cockshutt Plough, Austin Tractor.*

Average.	*Unchalked.*		*Chalked, 20 loads fine chalk.*		*Chalked, 50 loads "dug" chalk.*	
	Centre plot.	*S.E. plot.*	*Centre plot.*	*S.E. plot.*	*Centre plot.*	*S.E. plot.*
Miles per hour ..	2·14	2·21	2·50	2·27	2·27	1·88
Draught per plough, lb.	516	509	465	446	483	417
Per sq. in. in furrow section, lb. ...	7·37	7·12	6·63	6·37	6·90	5·95
Drawbar pull, lb. ...	1,548	1,527	1,395	1,337	1,450	1,250
Ransome Plough, Austin Tractor.						
Miles per hour ...	1·98		2·15		22·7	
Draught per plough, lb.	537		467		483	
Per sq. in. in furrow, section, lb. ...	7·67		6·67		6·90	
Drawbar pull, lb. ...	1,610		1,400		1,450	

Depth of ploughing, 7 inches.

Average of all results.

	Unchalked.	*Chalked.*
Miles per hour	2·11	2·22
Draught per plough, lb.	521	461
Per sq. in. in furrow section, lb.	7·39	6·57
Drawbar pull, lb.	1,562	1,380

in labour and will now save a great deal in the tractor. If it was desirable to apply chalk in the old horse days, it has become much more important to do so now, when every pound of drawbar pull has to be paid for and every fraction of a mile per hour additional speed means so much money saved. It is probably not too much to say that the liming or chalking of heavy land should be regarded as one of the essential factors in the use of the tractor. The difference becomes even more striking when a heavier tractor is used with the heavy plough, as would often happen in autumn and winter work. For comparison with the corresponding columns in Table II. the following figures are given.

Ransome Plough with Titan Tractor.

	Unchalked. Centre plot.	*20 loads chalk.* Centre plot.
Miles per hour	1·23	1·81
Draught per plough, lb.	608	475
Per sq. in. in furrow section, lb. ...	8·68	6·78
Drawbar pull, lb.	1,825	1,425

A part of this difference is due to the heavier weight of the Ransome plough, but the greater portion can be attributed to

the compacting of the soil in front of the plough by the Titan tractor, which weighs 60 cwt. against 30 cwt. for the Austin. In addition the Austin runs with two wheels in the furrow, whereas the Titan runs on the unploughed soil.

It would be interesting to know just why chalk or lime has the remarkable effect here described, and the inquiry is being made in the Soil Physics Laboratory at Rothamsted, because the action cannot properly be exploited until it is understood.

It is possible that the chalk affects the degree of moistness of the soil. There is a difference in the appearance of the land after rain, which suggests a difference in moisture content. In walking over the field in winter one notices a drier, more porous look on the chalked plots, and the land is less sticky; this is seen every winter, and is frequently demonstrated to visitors. This is no doubt an important factor in determining the improved growth of clover on chalked land, which then reacts on the subsequent crops.

It would not follow that the soil was actually drier because it looked so: the same results would be obtained if the soil were lightened or puffed up so that its pore space were increased.

It is not proposed, however, to discuss here the reasons for the effect of chalk: the important point is that chalk lightens the soil to the marked extent indicated by these measurements.

It is hoped to be able to extend these measurements and ascertain the effect of other manures on the work of cultivation. Farmyard manure is known to lighten the soil: green manure is assumed to have the same action. Sir A. D. Hall, when at Rothamsted, showed that the various artificial manures acted on soil each in a characteristic way, and it seems probable that these also may affect the work of the tractor. It is obvious that any action a fertiliser may have in increasing or diminishing the resistance of the soil to the tillage implements must be taken into account by the farmer in determining his choice of materials for use.

BRITISH GROWERS' SCHEME FOR GRADING AND PACKING APPLES.

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AND

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THE scheme for establishing in this country a proper system of grading and packing apples for the market, referred to in the article on "Grading and Packing" in the July issue of this *Journal*, has now been published by the Federation of British Growers. In this article an attempt has been made to explain this scheme, and a few notes have been added which, it is hoped, will be of assistance to those growers who may desire to adopt a system of grading and packing to meet the requirements of the scheme. In the past horticultural journalists have written much on this subject, and many meetings of the trade have been held to discuss measures of reform; this clearly indicates that the problem is not a new one. The minds of the traders and the general public, however, were not, a few years ago, susceptible to new ideas so drastic as to revolutionise the whole system of marketing, and little progress was made. Experience in marketing British apples during 1919, when a large quantity was wasted, combined with the large importations of well-packed foreign and colonial fruit during 1920, has caused horticulturists to view the matter from a different aspect. The retailer also, reflecting the preference of the consumer, has taken a definite stand, and by favouring in his purchases the well-graded and properly-packed imported fruit has clearly shown that he was by no means satisfied with the present system of marketing the home produce.

The Ministry has been urging all concerned to adopt improved methods of grading, packing and marketing, and with public opinion tending strongly towards action in the same direction, the Federation of British Growers has rightly seized a favourable opportunity for launching a practical scheme to deal with the problem. Those concerned in drawing up this scheme and in devising machinery for carrying it into operation deserve the support and goodwill of all British horticulturists, and of the public in general. If it is taken up enthusiastically by those interested in the growing and distri-

bution of applies, the scheme will probably revolutionise the system of packing fruit for the market and place it on a business footing. The Federation of British Growers is making history, and the movement will certainly be noted when the history of British fruit growing is written.

It is hoped that the articles on "Marketing of Fruit" and "Grading and Packing" in the June and July issues respectively of this *Journal*, made it clear that to ensure success it was necessary that any scheme should be an agreed one, approved and supported by all sections of the horticultural industry—the grower, the wholesaler and the retailer. The Federation of British Growers fully realised this important point, and having prepared a tentative scheme, convened a meeting on 24th May, the Controller of Horticulture being chairman, at which representatives of the Ministry, growers, wholesalers and retailers were present. The scheme of the Federation was, after consideration and amendment to meet the views of other sections, finally agreed to in the form set out below.

Before definitely setting out the scheme, it is probably wise to inform readers as to the course which the consideration of measures of reform has taken. A review of previous articles in this *Journal* would show that the Federation of British Growers proposed to issue labels to be used on packages containing apples properly graded and packed in accordance with the agreed conditions. Secondly, it was necessary to lay down standards for grades of fruit, quality, size of package, in terms of figures, so that the buyers and the sellers of the labelled packages would be able to discuss business matters in a language understood by all.

Spaces are left on the label for the grower to fill in the name of the variety, the grade of apple, and net weight or count of the package, and to add, if he desires to do so, his trade or other private mark. The label, duly completed by the grower, and used on the packages of standard size, purports to describe the apples accurately, and therefore becomes a form of contract between the seller (the grower or his agent) and the buyer of the fruit. It thus goes far to establish the system of "honest dealings," a point strongly emphasized by the Ministry in the provisional scheme.

The Federation of British Growers proposes to establish an Association known as the British Growers' Marketing Association, which will be responsible for the distribution of

the labels, and for the general organisation of the scheme. All growers of fruit, and associations of such growers, will be able to join this Marketing Association, and so reap all the advantages which are afforded by a scheme of this kind. Whilst an organisation of this kind cannot relieve the grower of financial responsibility for packages bearing the label, the contents of which fall below the stated standards, it must, as a necessary safeguard to the scheme, set up a Tribunal of Arbitration with power to give authoritative decisions in such cases.

The Scheme of the Federation of British Growers.—The particulars of the scheme as agreed to by the industry are as follows :—

1. **Apples.**—SPECIAL DESSERT fruit such as Cox's, &c.
   Quality—Perfect fruit only. Uniform colour and size.
   Grade—Min. diam. $2\frac{1}{4}$ in.
   Package—Peach box $17\frac{1}{2} \times 11\frac{3}{4} \times 4\frac{1}{2}$ in. inside.
   Count—
2. **Apples.**—DESSERT.
   Quality—Colour, even throughout package; sound, without any blemishes affecting keeping or quality; skin blemishes not to exceed 10 per cent. of the apples; evenly sized, min. diam. 2 in.
   Grades—(sizes) 2 to $2\frac{1}{2}$ in., Blue paper; $2\frac{1}{2}$ to 3 in., Pink and White paper; 3 in. and over, Pink paper.
   Packages—British standard box, $18 \times 11\frac{1}{2} \times 10\frac{1}{2}$ in. inside; Bonnet; Half-bushel sieve.
3. **Apples.**—COOKING.
   Quality—As in 2; Min. diam. $2\frac{1}{4}$ in.
   Grades—(sizes) $2\frac{1}{4}$ to $2\frac{3}{4}$ in., Blue paper; $2\frac{3}{4}$ to $3\frac{1}{4}$ in., Pink and White paper; $3\frac{1}{4}$ in. and over, Pink paper.
   Packages—Half-barrel; Barrel; Bushel-sieve; British standard box.

2 and 3. Every package to be well lined, with coloured paper showing at top. All wicker packages to be lined with stiff paper. Every apple packed in British standard boxes to be diagonally packed and separately wrapped.

Sale. (*a*) Boxes—count or net weight, or minimum net weight.
(*b*) Bonnet—Half-bushel and bushel sieves—tightly packed in layers.
Half-barrels and barrels—tightly packed.
Net weight or minimum net weight.

All these conditions only apply "*when packed.*"

Recommended standard sizes of empties (inside):—

Half-bushel—diam.	15 in.;	depth at side 8 in.;	depth in middle 7 in.
Bushel-sieve— ,,	17 ,, ;	,, ,, $10\frac{1}{2}$,, ;	,, ,, 9 in.
Half-barrel—diam	at top and bottom 15 in.;	depth $16\frac{1}{2}$ in.	
,, ,,	middle 17 in.		

It will be noticed that the apples are classified into three groups: Special Dessert, Dessert and Cooking. To be

marketed under the heading Special Dessert, the apples must be perfect fruits, of uniform colour and size, the minimum diameter of which shall be $2\frac{1}{4}$ in. They are to be packed in peach boxes, and the number of apples is to be stated on the label. Many people will need convincing that perfect apples packed in shallow boxes will need any guarantee or label to sell them; from the method of packing the quality of the apples is apparent to the buyer, and no deception can be practised. Experience shows that growers now packing "Specials" in peach boxes have been quite satisfied with the results; and little complaint as to this class of fruit has been raised by the wholesaler or retailer. The action of the Federation of British Growers does, however, follow the practice which has been adopted in South Africa for oranges, where the First Grade is described in the Fruit Export Act as "Extra Specials." In this connection it is interesting to note that the Inspection and Sales Act of Canada, 1915, described the best grade as "Fancy Quality," but in the Amending Act of 1918 this quality was omitted, the inference being that no regulations were necessary for "Fancy Quality" fruit.

Reviewing the grades for dessert apples other than "Specials," it will be noticed that the apples have been graded according to size; the distinction between the grades or sizes is to be made apparent by the use of different coloured paper. This has distinct advantages, one being that theoretically the grades all start equal, and thus controversy as to whether a dessert apple of $2\frac{1}{2}$ to 3 in. is superior or inferior to those of larger or smaller size cannot arise; secondly, traders have been accustomed to the use of coloured paper for differentiating the various grades of tomatoes—pink and white is used for the more expensive samples, pink for the medium price, and blue for the cheaper samples. This nomenclature for grades of apples appears to be unique. Most countries adopt a numerical system for classifying grades, such as 1, 2 and 3, though in some countries the word "Domestic" occurs. The scale of sizes 2—$2\frac{1}{2}$ in., $2\frac{1}{2}$—3 in., and 3 in. and over would appear to apply well so far as British-grown dessert apples are concerned. It is probable that the middle size of fruit ($2\frac{1}{2}$—3 in.), being the normal size, will soon establish for itself the premier place on the markets in preference to the larger and smaller sizes; so that, like tomatoes, the grades of apples "Pink and

Whites," "Pinks," and "Blues" will in virtue of their respective merits adjust their positions in commerce. The scale of sizes must be subject to alteration, and possibly the standards of quality may be subject to modification: the selected packages now chosen may give place to newer and more adaptable ones; but the colours, once selected should, like the laws of the Medes and Persians, remain unalterable.

One can imagine that the Federation of British Growers and the Committee appointed to help them when discussing the matter, found very considerable difficulties in arriving at an agreement for standard packages. The British Standard Box would no doubt be recognised by most as the best package for dessert apples, but bonnets, in spite of their many disadvantages, by being non-returnable and of light weight, would be favoured by many; while the popular half-bushel sieve has served the British fruit grower too well in the past to be discarded lightly. Recognising these claims the Grading and Packing Committee of the Federation of British Growers acted wisely in deciding to include for the present all three packages. The measurement of the box and the half-bushel are stated so that standards for packages have at last been laid down.

For cooking apples a similar method of grading and classification is provided; but the scheme has not recognised cooking apples of a size less than $2\frac{1}{4}$ in. in diameter, a decision with which all growers may not agree. It should be realised that the label, to be of value, must be reserved to distinguish superior classes of apples, and most people would admit that generally the public does not regard a small apple for cooking purposes as ideal. The grades, the sizes, and the selected colours of papers will probably meet with general approval.

Four different types of packages are to be recognised, the half-barrel, the barrel, the bushel sieve, and the British standard box. Experience will soon decide the most suitable of these packages for each variety of apples. For most varieties and samples of cooking apples the box may be too costly to use, but it is no doubt included in order to provide a package for special cookers such as Newton Wonder, Gascoyne Scarlet, Blenheim Orange and Peasgood Nonsuch. Again, the respective sizes of these packages have been stated. The Ministry has been asked to bring to the notice of manufacturers the necessity for making only such packages as are of the prescribed measurements.

Quality.—It is very difficult indeed to define and describe on paper what is meant by quality, and little criticism on the standard adopted can be made as the Committee has adopted a perfectly safe course in fixing a high and uniform standard for all apples. The scheme reads: "Colour even through package; sound, without blemishes affecting keeping or quality; skin blemishes not to exceed 10 per cent. of the apples; evenly sized." In Canada, where a different standard of quality is fixed for each separate grade of apples, 1, 2, Domestic, and 3, not less than 90 per cent. of the fruit must be free from scab, bruise, wormholes and other defects in order to reach the standard of Grade 1; not less than 85 per cent. for Grade 2 and 80 per cent. for the Domestic Grade; and for Grade 3 the fruit must include no culls. After deciding to differentiate grades merely by sizes, each of which would be distinguished by a special coloured paper, and not by the usual classification of superiority, it was logical that the standard of quality should be the same for all grades. The Committee and the Federation of British Growers have, therefore, in establishing grades and quality, departed, and departed widely, from the usual custom; but by adopting a very high standard of quality greater limitations on the extended use of the label have been imposed, and it may be necessary for most growers to adopt better hygienic measures for controlling pests and diseases before they will be able to produce apples in any quantity 90 per cent. free from blemishes and skin spot. The value of the scheme in stimulating action in this direction will not be small. Again, the higher the standard of quality of fruit sold in labelled packages the greater appreciation will be given by buyers to such packages, which will raise the potential value of the label.

Packing.—All existing legislation on this subject in exporting countries requires that the apples shall be "properly packed." It is very difficult to define the expression further, though Canada states that "properly packed" means that the package should be well and properly filled.

The Committee and the Federation of British Growers have expressed their intention clearly by stating that every package must be well lined, presumably with paper, to protect the sides of the package from bruising the apples, and so arranged that coloured paper shows on the top. It is further recognised that the sides of wicker packages, being rougher, tend to bruise apples more readily, and packing with stiff paper is insisted

on in this instance—a wise ruling. In all cases the apples are to be tightly packed in layers. To those experienced in packing this rule appears unnecessary, for they recognise that apples cannot be packed otherwise than in layers, and that tight packing is essential if the pack is to remain firm during the journey. Large numbers of fruit growers are, however, not familiar with packing, so that the ruling is sensible and necessary. For boxes the Committee and the Federation of British Growers have accepted the diagonal pack which is admittedly the best pack for market fruit, and one that remains firm under rough handling; but it will be a surprise to many to read that every apple must be separately wrapped. It is recognised that wrapped apples are easier to pack than unwrapped ones, that the fruit is prevented from slipping about and so travels and keeps better because of its added protective covering. The public too is familiar with and expects to buy oranges, and even some imported apples, wrapped in tissue paper. Both in the standard of quality fixed, however, and also in this regulation as to wrapping, the Federation has boldly set itself to reach a high ideal by one jump. The Ministry could not withhold its approval, but it may be questioned whether to start with the realisation of the ideal is not something of a counsel of perfection, and whether as a practical policy it would not have been better to have made a beginning with provisions a little less rigorous and then, as growers became familiarised with the scheme, to have tightened it up. The high level to which costs have mounted creates a difficulty for all growers, and amounts to a veritable scare to many; even the cost of tissue paper wrappers may be the straw that weights the scales of judgment against the adoption of the scheme. The more up-to-date growers will, however, probably consider that the greater efficiency outweighs a slight extra cost.

It must never be forgotten that the scheme under review is primarily concerned with the home market. Regulations which may be absolutely necessary for an export trade can here be safely and wisely dispensed with. One does not, in saying this, lose sight of the nascent export trade in English apples which before the War was attaining quite respectable dimensions, and which it is of immense importance to encourage to the utmost. In the question of packages, as a contrast, the Federation scheme wisely deals with the well-known susceptibilities of the grower with almost maternal tenderness, and has lent the ægis of its protection to prolong the life of

several forms of package hoary with antiquity—forms which the ardent reformer, hasty for the attainment of the ideal, might have rejected.

Net Weight or Count.—The scheme to succeed has to meet the grievance of the retailer as to the honesty of the fruit, and especially so as regards the count or weight of apples in the package. For "Special Dessert" the number is more important than weight, and the count must be stated. For boxes of dessert or culinary apples either the count or net weight (or minimum net weight) gives the needed information, and according to the scheme the grower may decide which to declare. For half-bushels, bushels, barrels, half-barrels, and bonnets, &c., net weight, or rather the minimum net weight has to be declared. Few will take offence or object to this, for it is now generally realised that the buyer of fruit is entitled to know the weight that he is purchasing.

In conclusion, it should be stated that this voluntary scheme drawn up by the Federation of British Growers and approved of by the Committee representative of the horticultural industry, has adopted novel methods of classification of grading, and established a peculiarly high and fixed standard of quality for all grades of apples. The scheme is to be launched by the Federation of British Growers, and experience in working the scheme will indicate where modifications can be made. It has received the general support of the Ministry, and is earnestly commended to British fruit growers as the first step in the direction which the packing and marketing of all classes and kinds of vegetable produce, as well as fruit, must take (1) if the legitimate demands of a discriminating public are not to be met by imported produce only; (2) if the reasonable requirement of the retail distributor, that he shall be able to buy on something akin to the same basis on which he must sell, is to be met, and (3) finally, if British growers are not to be relegated into the wilderness of economic failure by the men who will organise upon business lines and adopt the new methods.

This scheme is purely voluntary, and will in no way interfere with, though it may exercise an influence upon, the marketing of produce of lower grades than those stated in the scheme.

COST OF HARVESTING POTATOES.

OFFICIAL Statistics for 1920 show that the acreage of potatoes in England and Wales was 544,615 with an estimated yield of 3,151,000 tons. Considering the importance of this crop it is a surprising fact that no figures have previously been published dealing with the cost of harvesting potatoes. This report gives an account of an attempt which has been made to obtain information on this subject.

Methods of Lifting.—Lifting is generally done by using the fork, the plough, or the potato digger. During the past year a few American potato lifters have been used.

Lifting by the *Fork* is undoubtedly the oldest method. In this way the work is well done, and practically all the potatoes are removed from the soil without bruising. The work is both slow and laborious, however, and hence where large acreages had to be lifted, the *Plough* soon displaced the fork and generally gave satisfaction. The wastage with the plough is undoubtedly more than when the fork is used, but it is generally believed that the crop is harvested with a considerable saving of labour and expense. This practice is still followed for lifting potatoes grown in the heavier classes of soil, and even for first early varieties grown in light soils.

In more modern times engineers turned their attention to machinery for agricultural purposes, and produced a mechanical *Potato Digger* which lifts the crop much quicker than had hitherto been possible with either the fork or the plough. In the early days, when the digger was in its experimental stage, it bruised the tubers considerably, and even with the present-day machines a certain amount of damage is done. Some bruising seems inevitable, as considerable force has to be exerted in throwing both tubers and earth well up into the air. Further wastage from loss of tubers occurs since the earth on falling to the ground covers many of the tubers, and it is probable that a considerable number remain buried in the soil and are not turned up by the harrows. In spite of these drawbacks, the digger has gained favour, and is now largely used in the extensive potato areas.

Scope of Enquiry.—The Ministry was anxious to obtain, if possible, figures showing the comparative and approximate costs of harvesting potato crops by the three methods, and accordingly

invited farmers to fill up a Questionnaire giving particulars of the soil, crop, acreage, method of lifting, and the man and horse power employed. Inspectors of the Horticultural Division co-operated with farmers in obtaining these figures. As a result the Ministry received reports of the cost of harvesting 703 acres of potatoes on 50 separate holdings; the information in 15 cases relating to 104 acres was not of sufficient value for the purpose, and was disregarded.

Bearing in mind the fact that a small holder might not be in the position to use the same method of lifting as that employed by a large potato farmer, an attempt was made, (1) to find out what constituted a "working unit" for each system, *e.g.*, the number of horses and amount of labour to keep one plough or one digger at work; (2) to determine the cost of keeping one of these units at work for one day; and (3) to ascertain the quantity of potatoes lifted by each unit per day.

It was expected that the cost of lifting the potatoes would vary with the different classes of soil, seeing that both the size of the crop and ease of working the soil would be largely influenced by its texture. The figures for each class of soil were tabulated under three headings, *Heavy Soils*, *Medium Soils*, and *Light Soils*. From these figures it was seen that a working unit could raise in a day a larger quantity of potatoes on medium soils than on heavy soils, whilst on light sands the tonnage raised per day was slightly less than on medium loams. The latter is probably due to the fact that the medium soils yield heavier crops than do sands.

Lifting by the Fork.—From the information received, it was impossible to draw any conclusions as to what constituted a "working unit" in the case of the fork. For instance, one farmer employed 7 labourers with forks to 3 women gatherers; another farmer, 2 labourers with forks to 2 boys; and a third 12 labourers with forks to 12 gatherers. Neither did the figures obtained give any definite information of the acreage lifted per day by one man with fork.

Lifting by the Plough.—Similarly, the figures obtained where the plough was used were on the whole so unsatisfactory that no safe conclusions could be drawn. In one case, however, the return received showed that the farmer had been to some pains to prepare a clear and accurate statement, and the results are interesting as showing that with a good crop and efficient organisation the cost of harvesting can be kept low.

The "working unit" was constituted as follows :—

Ploughing	...	1 man, 2 horses.
Harrowing	...	1 „ 2 „
Carting ...	...	2 men, 2 „
Pickers ...	...	10 women behind the plough and 2 women clearing behind the harrows.
At Clamp	...	2 men.

The soil was of the medium loam type and the crop lifted was approximately 10 tons per acre. This unit was able to clear 2 acres (*i.e.*, 20 tons) per day. The actual cost per day of keeping the unit at work was as follows :—

	£	s.	d.
1 man with 2 horses for Plough	1	10	0
2 men with 2 horses for Carts	2	0	0
1 man with 2 horses for Harrows...	1	10	0
12 women (pickers) at 8d. per hour	3	4	0
2 men at Clamp at 8s. 1d. per day	0	16	2
	£9	0	2

From these figures it will be seen that the cost of harvesting the crop was only 9s. per ton. It should be borne in mind, however, that the figures relate to a particular case, in which the working costs are probably less than the average and the weight of the crop considerably above the average. The charge for horse labour alone is considerably lower than that obtained (13s. 6d. per day) by taking the average of all the returns.

Lifting by the Digger.—1. *The Composition of a "Working Unit."*—From the returns received it appears that an average "working unit" required to keep a potato digger at work, and to pit the potatoes as lifted, is 1 digger, 1 pair of harrows, 3 carts, 6 horses, 1 foreman, 4 horsemen, and 21 labourers and gatherers. As might be expected the number of labourers and gatherers required is greater in the case of the lighter and medium classes of land and less for the heavier classes of land.

2. *Results.*—On the lighter classes of land, such as the sands and the light loams, about 2.8 acres could be cleared by one unit in a day, whilst on the heavy loams and the clays, where the digger meets greater resistance from the soil, and transport problems are more difficult, the acreage cleared by the same unit was no more than a little over 1.8 acres, or 1 acre a day less than on light soils. When it is remembered that the larger crops of potatoes are also produced on the medium classes of land such as light loams, the full importance of this will be appreciated. From the lighter soils a "working unit" on the

average raised and pitted 25 tons 12 cwt. per day—though in one instance the figures were as high as 36 tons 13 cwt., probably the result of superior organisation on the farm. The highest quantity lifted and pitted from the heavy soils by a "working unit" was 15 tons, whilst the average was as low as 13 tons 17 cwt. The weight of the crop per acre is also not without influence on the quantity lifted per day, as will be seen from the following Table, which relates entirely to crops produced from the various classes of light and medium soils.

	Crop per acre.		*Tonnage lifted per day by unit.*	
	Tons.	Cwt.	Tons.	Cwt.
Holding No. 1	11	—	36	13
„ 2	10	—	30	—
„ „ 3	10	—	27	10
„ „ 4	9	—	27	—
„ „ 5	7	—	18	8
„ „ 6	6	—	12	—
„ „ 7	3	2	7	—

3. *Costs.*—The figures have been deliberately presented so far without any reference to cost. In these changing times, any prices mentioned only remain of value for a limited period, and often are out of date before being published. So far as labour for potato raising is concerned, the wages have been fixed by the Wages Boards for the respective districts, and naturally vary for each district and for each class of labour.

All horse labour is charged on the assumption that the grower had to hire the necessary horses at the current rate of the district, which on the average appears to be 13s. 6d. per day. The average wage for a foreman is 12s. 6d. per day; for skilled labourers, such as horsemen, &c., 9s. 9d. per day, for labourers 9s. per day, and for women 5s. per day.

The daily cost of maintaining a "working unit" with a digger on harvesting potatoes, as determined from the returns sent in, and at the prices stated, would therefore appear to be £12 13s. 6d. This means that the average cost of harvesting a ton of potatoes grown on the lighter and heavier classes of soil would appear to be 9s. 11d. and 18s. 4d. respectively.

The figures bring out in a striking manner the financial disadvantage of the grower of potatoes on heavy solis: (1) His cost of preparatory cultivation is greater and the comparative cost of raising his crop is higher, than that of his fellow farmers on the light loams; and (2) the crop from the heavy lands will be appreciably smaller than from the light loams.

These factors operate in the same direction so far as the potato farmer on heavy soils is concerned.

In each case, the cost of the disposal of the crop, either by clamping, or bagging and conveying to the nearest railway station, or dispatch to the nearest railway station for conveyance in bulk (*i.e.*, unbagged), was taken into consideration in obtaining the cost of harvesting the crop.

Value of Spraying.—The Questionnaire asked growers to state whether the crop had been sprayed or not. In 13 cases the crops were reported to have been sprayed, whereas in 27 cases no spray had been used. The average crop on the sprayed area was approximately 10 tons per acre; while that on the unsprayed area was a little over 8 tons per acre. The heaviest crop on a sprayed area was 15 tons per acre in Bedfordshire. The area was slightly over 18 acres, the varieties being Great Scott, Ally, Lochar.

The next heaviest sprayed crop was 14 tons per acre over an area of 22 acres in Surrey. The varieties were Arran Chief, Ally and Majestic, the first variety occupying two-thirds of the area. The heaviest unsprayed crop was 12 tons per acre over an area of 17 acres in Surrey, the varieties grown being Arran Chief and Ally in about equal proportions.

It is recognised that growers who spray their potatoes may also give more attention to cultivation than do other growers, but this fact does not lessen the value of spraying as a means of securing a larger tonnage per acre.

WOMEN IN RURAL LIFE.

GRACE E. HADOW.

AMONG the many unexpected results of the War has been a dawning realisation of the part which must be played by women in rural life if our country-side is not to become depopulated. The Land Army did splendid service in helping to keep farms cultivated when otherwise they must have lapsed. Women ploughed, thatched, drove horses and tractors, and, as women have always done, weeded and hoed. Undoubtedly the result was to make many women realise ways in which they may become agricultural workers in peace as well as in war; to stimulate their desire for an open-air life; and to give farmers confidence in women, especially for dairy work and market gardening. A certain number of women have taken, and will continue to take up these occupations as a direct consequence of the call to service on the land.

The influence of the Land Army, however, was far wider, and in a sense far more important than this. It taught country women of all classes to take an intelligent interest not only in agriculture and horticulture, poultry keeping and pig keeping, but in rural life generally. The extraordinary growth of the Women's Institute movement is perhaps the most conspicuous and striking evidence of the new life stirring in the country-side, but it is only an evidence of something still more wide spread. During the War educated women lived in cottage homes and worked side by side with agricultural labourers. Town dwellers came from crowded alleys to make hay and stook wheat; country girls who had never left home before, went away to work in huge munition factories. In the great kaleidoscope of war we were shaken together—we are still being shaken—and in forming new patterns we gained new adaptability.

Two forces in this freshly-shaping world are at present in danger of pulling opposite ways. The improved status of the woman labourer, the intelligent interest which has been developed in food production and in house-craft, pull one way; the increased consciousness of the dullness of country life pulls the other. No sane being wants to see all farms "womaned" instead of "manned," or even the majority of country-women become agricultural labourers. Quite apart from their actual work in dairy or poultry-yard or garden,

however, women have a vital part to play in rural development. The elimination of this tug-of-war is important. The War encouraged us to use our reason. No person who does so is going to submit to the conditions which have hitherto prevailed in many villages. A picturesque cottage with no water laid on may give pleasure to the tourist, but it has disadvantages from the housewife's point of view. A life of—largely unnecessarily—hard work, enlightened only by an annual village concert, is not one which ought to hold men or women. The natural shrewdness of the peasant is beginning to ask why it should. In one village it was said that twenty-eight men returned from the Army to work on the land as they had done before. At the end of a month, twenty of them expressed their intention of leaving and going into the town because neither they nor their wives could stand the monotony of country life. The same plaint rises from all sides.

If our rural problem is to be solved, there is one way and one way only in which to meet it, and that is to allow countrymen and women to develop rural life on lines hitherto little explored. Probably there has never been so good an opportunity for farmers to get intelligent workers, because there has never been so wide-spread a desire for education and for the stimulus of recreation. Most of us have met the Rev. Abraham Plymly, who through living long in the country "had become as it were a kind of holy vegetable." Let him be contrasted with the group of ploughboys of 15 and 16 who recently came to ask for help because they were forgetting what they had learned at school, or the class of elderly working women in a tiny village who asked for—and attended—a six weeks' course on Mediæval History. Not long ago the writer asked the members of a Women's Institute on what subject they wished to have a speaker at their next meeting. The answer came prompt and unmistakable, "The connection between Wages and Prices, please." Most interesting and most hopeful of all, these women are beginning to want information on which to form their own opinions. They want people to give them facts, and then to discuss them themselves.

The intelligence developing on these lines is making itself felt, as it inevitably must, in other directions also. The matter of rural industries is by no means a simple one, but without going into vexed questions of competition, local trade, and home industries generally, it may fairly be said that a large and rapidly increasing number of village women are learning

to make certain articles for home use and for sale to a small extent, and in doing so are at once adding a great and growing interest to village life and learning the elements of co-operation. The "Members' Stall" which is a feature of many a Women's Institute Meeting has often a tiny turnover reckoned in money, but the stimulus that it gives to craftsmanship and to interest in learning new methods reacts on the whole village. In certain market towns village women have now their own market stall, to which they bring such odds and ends of produce as they may have each week. It would not be enough to supply a shop. It is uncertain in amount and irregular in character. One such stall, however, had a turnover of £800 last year. Not only does this give the women an interest in production, on however small a scale, but it teaches them to co-operate in buying seed or chicken food or what not, and in marketing. It also leads women and men to a greatly increased interest in county council lectures on food production and preservation.

Country life is far from dull in itself; it becomes dull when it is allowed to become lonely and monotonous. The Postmaster-General spoke a short time ago of his dream of having the telephone in every village. At the moment opinion might differ as to the added gaiety and content likely to result from the installation of a telephone in every home, but the principle is sound. Many facilities for social and educational life, many appliances for lessening labour, which we consider essentially urban, are to be found in the far more scattered and remote villages of Canada and the United States. When English country-women really face the problem, not how to endure but how to enjoy country life, a larger number of agricultural difficulties will be diminished, if not removed, than farmers possibly realise, for in the long run the women have considerable control over the situation in their power to make home life comfortable or uncomfortable, and in their influence on husband and children. In many districts before the War, work on the land, the true aristocrat of industry, had fallen into disrepute. It was considered a rise in the social scale to wear the black coat and pasty face of a sedentary worker, and agriculture was in danger of becoming like one of those stately old homes which the tide of fashion has left slowly decaying in what is now a back street. The War has done much to bring back a more sane and healthy point of view, but it depends largely on country-women if that standpoint is to be maintained.

BESOM-MAKING IN DERBYSHIRE AND NOTTINGHAMSHIRE.

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SMALL rural industries are often hereditary in their nature. Providing little more than a bare subsistence in return for long hours and exacting work, they do not attract youth from elsewhere. Boys learn from their fathers because they are surrounded by the tools and the jargon of the trade from their infancy upwards, and because the father presses the boy into it as soon as possible: even a child's help in handing tools, preparing material and other small matters will lighten a man's work. The trade connections, both for the supply of raw materials and the distribution of goods to the customer, make an easy niche into which the boy can slip, and unless he feels active dislike of the work and has an enterprising nature into the bargain, he is likely to settle down to his father's trade. Many young people continue a hereditary industry for negative reasons of this sort, but there are some who carry it on in a positive way. Love of the work and aptitude for it are bred in the bone, and pride of family and craft mingle to give working life an interest and a meaning that can only be obtained for most people through the pursuits of their leisure time. An eight-hour day is only necessary for the man whose work is uncongenial, and who must have leisure in which to follow out that part of his life in which he can truly live. Men who work from 5 a.m. to 10 p.m. are not entirely legendary, but are always to be found among those whose work satisfies every side of their nature. Men carrying on hereditary crafts may possibly be included among these.

Forest products provide much material for small rural industries, and writers on social conditions have often noted the variety of occupation and comparative prosperity of even the poorest villagers who live within reach of woods. A modern example of a small but flourishing industry that depends on woods or forests on the one hand and heather moors on the other is that of besom-making.

Materials.—Many besom-makers are found around Chesterfield and at isolated places on or near moors—Dore, Darley Dale and Bamford in Derbyshire, and near Mansfield and Ollerton.

A besom-maker usually goes with his horse and cart and cuts the heather under the direction of the gamekeeper, to whom it is an advantage to have the heather kept down by this means. If it were not cut, it would have to be burned—a more laborious and less satisfactory method for the keeper. On some estates a nominal sum is paid for the privilege of cutting, on others a tip to the keeper is in vogue, while on a few there is no money transaction. The heather must usually be cut before Lady Day, but as there appears to be little deterioration in it when stacked if it is cut in dry weather, this is not a disadvantage to the besom-maker.

The other most important material used is wood for the stakes (or handles). If the besom-maker lives in a wooded district, as well as near the moors, so much to his advantage, and it is usual for the two supplies to occur together, as extensive moors are part of large estates on which there are almost invariably some plantations and therefore underwood for sale.

Another material for making besoms is birch twigs. These can usually be obtained near the stakes, from the underwood cut on the estates. In Derbyshire and Nottinghamshire, however, a far more important outlet is to be found for heather besoms. These are used in the steel works of Sheffield and in malt kilns, whereas birch besoms are mainly used for lawns and gardens.

Old-fashioned besom-makers used split ash for binding the heather or birch, and one or two men who make besoms as a part-time occupation have never troubled to learn modern methods and still use it. It is very laborious; only half-a-dozen strands can be cut off each stick and then the centre is used as a thatch pin. Cane is used for this purpose by all whole-time besom-makers: one man said that he was able, in one hour with cane, to supply his son with all that he would require for a day's work; with split ash it would have taken four hours.

Implements.—Besom-making is almost entirely a hand-industry. With the exception of a tool known as a "needle," for threading the cane through the brush, the only implement used is a very simple iron press or vice worked with the foot which presses the heather into place while the cane is being wound around it. It is a comparatively modern invention and was unknown to the fathers of present besom-makers. One man was heard of who had begun to use it only last year, but he was one of the part-time workers of the forest district of Nottinghamshire. These men usually make besoms of

birch because they are out of reach of the moors; they make them for a few old regular customers and only keep on the trade because it has come to them from the previous generation and they have got the habit of it, while for their main livelihood they rely on something else. The only man to use split ash was one of the part-time workers. The old method of pressing the brush into shape was done by gripping the ash or cane in an instrument known as a "stool" or "saddle," which stood on the floor, and pulling. The strain then came on the binding and often broke it before it was put in place. With the iron foot-press the strain comes on the heather where every ounce of it is an advantage. The press is so simple that after a brief description of it any village blacksmith can make it.

Quantities.—The time it takes to cut and fetch heather, and the quantity in a load, differ. From Mansfield it was said to take three days to cut and bring in a load. Six armfuls of heather was called a bundle and there were forty bundles in a load; one bundle made a dozen besoms and one old man and his son used five bundles in a day.

From Chesterfield one load of heather took only one day to cut and fetch. There were 160 bundles of heather in a load, but each bundle only made seven besoms at the outside, and sometimes only five or six. Distance from the workshop to the moor would make the difference in the time it took to cut and bring in, but there must also have been a difference in the size of the bundles.

Prices.—The usual price for the completed besoms seems to be 6s. 6d. or 7s. a dozen. It is difficult to estimate the cost of heather; one man considered that carting it cost him 8s. to 10s. a load, but when the price of a carter with his horse and cart is usually reckoned in the same neighbourhood to be about £1 a day this would seem to be under-estimated unless there is some special arrangement. Besom-makers who employ more than one or two men find it convenient to keep a horse and cart of their own, and for those who are part-time besom-makers the occupation into which it best fits is found to be carting.

Beson stakes cost 4s. to 5s. a hundred, where before the War they were 1s. 6d. a hundred. In some districts, especially near Chesterfield where there are several besom-makers and few trees, they may have to be sent from some distance. When this occurs the price may be doubled by railway carriage, and stakes will cost, perhaps, 8s. a hundred.

Cane sometimes costs 10s. a cwt. and freight another 5s. a cwt.

A man who does not own a horse and cart has another expense. To send besoms to the station ready to be shipped away may cost 2s. 6d. a load; before the War the railway collected them free.

Markets.—Sheffield seems to provide an unlimited market for besoms. They are used to sweep up steel-shavings in many works, and as some of the floors are hot and burn away the besoms quickly, they are required in large quantities. One man who has a larger establishment for making besoms than most others, sends fifty dozen a week to Sheffield. Others supply railway companies, coal mines, and malt kilns at Derby, Newark and many other places. For malt kilns, besoms made of ling rather than heather are preferred; for lawns they are always made of birch.

Some years ago when many battleships were being built and large quantities of steel plates were being made in Sheffield, another use for birch twigs was discovered. Red-hot steel plates develop a kind of flake or shale when they first come in contact with the air; the burning of birch twigs strewn lightly on them removes the flake. One besom-maker who supplies the steel trade in Sheffield used to send bundles of birch twigs to be used for this purpose. Other twigs can be used but birch are the best. This trade is now at a standstill.

Besoms and Baskets.—One or two besom-makers combine with their business that of making a sort of rough oak basket known as a skipp or skepp. The oak is soaked in hot water and then split into wide thin strips: these are then woven round a framework of strong osier or thin hazel. The basket when finished is not tight enough for coal but is used for coke, and in some of the Sheffield works it feeds furnaces where basket as well as coke must be consigned to the flames. It is particularly useful for such a purpose because all the material of which it is made will burn.

The oak is usually of that quality which, in the winter of 1920-21, was sold for 3s. 6d. a foot. This is not the best quality, but any size will do for the besom-maker as long as it is "kind." It must be straight and without knots. About sixteen dozen of these baskets go to Sheffield each week and the price is 30s. a dozen. One man can make ten baskets in a day (from 7 a.m. to 5 p.m.), but if his oak is split and all materials ready he can make sixteen to eighteen baskets a day.

EXPERIMENTS ON THE CONTROL OF ONION SMUT.

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THE attention of growers in this country was first drawn to the new and serious disease of Onions and Leeks, called Smut, by A. D. Cotton in this *Journal* in 1919.* The disease which is due to the fungus *Urocystis cepulæ*, and fortunately appears to be localised in a few centres; and there is no evidence that it is spreading rapidly, if at all. It should be remembered, however, that Onion Smut is a seedling disease, and is very easily overlooked at that stage in the growth of the plant when it is most destructive, *i.e.*, when it is in the two-leaf condition. It is possible, therefore, that the disease is more widely distributed than is at present suspected.

The serious result that would follow any increased distribution of the disease is evident from the fact that in Northumberland, where the most severe attacks have been experienced, a loss of 90 per cent. of the crop may be expected if the growing season is unfavourable.

As early as 1884, Worthington G. Smith† expressed the fear that Onion Smut was already present in this country. He was led to this conclusion by the many complaints that onions were falling into a black, dusty mass after harvesting. It is not possible to say whether the disease did exist at that time in this country, but the fear expressed, at any rate upon the evidence given, was unfounded, for it is now known that Onion Smut does not produce the symptoms described. There can be little doubt, however, that the disease existed in this country many years before it was first identified, in 1914, by W. B. Mercer, then Adviser in Agricultural Botany at Armstrong College, Newcastle-on-Tyne.

The Northumberland Outbreak.—The early history of the two infected centres in Northumberland has been investigated by the writer. The disease was apparently first noticed in or about the year 1900. In one case it appeared the first season after purchasing seed from the south of England. Before this seed had always been purchased from a small grower in Edinburgh, and in view of the discovery in 1912 that smut was present in the neighbourhood of that city, it is an interesting conjecture

* A. D. Cotton, Onion Smut:—A disease new to Britain, this *Journal*, Vol. xxvi., No. 2, 1919.

† Worthington G. Smith, *Diseases of Field and Garden Crops*, 1884.

whether the disease at Crookham-on-Tweed was introduced by the use of contaminated Scottish seed. At one centre (Wylam) the grower is of the opinion that the Smut followed the purchase of an unusually large quantity of seed consequent upon the decision to increase the acreage under onions; but he is unable to recollect the locality from which the seed was purchased. It appears to be definitely established that Onion Smut can be carried by means of contaminated seed.*

So far as the writer is aware the total acreage infected in Northumberland is as follows:—Crookham-on-Tweed, $\frac{1}{4}$ acre; Wylam-on-Tyne, 7 acres, and one 3-acre field on the eastern boundary of the village; Horsley, one 3-acre field and three separate plots of $\frac{1}{2}$ acre each. A further small plot at Whitley Bay is possibly infected since it is known that seedling onions grown in infected soil have been planted there.

All the plots except the first and last are cultivated by the same grower, and in all probability the disease has been carried from one field to another on the boots or implements of the workmen. Examination of neighbouring gardens failed to reveal any signs of Smut.

The system of cultivation on all the infected plots follows the usual lines except that most of the crop is left unthinned. The only manure used is either farmyard or stable manure, and the seed is drilled in rows about 12 in. apart. At Wylam, the main sowing is done in August, the crop being sold the following spring as "scallions" for the table. The practice at Crookham, however, is to sow in spring, usually for sale as transplants.

The actual date of sowing has little effect upon the intensity of attack, this being very largely determined by the kind of growing weather experienced. Autumn-sown crops usually suffer much more severely than do spring-sown, and a dry growing season undoubtedly results in a greater loss from smut than is to be expected if the season is warm and moderately damp.

Experiments on Controlling the Disease.—The first attempt to control the disease was made by W. B. Mercer, in 1915, at Wylam, on a plot of land which had carried gooseberry bushes for 16 years and had never been under onions within the memory of the grower.†

* G. H. Chapman, Mass., Sta. Rpt., 1909, pt. 1, pp. 164-167.

† The question as to how this plot became infected can now be merely a subject for speculation. Since the plot is centrally placed in a garden which is badly infected, there is little doubt that both wind-borne spores and spores carried on the boots and implements of the gardeners have contributed to the dissemination of the disease. The possibility, however, of surface drainage water playing its part in distributing the spores should not be overlooked.

After being harrowed flat the land was treated as follows :—

Plot A (64 sq. yd.) received a mixture of 12 lb. of sulphur and 24 lb. of builder's lime ; the latter, however, when received, appeared to be completely slaked. Immediately after application the mixture was harrowed in.

Plot B (28 sq. yd.) received 10 lb. of calcium cyanamide worked in as in Plot A.

Plot C (18 sq. yd.) was treated with a solution of formaldehyde (1 lb. of commercial formalin dissolved in 3 gal. of water). The solution was applied by means of a watering can.

In all three cases the seed was sown a fortnight after the land had been treated. The main crop of onions on an adjoining plot acted as a control.

A considerable amount of disease appeared on all the plots. None of the treatments seemed to have effected any diminution in the intensity of attack. The one interesting fact brought out was the value of thorough surface cultivation. A strip of land, including about four rows along the edge of all the plots, was left unhoed and it was noticed that this strip suffered far more from Smut than did the remainder. This fact has been repeatedly observed in subsequent experiments.

Unfortunately, the trials had to be abandoned, and were only resumed when Mr. Mercer and the writer returned from war service in 1919.*

A further set of trials was devised in 1919. These trials were based upon three suppositions :—

(1) That a trial of varieties might reveal differences in susceptibility to attack, which might be turned to account. In the United States, for instance, it has been stated that tender white varieties are more susceptible than are yellow ones.†

(2) That some means must be discovered of increasing the rate of germination of the seed, since once the seedling is above ground it is not susceptible to attack.‡ It was found in the course of laboratory experiments that a weak solution of sulphuric acid greatly increased the energy of germination of onion seed, possibly by hydrolysing the starchy endosperm or by rendering the seed-coat more permeable to watery salts.

(3) That the failure of the formalin treatment in 1915 might be due to the volatile nature of that compound. An attempt was therefore made to increase the length of time during which the gas would act by applying solid paraform instead of liquid formalin.

* The first 1919 trial was devised conjointly, but as Mr. Mercer left the locality shortly after the seed was drilled, the responsibility for observations and conclusions rests with the present writer.

† B. D. Halstead, New Jersey Sta. Rpt., 1898.

‡ T. Whitehead, *On the Life History and Morphology of Urocystis cepulæ*, Trans. Brit. Myc. Soc., Vol. vii. pt. I, 1921, pp. 65—70.

Seed Treatments, 1919.—The following treatments were carried out. The very susceptible variety "White Lisbon" was used throughout, and the seed was drilled on May 1st.

Plot 1 (Rows 1 to 4). Soot and salt applied to land on May 1st, and thoroughly worked in.

Plot 2 (Rows 5 to 8). Untreated control.

Plot 3 (Rows 9 to 12). Row 9. Soil untreated, seed soaked for two days in 0·1 per cent. sulphuric acid, washed and dried.

Row 10. As in row 9 but 0·5 per cent. acid used.

Row 11. As in row 9 but 1 per cent. acid used.

Row 12. As in row 9 but 2·5 per cent. acid used.

Plot 4 (Rows 13 to 20). Row 13. Seed treated with 0·5 per cent. acid as in row 9 and afterwards shaken up with 0·07 grammes of paraform, just before sowing.

Row 14. 0·5 per cent, acid treatment and 0·28 grms. of paraform.

Row 15. 0·5 per cent. acid treatment and 0·56 grms. of paraform.

Row 16. 0·5 per cent. acid treatment and 1·4 grms. of paraform.

Row 17. No acid treatment but treated with 1·4 grms of paraform.

Row 18. No acid treatment but treated with 0·56 grms. of paraform.

Row 19. No acid treatment but treated with 0·28 grms. of paraform.

Row 20. No acid treatment but treated with 0·07 grms. of paraform.

The seed for Plot 4, *i.e.*, rows 13 to 20 inclusive was, in each case, shaken up with the proper quantity of paraform immediately before sowing. It was found, however, that the seed hopper became dusted inside with paraform, so that the last four rows probably received a heavier dressing than was intended.

NOTE.—A small plot (8 sq. yd.) along the edge of Plots 1 to 3 inclusive had about ¼ lb. of paraform worked in on Feb. 21st. This plot produced but a scanty crop and many of the plants were diseased.

In addition to the White Lisbon seed used throughout Plots 1 to 4, seven other varieties were tested.

Taking a full crop as 33 plants. a count gave the percentage of healthy plants in one foot of each row as follows :—

Row (1) 54·5 ; row (2) 21·2 ; row (3) 60·6 ; row (4) 12·1 ; row (5) 9 ; row (6) 12·1 ; row (7) 6 ; row (8) 15·1 ; row (9) 3 ; row (10) 3 ; row (11) 6 ; row (12) 0 ; row (13) 3 ; row (14) 3 ; row (15) 0 ; row (16) 3 ; row (17) 12·1 ; row (18) 6 ; row (19) 6 ; row (20) 12·1.

All the varieties tested proved to be susceptible ; the best one (Red Garganus) giving only 36 per cent. of healthy plants.

Soil Treatments, 1919.—In the autumn nine plots, each one yard wide, and extending across the whole trial ground, were treated as follows :—

Plot (1) ½ lb. of paraform worked into the land on Aug. 25th.

Plot (2) 2 lb. of bleaching powder applied as in plot (1).

Plot (3) 2 lb of soot worked in on Sept. 1st.

Plot (4) 2 lb. of salt worked in on Sept. 1st.

Plot (5) 2 lb. each of soot and salt worked in on Sept. 1st.

Plot (6) Untreated control.

Plot (7) 2 lb. of lime worked in on Sept. 1st.

Plot (8) 1 lb. of Nitrate of Soda worked in on Sept. 1st, followed by a similar top-dressing after sowing (Sept. 3rd).

Plot (9) Top 3 in. of soil removed, burned and replaced.

Across these plots, seed, treated as under, was drilled on Sept. 2nd in rows 12 in. apart by means of a Planet Junior single row drill :—

Series (1) 8 rows drilled with 2 oz. of seed mixed with 14 lb. sand.

Series (2) 4 rows untreated seed as control.

Series (3) 4 rows (2 oz.) seed soaked in water two days and dried.

Series (4) 2 rows (1 oz.) seed soaked in 0·5 per cent. sulphuric acid for two days and dried.

Series (5) 2 rows seed soaked in 0·5 per cent. acid, dried and dusted with 0·07 grms. paraform just before sowing.

Series (6) 4 rows seed soaked in 1 per cent. acid for two days and dried.

Series (7) 4 rows treated as in (6) but using 5 per cent. acid.

Series (8) 2 rows treated as in (6) but using 10 per cent. acid.

Series (9) 2 rows treated as in (6) but using 10 per cent. acid for 1 hour.

Series (10) 4 rows seed shaken up with 0·14 grms. of paraform.

Series (11) as in (10) but using 0·28 grms. of paraform.

Series (12) as in (10) but using 0·56 grms. of paraform.

This trial gave 108 different combinations of seed and soil treatments; the part where Series (2) crossed Plot (6) acting as control. Counts were made of the number of healthy plants in the middle foot of each row of seed along the untreated plot; this gave the effect of seed treatment. Another count was made of the number of healthy plants in the middle foot of each plot along the untreated seed rows; this gave the effect of soil treatment.

Effect of Seed Treatment.	*Effect of Soil Treatment.*
Series (1) average = 13	Plot (1) average = 9·5
Series (2) average = 10 (control)	Plot (2) average = 14·75
Series (3) average = 25·25	Plot (3) average = 14·5
Series (4) average = 12.5	Plot (4) average = 15·25
Series (5) average = 18·5	Plot (5) average = 11
Series (6) average = 12	Plot (6) average = 10 (control)
Series (7) average = 14·5	Plot (7) average = 22·5
Series (8) average = 4·5	Plot (8) average = 1·5
Series (9) average = 26	Plot (9) average = 3
Series (10) average = 16·5	
Series (11) average = 21	
Series (12) average = 14·25	

The best seed treatments, therefore, were :—soaking in water for two days; soaking in 10 per cent. sulphuric acid for one hour; and dusting with 0.28 grammes of paraform.

The best soil treatments were :—lime, salt, bleaching powder and soot.

The sowings were made so late (Sept. 2nd) that it is certain that these figures include plants killed out by the cold weather as well as those killed by Smut, but that they roughly represent the mortality due to Smut is shown by the fact that adjoining plots which were sown earlier had 90 per cent. of the crop diseased.

Probability of Death Resulting from Infection.—To test whether infected plants are able to " grow out " of the disease, 45 plants affected with Smut were marked and kept under observation. The fact that 42 of these plants succumbed shows that the chances of an infected plant surviving are somewhat remote.

Soil Treatment, 1920.—On May, 6th, 1920, a trial, was laid down similar to the autumn trial of 1919, with the addition of a plot treated with 2 lb. of carbon bi-sulphide worked into the land a fortnight before sowing.

In each case an area of 7 yd. by 1 yd. constituted a plot.

Counts were only made along the untreated seeds rows with a view of determining the effect of the soil treatments.

Taking 100 as representing a full crop for one yard :—

Plot (1) ½ lb. of paraform worked into the land a fortnight before sowing gave 60 healthy plants.

Plot (2) 2 lb. of bleaching powder applied as in plot (1) gave 0 healthy plants.

Plot (3) 2 lb. of salt applied as in plot (1) gave 10 healthy plants.

Plot (4) 2 lb. of soot applied as in plot (1) gave 30 healthy plants.

Plot (5) 2 lb. each of soot and salt applied as in plot (1) gave 2 healthy plants.

Plot (6) Untreated Soil gave 15 healthy plants (control).

Plot (7) 2 lb. of lime applied as in plot (1) gave 15 healthy plants.

Plot (8) 1 lb. of nitrate of soda worked into the land a few days before sowing, followed by a similiar application a few days after sowing, gave 10 healthy plants.

Plot (9) Top 3 in. of soil removed, burned and replaced, gave 70 healthy plants.

Plot (10) 2 lb. of carbon bi-sulphide applied as in plot (1) gave 50 healthy plants.

From these results it would appear that the best soil treatment was burning; the next best was paraform; and the third best carbon bi-sulphide.

In addition to the above trial, 21 varieties of onions and 11 varieties of leeks were tested.

All varieties which have been tried, both of onions and leeks, have proved to be susceptible, though the latter were much less so than the former. It is a curious fact that at Wylam-on-Tyne leeks have always proved to be only slightly susceptible to smut, whereas at Crookham-on-Tweed the contrary is asserted to be the case. Until the above trials were laid down it seemed likely that this marked resistance of leeks to smut at Wylam was connected with the fact that at this centre, leeks have been grown for seed (known as Wylam seed) for many years; in this way a resistant variety might have been produced by unconscious selection. The result of the trials, however, appears to have negatived this view, and renders it extremely difficult to account for the difference in susceptibility of leeks at the two centres.

"White Lisbon" Onion (the variety used throughout these experiments), though extremely susceptible, is so rapid a grower, that, given good growing weather, it probably suffers less than any other variety. In bad seasons, however, the entire crop may be lost, *e.g.*, in one case *the normal expectation was a crop of ten thousand bunches of five plants each—the actual crop pulled was 200 plants.*

Formaldehyde Experiment.—On 31st July, 1920, a trial was laid down by the Ministry of Agriculture and Fisheries at Wylam, under the charge of the District Inspector. The object was to test the value of the formaldehyde treatment which has proved of considerable efficacy in the United States.

A quarter of an acre of affected land was sown with White Lisbon seed by means of a Planet Junior drill, and a solution of formaldehyde (one pint to sixteen gallons of water) was applied immediately after to the open drill by means of an ordinary watering can with a fine rose. Three and a quarter pints of the solution were used, costing 17s. 10d. The drills were covered, but wet weather setting in prevented rolling. Another portion of the plot (50 sq. yd.) was sown in the same way, but without formaldehyde treatment.

The ground was inspected 6 weeks later. On the untreated portion 95 per cent. of the plants were affected with smut, very few showing signs of being able to recover. On the treated portion careful countings showed that 20 per cent. of the plants were infected, or had been infected. Some were apparently dying, but others appeared to be recovering. The treated portion

as a whole looked much healthier and greener, and was altogether more vigorous.

The garden was again visited by the Inspector on Nov. 14th, when no disease was present either on the treated or untreated portions. The estimated crop on the treated area was 10,000 bunches, a fair average for such a crop being 12,000 bunches. On the control portion not more than a quarter of a crop existed. It is believed that if wet weather had not followed immediately after sowing, the formaldehyde treatment would have been even more effective.

The experiments are being continued by the Ministry.

Summary.—From the above experiments it is clear that the most effective treatment against Onion Smut is undoubtedly the application of formaldehyde to the open drill, the spores of the fungus present in the soil being prevented from infecting the germinating seed, either because they are killed or are temporarily paralysed. That the latter may be the more likely reason is indicated by the failure of the 1915 trial, when application of a much stronger solution a fortnight before sowing proved ineffective. In the United States the application is made by means of a receptacle attached between the handles of the drill. The solution is fed into the drill from an open pipe which is sufficiently long to prevent splashing of the liquid. Further search for resistant varieties will probably be repaid.

The writer desires to express his thanks to Mr. John Mordue, of Wylam-on-Tyne for placing land and labour at his disposal, and to Mr. Fred Dawson for the care he has taken in carrying out the trials.

THE GREY FIELD SLUG.

(*Agriolimax agrestis*, Linn.)

HERBERT W. MILES, M.A., F.E.S.

THE Grey Field Slug is common in Europe, and is a well-known pest of gardens and cultivated land in the British Isles, where it was first recorded in the 17th century. Its habits are such that world-wide distribution has been effected, and it is established in most countries, having gained admittance with agricultural produce and with bales and packages in which shelter in damp straw, moss or sacking was obtainable.

Feeding Habits.—Slugs feed chiefly in the evenings, during the night, and in the early morning. They commence at about 9.30 p.m. (G.M.T.), and on misty mornings will feed as late as 9 a.m. They feed omnivorously on growing plants, decaying vegetation and organic matter, and at times on aphids, small earthworms and weakly soil grubs. Feeding takes place both in the soil and on the surface, and at times on the vegetation above the soil. Messrs. Lovett and Black,* of the Agricultural College, Corvallis, Oregon, U.S.A., sum up the feeding activities of slugs as follows:—

> "The attack is most frequent on plants. It is during the early growth that serious injury occurs. Young plants just pushing through the ground are consumed entirely; the foliage of plants in cold-frames and of newly transplanted cabbage, lettuce and tomatoes is devoured or great ragged holes eaten through it. They destroy sprouting corn or tunnel into the base of the older corn, killing or devitalizing it. Field peas, young clover, hops and similar crops adjacent to uncleared areas are often wiped out entirely for a distance of several yards from the border of the field. They eat the leaves, buds, blossoms and fruit of strawberries; injure the blossoms of many ornamentals; disgust one constantly by their repulsive presence; and everywhere leave behind their disagreeable trail of slime."

The attack is perhaps most important among seedlings, particularly when they destroy the seed leaves and growing points. Vegetation and crops everywhere suffer from the depredations of slugs, winter corn being very susceptible to their attacks. When feeding on corn, evidence of their attack may be found in the fact that the leaves of numbers of plants have been eaten away, the thready vascular strands remaining behind and giving the whole plant a ragged effect. The year

* Station Bulletin 170, "The Grey Garden Slug."

1920 was particularly favourable to slugs, and therefore during the past winter many fields of cereals suffered from their attack. The damage to plants was distinctly noticeable in the Bristol district, and examination showed large numbers of slugs in the soil, beneath clods, under stones, root residues and the like.

In moist, showery weather, when vegetation is very damp, slugs crawl about on their food plants and feed quite openly, but in the dry weather they feed low down amongst the leaves near the ground, and in very densely foliaged plants, like cabbage, they get inside the "heart" and feed where it is more moist, and therefore more suited to their requirements. In particularly bad attacks, slugs may tunnel into plants below the surface of the ground; root crops and tubers suffer most in this connection. Instances have been cited where damage to gooseberries and currants has been quite serious; this happens occasionally after continued heavy rains. Though most plants are attacked by slugs, certain weeds seem to be consistently selected as their food plants. These include charlock, cresses, garlic mustard, docks and nettles.

Description and Life History.—The adult grey field slug varies in colour from pale-grey, through dark-grey to brown, and occasionally yellow. When extended it measures up to 2 in. in length; the most common length, however, is 1½ in. The tail end tapers off, while the head is blunt and bears two pairs of retractile tentacles. Below, and behind, these tentacles is the mouth, which has a fleshy lip above and a rasping organ, the radula, below. This organ is furnished with a mass of blunt teeth, by means of which the plant tissue is rasped or scraped away, the vascular strands being left. A short distance behind the head is an irregularly oval mass, the mantle, associated with the small rudimentary shell. The mantle, in which is located the respiratory orifice, is generally darker in colour than the body, above which it is slightly, but distinctly raised. From the mantle to the tail the body has reticulate markings which are less distinct towards the sides.

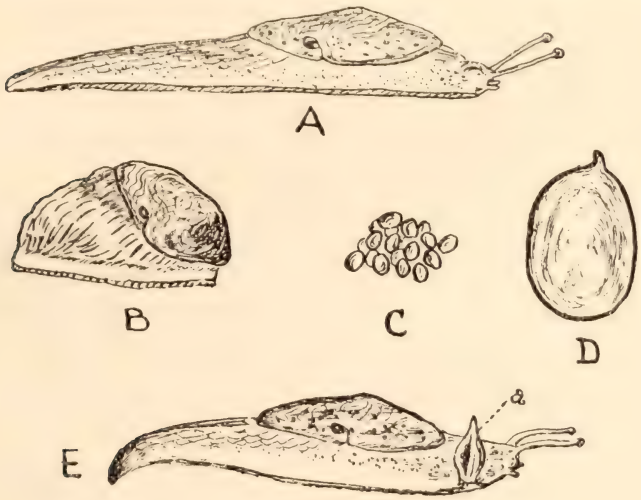
The body is rounded above, but below it has a flattened surface, the sole or foot, which is readily distinguished as it is lighter in colour than the body. The sides of the sole are provided with tubercles, the whole structure being distinct from the body which lies above it. A viscous mucus is secreted from slime glands located in the skin. According to Taylor,* the slime is "often clear when crawling but

* "Land and Fresh Water Molluscs of the British Isles."

becoming milky white on irritation, due to innumerable particles of carbonate of lime."

Slugs, like snails and allied forms, are hermaphrodite. The sex organs are located on the right side, just behind the head; when mating these are extruded and become swollen, distended and globular, the colour being whitish with a tinge of blue. Mating takes place early in the morning, between 4 a.m. and 6 a.m., especially on wet or misty mornings, when the ground is very wet. After mating the slugs retreat and hide in tunnels and crevices in the soil.

Egg-laying commences about a fortnight or three weeks after mating, the adult becoming quiescent shortly before the ova



A.—Adult slug extended. B.—Slug contracted.
C.—Cluster of Eggs. D.—Egg enlarged.
E.—Adult slug extended, with sex organs (*a*) extruded.

are deposited. The eggs, which are elliptical and practically transparent, are laid separately, but in clusters of as many as 60, under moss, vegetation and decaying roots. Lovett and Black quote an interesting observation in connection with the egg-laying habits of slugs: "Stock turnips, which had become pithy and split open, were found with great masses of eggs in the fibrous and slightly moist interior."

On hatching, the young slug is whitish in colour. This gradually gives place to pale-grey, which in turn becomes mottled-grey and brownish as development proceeds. The slug attains maturity in from three to four months and may live for two years or longer.

Control.—(*a*) *Effect of Climate.*—Dry weather appears to be antagonistic to slugs to a small extent only, merely driving them to moist situations lower down in the soil or into the depths of dense vegetation. Heavy rains, as such, apparently do not affect them, except that drowning may take place in pools and ruts in roadways, paths and buildings. During cold weather they may go a little deeper in the soil or hide under any available shelter, and become dormant.

(*b*) *Natural Enemies.*—It is probable that the slug has few natural enemies. Insects and fungi are only very seldom found preying on them, and though in 1920 observations in Shropshire revealed a number of dead slugs infested with maggots, it is improbable that these were the cause of death. Birds such as the thrush, blackbird, jackdaw and rook have been observed eating slugs, and Collinge* states that slugs and snails form 6.5 per cent. of the animal food of starlings. Poultry destroy numbers of slugs, ducks and geese being particularly partial to them.

(*c*) *Combative and Preventive Measures.*—As slugs readily take advantage of all kinds of refuse for shelter in the daytime, it would seem advisable to plough-in crop residues immediately after the removal of the crop, and organic manures as soon as applied. Hedge-brushings and ditch-side vegetation should be destroyed: it should never be allowed to remain in heaps about fields and roadsides. This is specially important during the periods when no crops are available on arable land. All vegetation on waste ground, hedge-, ditch- and pond-sides should be periodically burned. Cleanliness and tidiness in stack-yards, around root clamps, and in gardens should always be maintained, since all material lying about harbours slugs to a remarkable extent.

Trapping, by means of sacks or pieces of board and bark, is effective in gardens and around cold frames. Where slugs are very numerous it might be advisable to apply Bordeaux mixture either as a spray or in the powdered form. This has given good results in America on lettuce, and in the tests carried out by Messrs. Lovett and Black, "Plants sprayed with Bordeaux Mixture 2-2-50 and 4-4-50, respectively, showed very little indication of slug injury for a month after the time of treatment." These workers also tested various stomach poisons and contact irritants, but no very satisfactory or practicable application was forthcoming. Copper sulphate was

* "The Starling," *Jour. Min. of Agric.*, March, 1921.

found to be comparatively effective, but owing to its injuring the foliage it was deemed impracticable. The most satisfactory poison bait consisted of chopped lettuce and calcium arsenate (16:1); this gave good results, a high percentage of slugs being destroyed.

In England, lime, soot and salt have been advocated as dressings against attacks by slugs. Applications of a mixture of equal parts of these constituents between the rows of cabbages and similar crops have been found to give some relief. In view of the fact that slugs have the power of exuding considerable quantities of slime on coming into contact with an irritant, and can successively overcome several irritant dressings in this manner, it is necessary to apply three or four light dressings at short intervals. The best results have followed the repetition of the dressings at hourly intervals in the late evening; where this is impossible, however, applications morning and evening should be effective. Perhaps the greatest factor in slug control is cleanliness; clean farming would undoubtedly tend to keep this widely distributed and exceedingly troublesome pest in check.

SMALL HOLDINGS SECTION AT THE BATH AND WEST SHOW.

THE Bath and West and Southern Counties Society was the first of the big agricultural societies to act upon the suggestion of the Ministry of Agriculture that they should include in their programme special sections for the small cultivator. This they did recently in connection with their Bristol Meeting in June by devoting a section to the interests of the small man on the land. A Sub-Committee was appointed to deal with the Small Holdings Section and the result was the institution of competitions for the best managed small holdings and allotments, an exhibition of matters of special interest to the small cultivator, and an educational programme of instruction. The competitions were judged by Mr. A. R. White, Chairman of the Wiltshire Agriculture Committee and a member of the Bath and West Council. The classes and awards were as follows :—

Class 1.—Small holding of over 15 acres and under 50 acres in Gloucestershire or Somerset (open class). Prizes, £15 ; £7 ; £3. (2 entries)—

1. H. Symes, Orchard Farm, Pilning, Bristol ; 24 acres.
2. B. Stephens, Court Farm, Watchett, Somerset ; 48 acres.

Class 2.—Small holding of over 1 acre and not more than 15 acres in Gloucestershire or Somerset (open class). Prizes, £10 ; £5 ; £2. (1 entry)—

2. P. Y. Smith, The Laurels, Parson Street, Bedminster, Bristol ; 10½ acres.

Class 3.—Small holding of over 15 acres and under 50 acres in Gloucestershire (open to ex-service men only). Prizes, £15 ; £7 ; £3. (3 entries)—

1. H. Symes, Orchard Farm, Pilning, Bristol ; 24 acres.
2. A. J. Newman, Court Farm, Winterbourne ; 47 acres.
3. D. Pearce, Whychwell Farm, Wapley, Chipping Sodbury ; 31 acres.

Class 4.—Small holding over 1 and not more than 15 acres in Gloucestershire (open to ex-service men only). Prizes, £10 ; £5 ; £2. (7 entries)—

1. A. J. Kinchin, Mickleton, near Chipping Campden ; 4 acres.
2. S. J. Righton, Mickleton, near Chipping Campden ; 4 acres.
3. E. Chadband, Mickleton, near Chipping Campden ; 5 acres.

Class 5. Small holding over 15 and under 50 acres in Somerset (open to ex-Service men only). Prizes, £15 ; £7 ; £3. (10 entries)—

1. R. H. Shire, The Downs, Donyatt, near Ilminster; 50 acres.
2. R. S. Bond, Dimer, Castle Cary; 27 acres.
3. R. W. Fowler, The Crossways, Crock Street, Ilminster; 50 acres.

E. H. T. Vincent, Thrupe Farm, Masbury, Wells; 50 acres.

Class 6.—Small holding over 1 and not more than 15 acres in Somerset (open to ex-service men only). Prizes, £10; £5; £2. (1 entry)—

1. T. Gillingham, Court Farm, Seavington, Ilminster; 8 acres.

The prize fund was made up by contributions from the President, the Bristol Local Committee, Members of the Small Holdings Committee of Gloucestershire and Somerset and the Bath and West Society. The Championship Shield awarded to the best managed allotment estate was the gift of Mr. Savory, a member of the Bristol Town Council.

The entries in the open classes were somewhat disappointing in number. If similar competitions are instituted elsewhere, the pioneer experience of the Bath and West Society would suggest that the most effective method of securing entries is by personal canvas among likely competitors. This should, of course, be combined with advertisements in the local press, so as to give a fair opportunity of entry to all.

In the classes confined to ex-service men the entries were more numerous and some keen competition resulted, especially in the smaller holdings in Gloucestershire and the larger holdings in Somerset. In Gloucestershire the prizes went to market garden holdings at Mickleton; in Somerset the chief awards were made to small farms near Ilminster.

The Allotments Competition was arranged with the co-operation of the Agricultural Organisation Society in conjunction with the Bristol Federation of Allotment Societies. It should perhaps be explained that there are some 21 allotment societies in the Federation. They include a membership of about 11,000 and an area of 779 acres.

Two classes were provided for individual allotments, one of not less than 10 rods, and the other of an area from 10 to 20 rods. There were 325 entries for these, and the intention is to award a first prize among the entries from each allotment estate and then to judge the prize winners for a champion prize in each case. The individual allotments are being inspected twice and the final award will be made at the end of July or the beginning of August.

There was also a class for the best managed allotment es ate. For this there were 11 entries. The Challenge Shield was awarded to Fishponds Allotments Limited, with the Bedminster and Bristlington Societies a good second and third. The judging was undertaken by Mr. Hollingworth and Mr. Turner, the Horticultural Organisers for the counties of Gloucestershire and Somerset respectively.

The Exhibition was housed in a special pavilion provided by the Society. It included models and photographs of small holdings homesteads shown by the Ministry and the Somerset County Council. The Essex County Council also lent a small but very attractive model of a thatched cottage, which was in sections, to facilitate examination. The Ministry's leaflets and guides of particular interest to small holders were also available for distribution. An attempt was made to secure a joint exhibit from the Education Committees of the Gloucestershire and Somerset County Councils which would show the small holder what the local authorities were able to do for him in the way of agricultural education and advice, but on account of the expense the Somerset Council did not see their way to co-operate. The Gloucestershire County Council supplied an exhibit and arranged for their horticultural and poultry lecturers to be available during the whole time of the Show to answer enquiries and give information. This exhibit was of particular value and the lecturers were constantly surrounded by an eager party of inquirers.

An exhibit illustrative of co-operative methods of marketing was supplied by the Street and District Egg Collecting Society, members of the Committee of which were present to explain the Society's procedure. A demonstration of the day-old chick trade, an exhibit of hand implements for the small holding and the allotment, and an exhibit of bee-keeping appliances, added considerably to the interest of the Section.

In the case of every exhibit there was someone present to answer inquiries, and this proved a very satisfactory feature of the work of the Section.

The Allotments side was aided by a poster prepared by Mr. Randall, local Allotments Organiser of the Agricultural Organisation Society, setting out the work of the Federation and the prizes offered for competition among its members, and by a large pictorial diagram, specially prepared by Messrs. Sutton & Sons, showing the cropping of the Ministry's model allotment as described in Leaflet No. 315. It was originally intended to have an actual model allotment planted up on the Show ground, and

this Messrs. Sutton had kindly offered to undertake, but as on careful consideration questions of site and danger from late frosts were thought to render the proposal too risky, the diagram referred to was substituted.

In connection with the Section, a demonstration of the method of producing clean milk (*i.e.*, free from bacteria) was undertaken by Reading University. A special building was provided near the Small Holdings Pavilion and demonstrations were given twice daily during the Show. This was the first time that this demonstration had been held in a show yard, and when the usual minor difficulties had been overcome it proved a centre of considerable attraction to large numbers of people. It is probable, however, that such a demonstration would be more appropriately situated near the cattle lines, so that the cows for demonstration purposes might be more readily available and the herdsmen themselves might be interested.

The programme of the Section was completed by a series of "short talks" on such subjects of interest to small holders as "The Small Holder's Live Stock" and "The Small Holder's Bees."

Altogether, the Small Holders' Section has undoubtedly been a great success from all points of view. The interest taken in it both by press and public was very great, and much useful work was accomplished and helpful information given.

ERADICATING GALL MITE (BIG BUD) FROM BLACK CURRANT STOCKS.

H. GOUDE, N.D.Hort.,
Horticultural Adviser to the Norfolk County Council.

THE question of raising clean stocks of black currant bushes has been a problem in horticultural circles for a generation. The failure to do so is undoubtedly the cause of the annual propagation of the disease and its distribution to all districts where black currants are cultivated. The assurance that bushes for planting are free from " big bud " is of little practical value; the important point is whether they are free from " mite." None of the stocks that I have examined during the past seventeen years have been entirely free from " mite." The infestation was seldom so severe as to cause " big bud " in one- or two-year old bushes, but "big bud " would develop as soon as the bushes were subjected to the strain of faulty cultivation, adverse weather, or fruit bearing. The plantation then becomes unprofitable and is usually grubbed up.

Where a clean start can be made and the plantation established as far as possible away from all source of infection, the stock would remain free from " mite." Where it is not possible to secure this condition, clean planted bushes have remained free from " big bud " for seven years, even though planted side by side with infected bushes, and have at least six or seven years of profitable life before them, proving the value of an absolutely clean start. At the present time it is the exception to see profitable plantations twelve years old. Most cultivators have adopted the method of close planting and grubbing up the bushes as soon as they develop " mite " or " reversion." In this way the establishing cost is a frequently recurring charge on the cultivation of the crop, and what should be the heaviest fruiting years—the fifth, sixth and seventh—in the life of a plantation are lost.

The unfruitful condition known as " reversion " is prevalent in most plantations. Many observant cultivators associate this disease with an attack of " mite." True " reversion " has been observed in seedlings, proving that " mite " is not the sole cause. The toxic effect of the parasite on the sap is a probable contributory factor. The black currant is, like the asparagus plant, very much influenced by checks to growth, and any serious check, or, more particularly, combination of

Fig. 2.—Illustration of Black Currant Plants rooted in June from soft cuttings.

checks, to the normal growth of the plantation will start " reversion " in a wholesale manner. The causal agent, if there is one, may be able to develop while the bush is under the stress of adverse conditions.

It is hardly necessary to go into the details of the history of the " mite "; the only knowledge in this respect that cultivators appear to be interested in is how to get rid of the trouble. To raise clean bushes a start must be made during April and May, when green shoots should be taken from the bushes and rooted in a cold frame. This is the only period in the year when shoots carry no " mites " in the buds. The embryo buds are undeveloped, and offer no harbour for them.

FIG. 1.—Drawing of a Soft Cutting.

Method of Propagation and Dipping.—Soft cuttings about three inches long should be taken during April and May, and soaked in a bath of insecticide, viz.:—

Nicotine 98 per cent.	½ oz.
Soft Soap	4 oz.
Soft Water	5 gal.

This dipping kills any external " mites " the shoots may carry. After an hour's soaking the cuttings should be taken out, rinsed in clean water, and dibbled firmly six inches apart in a cold frame. The frame should be closed, shaded from the sun, and the cuttings treated as soft cuttings until rooted, which will

be in about a month. Gradual hardening should follow and the frame should eventually be lifted off to ripen the wood fully. The cuttings strike freely in small pots, from which they can be planted out when rooted to grow.

In the autumn the plants from the frames can be planted in a nursery, cutting back slightly to induce the basal buds to break strongly. By this method clean-stock bushes are provided for furnishing cuttings for the usual method of propagation, or they can be used for planting in fields direct from the frames. Major Evans Lombe tested these young plants at Marlingford under field conditions with good yearling plants raised from ripe wood. The plants from soft cuttings started growing earlier, and are now the larger plants. The photograph (Fig. 2) illustrates plants raised by Major Evans Lombe. The root system developed by the soft cuttings is a notable feature of this method.

Large numbers of cuttings can be taken from established bushes without detriment to the crop. The side shoots should be taken, leaving the terminals for producing the following season's fruiting wood. Although April and May are the best months for striking quantities of cuttings, the soft growing points of the shoots will strike through the growing season, but it is not advisable after August. If the wood has begun to harden there is a danger of the buds containing "mites," which have a preference for the terminal bud, and during June and July are found in large numbers on infected bushes at the apical ends of the shoots, and between the leaf stalk bases and developing buds.

Propagating from soft cuttings offers a means of rapidly increasing varieties of which stocks are low, and offers possibilities of raising clean stock in plants subject to perennial diseases. Red and white currant bushes are not uncommonly tainted with the same gall mite that infects black currants, and this should not be overlooked as a possible source of re-infection to clean stock.

NOTES ON FEEDING STUFFS FOR AUGUST.

E. T. HALNAN, M.A.,
Ministry of Agriculture and Fisheries.

Condemned Condensed Milk.—Numerous correspondents have written as to the feeding value and best method of feeding condemned condensed milk, large quantities of which appear to be available. In using any food of this nature for stock, it is advisable to start cautiously at first in order to avoid the possibility of poisoning the stock. Several breeders of repute have used this condemned condensed milk for their stock, and it is apparently most suitable for pigs. Pigs of all ages have been fed successfully, and a feeding trial at Moulton Farm, carried out by Mr. W. A. Stewart, Agricultural Organiser for Northamptonshire, demonstrated its value for pigs of all ages. This milk used in the right proportions proved of particular value for weanling pigs.

Method of Use.—The tins are spiked both ends and dropped into warm water to dissolve out the contents, after which the tins are raked out and the liquid mixed with the other food. The quantities fed should be at the rate of $\frac{1}{8}$ tin per weanling pig, gradually increasing in amount until the adult pig receives $\frac{1}{2}$ tin. These are the maximum quantities recommended. At present prices, the writer is of opinion that condemned condensed milk should be restricted to weanlings and young growing pigs.

Feeding Value of Condemned Condensed Milk.—The feeding value of condensed milk varies considerably with the brand of milk sold. Assuming that the milk is practically all digestible, and that the animal obtains full value from the digestible nutrients, sweetened full-cream condensed milk has a starch equivalent of 86, sweetened skim condensed milk has a starch equivalent of 70, and unsweetened condensed milk has a starch equivalent of 57. Compared with the market price of other feeding stuffs, the actual food value of the three grades of milk given above works out roughly at 1d. per tin for the unsweetened condensed milk, $1\frac{1}{4}$d. per tin for the sweetened skim condensed milk, and $1\frac{1}{2}$d. per tin for the sweetened full-cream condensed milk. The actual purchaser must assess for himself the extra money he is prepared to give for any special dietetic value this food may possess for young growing pigs. A tin of condensed

NAME.	Price. s.	Price. lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv. s.	Price per lb. Starch Equiv. d.
Barley, English Feeding	46/-	400	12 18	1 6	11 12	71	3/3	1·74
„ Canadian „ -	47/-	400	13 3	1 6	11 17	71	3/4	1·78
Oats, English „ -	46/-	336	15 7	1 9	13 18	59·5	4/8	2·50
„ Foreign „ -	33/-	320	11 11	1 9	10 2	59·5	3/5	1·83
Maize, Argentine -	47/-	480	10 19	1 5	9 14	81	2/5	1·29
Beans, English spring -	95/-	532	20 0	3 1	16 19	66	5/2	2·77
„ „ winter -	55/6	532	11 14	3 1	8 13	66	2/7	1·38
„ Rangoon - -	8/-	112	8 0	3 1	4 19	66	1/6	0·80
Peas, English blue -	59/-	504	13 2	2 13	10 9	69	3/-	1·61
„ „ dun -	80/-	504	17 16	2 13	15 3	69	4/5	2·37
„ „ maple -	93/-	504	20 13	2 13	18 0	69	5/3	2·81
Buckwheat - - -	86/-	392	24 11	1 9	23 2	53	8/9	4·69
Rye, English - -	59/-	480	13 15	1 8	12 7	72	3/5	1·83
Millers' offals—Bran -	—	—	7 5	2 10	4 15	45	2/1	1·12
„ „ Coarse middlings	—	—	11 5	2 10	8 15	64	2/9	1·47
Barley meal - - -	—	—	14 15	1 6	13 9	71	3/9	2·01
Maize „ - - -	—	—	10 12	1 5	9 7	81	2/4	1·25
Fish „ - - -	—	—	19 0	7 12	11 8	53	4/4	2·32
Linseed - - -	—	—	21 10	2 16	18 14	119	3/2	1·70
„ Cake, English -	—	—	15 15	3 12	12 3	74	3/3	1·74
Cotton seed „ „ -	—	—	10 0	3 5	6 15	42	3/3	1·74
„ „ decorticated	—	—	13 0	5 6	7 14	71	2/2	1·16
„ Meal, decorticated	—	—	11 10	5 6	6 4	71	1/9	0·94
Coconut cake - -	—	—	10 6	3 0	7 6	79	1/10	0·98
Groundnut cake - -	—	—	10 0	3 9	6 11	57	2/3	1·20
Palm kernel cake - -	—	—	8 10	2 1	6 9	75	1/9	0·94
Brewers' grains, dried, ale	—	—	7 5	2 7	4 18	49	2/-	1·07
„ „ wet „	—	—	0 18	0 12	0 6	15	0/5	0·22
Distillers' „ dried -	—	—	9 5	2 16	6 9	57	2/3	1·20
Malt culms - - -	—	—	7 5	3 6	3 19	43	1/10	0·98
Potatoes * - - -	—	—	2 11	0 8	2 3	18	2/5	1·29
Swedes * - - -	—	—	1 2	0 5	0 17	7	2/5	1·29
Mangolds * - - -	—	—	1 0	0 6	0 14	6	2/5	1·29
Vetch Oat and Silage *	—	—	2 9	0 15	1 14	14	2/5	1·29

* Farm value.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of June and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £2 1s. per ton. The food value per ton is therefore £7 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 1d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·11d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

milk weighs approximately 14 oz., and 2,560 tins contain roughly a ton of condensed milk, and from these data the purchaser can

assess the actual cost to him of the milk at present market prices. Maize meal, rice meal, pollards and bran would form suitable foods to feed in conjunction with this material.

Bully Beef and Egg Yolk.—Two other waste materials are at present in use for pigs, *i.e.*, condemned bully beef and liquid and dried egg yolk. Users of both these materials have fed them successfully to pigs, the chief point to remember being that these substances are highly nitrogenous foods and should therefore not bulk largely in the ration. Liquid egg yolk also contains much water and occasionally a fair percentage of boric acid.

Value of Fodder Crops for Dry Seasons.—The dry weather experienced lately has emphasised the value to the dairy farmer in particular, and to stock breeders in general, of planting a breadth of vetches and oats, cabbage, or maize as a supplementary succulent feed in periods of drought. The vetches and oats and cabbage will be available in the earlier summer months, the maize during August. This practice is fairly common in certain districts, and the farmers who have adopted it for this season have been relieved of the anxiety as to feed for their stock.

AGRICULTURE ABROAD.

POSITION AND PROSPECTS OF ITALIAN AGRICULTURE—AGRICULTURAL BOOK-KEEPING IN DENMARK—AGRICULTURAL CO-OPERATION IN SAXONY—IMPORTATION OF SEEDS INTO SWEDEN—PRUSSIAN PROGRAMME OF AGRICULTURE.

Position and Prospects of Agriculture in Italy.

ACCORDING to a report issued by the Commercial Counsellor and the Commercial Secretary to H.M. Embassy at Rome.* Italian agriculture, by reason of the increase in the population, has almost reached its territorial limits, and any increase in the cultivable area will depend upon the reclamation of land by drainage. Already the agricultural and forestal productive areas represent 91.1 per cent. of the geographical area of the country.

According to the report, the War temporarily arrested the development of agriculture,† but a significant recovery in the yield of some of the products for export took place in 1920. Being at the outset of the War less well equipped than other countries to bear the strain, Italy suffered in a special degree from exhaustion, disorganisation and impoverishment. Before the War her economic position was sound. Agriculture was, and still is, her greatest industry: it gave occupation to more than one-third of the population: agricultural products formed the biggest item in her exports. At the present moment the cost of imported agricultural produce is the heaviest item in national expenditure.

Owing to the great density of the population (332 per square mile), *wheat* has been cultivated on land which is more adapted for woods and pastures, and the wheat cultivated area has reached 16 per cent. of the territorial surface. A pamphlet published recently by the Italian Ministry of Agriculture states that, during the twelve years 1909-1920, the wheat crop has varied from a maximum of 27 million quarters in 1913 to a minimum of 17 million quarters in 1917, with an average of 21 million. It has been deduced that Italy is not particu-

* General Report on the Commercial, Industrial and Economic Situation of Italy in December, 1920, obtainable for H.M. Stationery Office, Kingsway, W.C.2. Price 1s. net.

† Italy differs greatly in this respect from some of the other combatant countries, in which phenomenal development in agriculture took place and greater quantities of foodstuffs than ever before were raised. The success attending the war efforts of Great Britain are well known, while this *Journal* for May told briefly what had been done in Canada.

larly adapted for the cultivation of wheat, especially on account of the heat and drought to which much of the land is subject. Better methods of cultivation, and, in particular, the growth of leguminous plants, which serve both to feed cattle and improve the land, would go far, it is believed, to overcome climatic disadvantages and raise the average of production. According to the most recent official estimate for the year 1920-1921, the total national requirements of wheat, including seed (of which 3 million quarters are required), are 30 million quarters. This will be provided as follows:—Home-grown wheat, 17½ million quarters; Foreign wheat, 12½ million quarters.

Among the other crops mentioned in the report, *maize*, with a yield in 1920 of 10 million quarters, still occupies an area of about one-third of that of wheat, although it is diminishing. *Tobacco*, which is a State monopoly, resulted in a yield of 246,000 cwt. in 1920. *Beetroot*, a recent introduction, is now cultivated on a large scale, the yield in 1920 being 29 million cwt., and allows for the production of sugar by national factories in quantities almost sufficient for the requirements of the country. The yield of *oats* was 2½ million quarters; *barley*, 700,000 quarters; *rye*, over 500,000 quarters; and *potatoes*, 1,400,000 tons. The export of *dried vegetables*, which in pre-war days reached nearly 600,000 cwt. a year, fell to 427,000 cwt. in 1919. The total yield of *pulse plants*, which are now cultivated in several districts, is about 14 million cwt. The growth of forage has been increased and now attains a production of over 450,000 cwt.

Italy's stock of animals has increased since 1908. Horses and asses each number about a million; mules, half-a-million; cattle, 6¼ million; swine, 2¼ million; sheep, 11¾ million; and goats, 3 million.

Among the projects for developing the commercial relations between Italy and the United Kingdom is one for the establishment of a rapid overland service for the carriage of perishable goods, especially fruit and vegetables, similar to that which existed before the war between Italy and the Central Empires. Agriculturists contend that the future of Italy lies in agriculture. Her natural resources and advantages are still what they were, and though weakened by her war efforts, as well as by labour troubles after the War, it is confidently believed that there is no reason why she should not regain her former position. The very important hydro-electric plants

which are being constructed in various parts of the country are expected to give a great impetus to agriculture by assuring a greater measure of security as regards irrigation. Assurance of progress is also given by the increased national production of chemical fertilisers and agricultural machinery, and the establishment of new schools and travelling boards for the education of farmers in modern methods of cultivation. Perhaps the most successful branch of the co-operative movement, which is extending rapidly and receives the active support of the Italian Government, is agricultural co-operation in the form of collective farms, established principally in the North and in Sicily; these have been found in most cases to result in an increase of production and of the number of persons who can live on the land.

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Agricultural Book-keeping in Denmark.

AT the suggestion of the Royal Danish Agricultural Society, supported by the principal agricultural societies and the Department of Statistics, Professor O. H. Larsen, of the Royal Danish Veterinary and Agricultural School, has established a Central Office of Agricultural Book-keeping, of which he is head, and an article by him on the subject appears in the Monthly Bulletin (March, 1920) of Agricultural Intelligence issued by the International Institute of Agriculture at Rome.

One of the objects of the Central Office is the elaboration of the account books kept by local societies, with whom it is collaborating with a view to ensuring that only the most suitable books shall be kept. In order to obtain uniformity and reliability the local accountants meet periodically at the Central Office to discuss the systems on which the books are kept. Another object of the Central Office is to ascertain the amount of capital invested and how it is allotted among the various agricultural enterprises. It also seeks to compile a comprehensive budget of gross profits, working expenses, net profits and interest on capital, and to show the cost of production, general working expenses (including those of horses and implements), household expenses, and the revenue yielded.

The Central Office was opened in the spring of 1916. During the first two years the work was of a preparatory nature, but by the year 1919-1920 collaboration with 29 societies had been effected, and it was believed that the number of account books requiring elaboration would be 350. The Office is under the

supervision of seven members representing the societies and institutions which took part in its foundation, and the staff also includes a consulting accountant, a permanent assistant and temporary officers. For the first two years the Office was maintained by the Royal Danish Agricultural Society, but afterwards it received a State subsidy, and contributions from the local societies. Some of these receive, in addition to free supplies of account books, a bonus for books containing data useful to the Central Office: others which correspond direct with the Office and receive book-keeping assistance from it, pay contributions in proportion to their size and to the extent of the book-keeping assistance received.

The origin of local societies for agricultural book-keeping dates from the beginning of the twentieth century, and was due partly to the control societies that have existed since 1895, and partly to farm competitions. In 1918 there were 670 control societies, whose chief object was the fostering of the dairy industry. They kept accounts of milk production and of the content of butter-fat as well as of the fodder consumed by each dairy cow placed under their control: they were thus in a position to indicate the most profitable animals. Sometimes their book-keeping extended to the feeding and growth of horses. These were the first steps towards a complete system of farm book-keeping. From 1902 till 1908 prize competitions were held in the island of Samso for the best-kept books covering various crops. In following years similar competitions were held in other parts of Denmark, and as interest in agricultural accounts grew, more branches of the farm were brought under book-keeping control.

The system of book-keeping used by most local societies and circuits is that issued in 1913 by the Royal Danish Agricultural Society. A typical circuit does its work thus: the society engages an accountant, who helps members to establish the system, guides them in making the daily entries, makes up the work book and the monthly cash and fodder accounts, draws up the yearly balance sheet and makes a detailed analysis of all accounts. The fees which the society charges its members vary from about 6d. to 1s. 1½d. per 2½ acres of the farm. Usually a circuit covers a small area, so that one accountant is able to visit each farm in his circuit as often as required, with the exception of the busiest time, when some assistance is needed. There are, however, circuits having more than 1,000 members. Since 1915 the societies can apply

for a State subsidy amounting to one-half the salary, office and travelling expenses of the accountant, provided that the Government standard of book-keeping is adopted and the balance sheets are published. The number of State-subsidised circuits for the financial year 1918-1919 was about 30 and included 1,094 farms with a total of over 108,000 acres; in 1919 the figures were much higher.

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Agricultural Co-operation in Saxony.

ACCORDING to an account, based on press reports, received from H.M. Consul at Leipzig through the Foreign Office, the Union of Co-operative Societies in Saxony, which 30 years ago comprised 24 societies, now includes 588 societies, having a membership of over 50,000 (that is, almost 75 per cent. of the independent farmers of Saxony) and a turnover of over 2,000 million marks. The total capital of the associations amounts to nearly 300 million marks. The Union includes no fewer than 405 mutual loan societies having a turnover in 1919 of 628 million marks. In the same year the turnover of the trading co-operative societies amounted to 354 million marks. The quantity of milk delivered by the dairy co-operative societies in 1914 was 55 million litres (over 12 million gallons), but owing to the War the amount has decreased by more than one-half.

The pasture societies, which are peculiar to Saxony, are considered to be of great importance at the present time in the rearing of young cattle. Their total expanse of pasture land is 653 hectares (about 1,614 acres) and 266 animals were reared in 1919.

The supply of raw materials obtained by the Union in 1919 was nearly three million cwt., which is only half its pre-war level. There are approximately 420 storehouses, having a storage capacity of 50,000 tons, at the disposal of the associations. An extension of the financial business of the societies, in the form of village banks, is foreshadowed.

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Importation of Seeds into Sweden.

A SWEDISH Royal Proclamation, dated 18th March, 1921, prohibits, under severe penalties, as from 21st March, 1921, the import into Sweden of the following:—Seeds of Timothy grass; Red clover and similar classes not particularly named; Hybrid- and white-clover; Cocksfoot; Rye-grass; Carrot, Swedish turnip; beetroot and rape; kitchen garden produce; and all seeds

exclusive of flower seeds, canary seed, pine and fir seed, hemp seed, flax seed, lupine, rape seed and seeds of all other oil plants.

As originally published, the Proclamation included flower seeds. A later Decree, however, rectified this and exempted them as from 4th April, 1921, from the import prohibition. Flower seeds may therefore be imported into Sweden.

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Prussian Programme of Agriculture.

IN introducing his new programme to the Prussian Landtag, Herr Warmbold, the Minister of Agriculture, stated that as agricultural production is at the present time only about 60 or 70 per cent. of that of pre-war days, certain measures are proposed with a view to increasing production up to the pre-war standard. These included a larger number of land settlements, which would, it is hoped, by increasing the number of small owners, attract people from the towns to the land and keep them there. The agricultural population was decreasing rapidly even before the War: in 1914 it was only about 28 per cent. of the whole Prussian population. It was hoped to create 4,000 new settlements in 1921. It is proposed that increased production of the soil already cultivated shall be encouraged by more State credits to farmers for purchasing fertilisers, while moors and waste land, particularly around the coasts, will be prepared for cultivation. The production of nitrates, which has lately been increased greatly, will have to be devoted entirely to the needs of agriculture. The working capital of farmers should in urgent cases be assisted by State credits. The number of schools of agriculture would have to be increased and the curriculum improved; and there was need of greater security for agriculturists and peasants against looting, theft and other risks. The present system of arbitration between employer and labourer also needed revising.

Report for 1919 on Plant Pests.

A REPORT on the occurrence of insect and fungus pests on plants in England and Wales for the year 1919 was recently issued by the Ministry. This publication was delayed through unavoidable circumstances, but its chief value—to preserve in permanent record a detailed survey of the situation in regard to plant pests year by year—is achieved.

In the year in question Frit Fly caused heavy losses, though these were perhaps not quite so serious as the wet character of the spring and the consequent delay in the sowing of oats would have suggested. The North Midland Counties seem to have

suffered most and the Southern Counties least, probably because in the south the oats grew away very rapidly during the latter half of May. The attacks of Frit Fly in winter wheat occurred in crops sown on ploughed-up grass, especially on rye-grass leys. Other insect attacks on cereals are noted, the drought in May and June combined with late sowing of Spring crops being held responsible for some of them. In the case of roots, it is noted that during the drought in early summer widespread damage was done by Flea Bettles; mangolds suffered especially, the difficulty being much increased by the slow and irregular germination which occurred during the drought.

With regard to fruit, the most notable occurrence of the year 1919 was the outbreak of the Lackey Moth, which occurred in the Sittingbourne area of Kent, and to a lesser, though nevertheless serious, extent in other Southern and Midland Counties. In the Sittingbourne area well over 1,000 acres of fruit were involved. In the worst cases, hundreds of men and women were employed to fight the attack, with the result that perhaps half of the crop may have been saved. The cost of the necessary labour to the growers, however, added a heavy outlay to other charges, and coupled with the loss of half the crop, made the business far from profitable for that season to the particular growers concerned. One grower is said to have spent £1,000 on labour in dealing with this pest alone. Winter Moths were rather less destructive than usual in the chief fruit-growing areas, except perhaps in South Devonshire. The Ermine Moth, a web-making species, like the Lackey Moth, was abnormally harmful and called for special attention in many districts. The Capsids did considerable damage to apples, notably from Wisbech northwards into Lincolnshire. Some divergence of opinion as to the results of lime-washing for this pest is reported, but nicotine in all cases appears to have been reasonably effective.

The situation with regard to attacks of fungi, bacteria, etc., in the year 1919 is also dealt with. Broadly speaking, little information has been available with regard to the distribution of these pests and the losses they bring about in this country. Comparing the Report for 1919 with those for 1917 and 1918, it is at once clear that much progress has been made. The list of authenticated fungus diseases noted in the Report numbers 255, not including fungi in which the attacks are trivial or occur only under special conditions. With regard to fungus diseases in cereals, excellent results were obtained against Bunt and Smut by proper pickling. Reports show

that through neglect of this precaution many thousands of bushels of wheat, barley and oats were lost. Important facts with regard to the outbreak of Black Rust on wheat in South West Wales were discovered, notably in connection with the presence of the alternate host, Barberry, in the area.

For fuller and more detailed information on insect and fungus attacks on plants in 1919, reference must be made to the Report itself, which gives, incidentally, some valuable information as to the best known means of controlling the attacks. This is the aspect of the matter which is of most importance to the grower, and the Ministry will always be glad to advise those in need of remedies for plant pests. The Report can be obtained on application to the Ministry, price 1s. 6d. net, post free.

* * * * * *

Cultivation of Lavender.

HISTORY has it that lavender was introduced into England in the year 1568, and that for a long time thereafter the home crop supplied the bulk of the lavender oil used in this country. In comparatively recent times, however, the industry of lavender-growing was sorely hit by a disease of the plant, and this had the effect of very much reducing the area under the crop and increasing the importation of lavender from France and other countries. The quality of the imported produce, however, was not so good as that grown at home and commanded a lower price on our markets.

The cultivation of the plant in this country is centred more or less round London, and the Mitcham produce is world-famous for the quality and fragrance of its oil. The plant flourishes best on a warm, well-drained medium loam with a slope to the south or south-west. A loam that is too rich is detrimental to the oil yield, as excessive nourishment tends to the growth of leaf. Protection against summer gales by a copse or wood on the south-west is also of considerable value, as these gales may do great damage to the crop by causing the tall spikes to break away at their junction with the stem.

As to cultivation, in the autumn the land should first be carefully cleaned of weeds, which should be burnt. The ashes should be distributed over the ground, together with some ordinary wood ashes if obtainable. The soil should then be prepared by "trenching in" a quantity of short straw and stable refuse, but not much rich dung, and should lie fallow until the following spring, when any weeds remaining should be dealt with as before and the whole ploughed over. Towards late

spring the young plants should be "dibbled in" in rows running from north to south, 4 feet apart and 6 feet between the rows. These wide spaces are not more than is necessary to allow the plant full growth for flower-bearing, room for cutting flowers and for keeping the ground free from weeds.

The crop is propagated from "cuttings" broken off with a root or heel, and planted in March, April or September. The "cuttings" should be of young growth, and should first of all be planted 3 or 4 inches apart in a shady spot and kept watered. In the following spring they can be transplanted to their proper positions in the field. Weeds should be destroyed regularly, but the hoeing should be not more than one inch deep as the roots of the plant spread near the surface of the ground. Young plants should as far as possible be kept from flowering during the first year by clipping, so that the strength of the plant is thrown into the lateral shoots to make it bushy and compact. A full picking is usually obtained from the second to the fifth years, after which the old plants should be cleared off and burnt and the ashes spread over the ground. The land should then be ploughed, manured, cross-ploughed, and left fallow until the following spring, when re-stocking can commence.

The harvest is more or less dependent upon the season, but as a rule it begins in the first week of August, though if the weather is wet it is best to delay the cutting of the flowers until later. The best oil is obtained after a hot, dry season. The flowers should be fully open when cut, and if required for distillation they should be spread out on the shelves or on the floors of dry sheds until partially dry, when they are ready for dispatch to the distillers. If required for sale in bunches for market, they can be bunched and sent straight away after cutting; this is also done sometimes when the produce is to be distilled.

It is estimated that about 1,200 lb. of partially dried flowers, yielding 25 lb. of oil, is obtained from an acre of good land under favourable conditions. Much, of course, depends on the energy and careful superintendence of the grower, and also on the care taken by the distiller in the process of distillation. Last year distillers paid £40 to £100 per ton for flowers, according to quality. For bunched lavender the prices on Covent Garden market have been remunerative for the last three years, but the demand is said to vary considerably, so that the business is somewhat precarious. Last year prices varied from 18s. to 24s. per dozen bunches of 200 flower stems each, and from 6s. to

12s. per dozen bunches of 50 stems each, according to quality, though higher prices were sometimes obtained for exceptionally fine produce.

* * * * * *

FAR greater attention is given to fruit bottling as compared with the bottling of vegetables. In certain cases, however, especially where green peas are available for the purpose, or green vegetables are not plentiful during winter, vegetables may usefully be preserved. The following notes on a simple method of bottling vegetables may be of interest in this connection :—

Simple Method of Bottling Vegetables.

1. Choose young fresh vegetables. Grade for size and colour. Wash and prepare as for cooking, *i.e.*, scrape carrots and celery, peel turnips, etc. Keep white vegetables under water as much as possible to preserve the colour.

2. Plunge the prepared vegetables into a saucepan of fast boiling salted water (one teaspoonful of salt to one quart of water). Bring water again quickly to the boil, and allow the vegetables to remain from one to five minutes according to the nature of the vegetable, *e.g.*, peas and delicate vegetables one minute, vegetables of hard texture three to five minutes. Remove the vegetables and place them into a large basin of cold water to check the cooking and to make them firm. Leave them in this until cold (five to ten minutes).

3. Pack the vegetables as tightly as possible into vacuum bottles. Place one teaspoonful of salt on the top of each bottle.

4. Fill the bottles to overflowing with cold water. Place on the rubber ring, glass cap and screw band or clip. Screw up and then release slightly to allow air to escape during sterilisation. Place the bottles in a saucepan with a false bottom. Cover the bottles with cold water. Bring to boiling point in half-an-hour. *Boil gently for two hours.*

5. Lift out one bottle at a time and screw it down tightly before removing the next. When cold, remove screws or clips, and test lids to see if they are firm.

* * * * * *

THE most effective remedy for Sheep-Scab is dipping, provided that the dip used is one that has been approved by the Ministry of Agriculture, and care is taken to see that the dipping is thoroughly carried out in accordance with the instructions on the label.

Sheep Scab: Its Cure and Prevention.

The Ministry of Agriculture makes a special appeal to sheep-owners for their co-operation to see that

dipping is properly carried out; otherwise Scab can never be eradicated.

When dipping to comply with Orders of the Ministry of Agriculture or Regulations of the Local Authority, it is of the utmost importance to remember that:—

(1) the dip used must be one that has been approved by the Ministry of Agriculture. *There are a large number of effective dips for scab, non-poisonous as well as poisonous, which have been so approved and the responsibility in selecting an approved dip rests with sheep-owners,*

(2) the dipping bath must be mixed in the proportions specified as approved by the Ministry. It is inadvisable to make up a dipping bath by mixing two or more dips together, as this may result in neutralising the effect of both dips for scab, and may in some cases be injurious to the sheep,

(3) the directions and precautions indicated by the manufacturer on the label must be strictly observed,

(4) the sheep must be kept immersed in the bath for the period mentioned on the label. Special attention should be paid to the heads, necks and tails,

(5) during the dipping operations proportionate quantities of dip and water must be added to keep the bath up to proper strength,

(6) after each lot of sheep have been dipped and before the bath is re-mixed the dipping bath should be carefully cleaned out, the residue being disposed of in such a manner that it cannot injure animals or pollute streams. A satisfactory method is to run the residue from the bath into a trench or pit, the sides and bottom of which have been plentifully sprinkled with lime, so that the liquid from the bath runs through the lime before passing into the soil. *This is specially important when poisonous dips are used in order to avoid risk of injury to sheep through accumulation of poisonous matter.* Under no circumstances, however, should the lime be added to the liquid while it is still in the bath.

(7) If Arsenical Dips are used, the second dipping should be at half the strength of the first dipping, when two dippings are required, with an interval of not more than 14 days between them.

Persons using poisonous dips must take the precautions necessary for the avoidance of accidents or injury to sheep through the use of such dips, and the Ministry will not entertain any claim for compensation for injury or loss due to their use. The choice of an approved dip rests entirely with the user. The responsibility for the class of ingredients is a matter for the manufacturer of the dip. The approval of the Ministry only means that the ingredients of a dip are effective for Scab in the proportions approved.

WARNING.—All persons having or having had under their charge a sheep affected with, or suspected of, Sheep-Scab, are required by Law to give notice to the Police with all practicable speed. Persons failing to do so are liable to heavy fines, and in certain circumstances to imprisonment.

* * * * * *

Imperial Fruit Exhibition.

THIS Exhibition will be held at the Crystal Palace from 28th October to 5th November. The competitive classes are arranged in eight sections as follows :—

1. Amateur Section; organised by the Royal Horticultural Society.
2. Cider-Fruit Section; organised by the National Fruit and Cider Institute, and the National Association of Cider Makers.
3. Kent Commercial Section; organised by the Executive Committee of the Kent Commercial Fruit Show.
4. Eastern Counties Commercial Section; organised by the Executive Committee of the Eastern Counties Commercial Fruit Show.
5. West Midlands Commercial Section; organised by the Executive Committee of the West Midlands Commercial Fruit Show.
6. Overseas Section; organised by the Canadian Fruit Trade Commissioner in England.
7. United Kingdom Section.
8. British Empire Section.

The classes in Section 7 are open, without additional entrance fees, to all commercial growers of apples in the United Kingdom who have exhibited in either of Sections 4, 5 and 6. Those in Section 8 are open to all commercial growers of apples, or Associations of such growers, in the British Empire, and it is anticipated that the competition between home grown and imported fruit will be exceptionally keen.

It is hoped to arrange for non-competitive exhibits of an attractive and instructive nature.

The exhibition is organised and financed by the *Daily Mail*, and the technical details have been settled by an Advisory Committee convened by the Ministry of Agriculture. Further information can be obtained from the Organising Secretary, Imperial Fruit Exhibition, 130, Fleet Street, E.C.

Rabies.—*Middlesex (Acton District).*—All restrictions imposed in connection with the outbreak at Acton on the 8th December last were withdrawn as from the 30th June.

Berkshire District.—There have been no developments in this area, and providing no further outbreaks occur in the district, it is hoped to withdraw all restrictions from this district about the end of September next.

Wiltshire District.—A considerable modification of the restrictions has been made as from the 1st July by the exclusion of the portions of Dorset and Somerset which were subject to muzzling restrictions, and by the exclusion of portions of the Counties of Wiltshire and Southampton. As a result of this

modification the restrictions now apply to two districts; one lying wholly in the Counties of Southampton and Wiltshire, which includes inner controlled areas subject to special restrictions surrounding Salisbury and Southampton, and the other a small area in Wiltshire and Berkshire immediately to the south of Swindon.

One case of Rabies has been confirmed since those referred to in the July issue of the *Journal*, namely, on 5th July, at Southampton, in a dog which died on 4th June.

Foot-and-Mouth Disease.—Orders have been issued by the Ministry withdrawing all restrictions as from 4th July, on the movement and marketing of animals which were imposed in connection with the recent outbreaks of Foot-and-Mouth Disease in the North Midlands and in Yorkshire. No outbreak of the disease has occurred in any part of Great Britain since 7th June last.

Ireland.—An order has also been issued withdrawing all special restrictions as from 6th July on the importation of Irish animals, which were imposed on account of outbreaks of Foot-and-Mouth Disease in Ireland. From this date, therefore, the trade in Irish animals was resumed subject to the normal condition of 10 hours' detention in the landing place. Intending importers should, however, ascertain beforehand whether the Local Authority of their district have regulations in force prohibiting or restricting the movement of animals into their district.

Liming.—With reference to the article on "Liming" which appeared in the July issue of this *Journal*, p. 341, Mr. J. J. Griffith, B.Sc., wishes to point out two errors which inadvertently occurred :—

P. 344, last paragraph. 1·25 per cent. of calcium carbonate should read "0·125 per cent. of calcium carbonate."

P. 348 footnote, 1 per cent. lime requirement, &c., should read "0·1 per cent. lime requirement," &c.

Leaflets issued by the Ministry.—Since the date of the list given on page 384 of the July issue of this *Journal* three new leaflets have been issued and circulated :—

No. 374.—Hints on Egg Production.
,, 375.—Hints on the Production of Table Poultry.
,, 376.—Hints on Rabbit Keeping.

The following leaflets have been revised and brought up to date :—

No. 27.—Remission of Tithe Rent-charge.
,, 146.—The Value of Records of the Milk Yield of Cows.
,, 194.—Coltsfoot.

The following leaflets have been re-written :—

No. 2.—Wingless Weevils.
,, 24.—The Gout Fly.
,, 245.—Crown Gall.

The following leaflets have been withdrawn from circulation :—

No. 64.—White Root Rot.
,, 209.—Gooseberry "Cluster-Cup" Disease.
,, 225.—The Septoria Disease of Tomatoes.
,, 272.—Supply of Store Cattle and Slaughter of Young Calves.
,, 310.—Poultry on Allotments and Small Garden Plots.
F.P. 11.—Hints on Purchasing and Using "Seed Potatoes."
,, 60.—Dung Heaps and the Preservation of Farmyard Manure.

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

Curtler, W. H. R.—The Enclosure and Redistribution of our Land. (334 pp.) Oxford : Clarendon Press, 1920, 16s. net. [333.1.]

Andrew, R. C.—A Farmer's Handbook : A Manual for Students and Beginners. (126 pp.) London : G. Bell & Sons, Ltd., 1920, 6s. net. [63(022) ; 63.17(02).]

Pawson, H. C.—The Study of Agriculture : Hints for Students. (111 pp.) London : Vinton & Co., 1921, 5s. [37(02).]

Doyle, K. D.—Agriculture and Irrigation in Continental and Tropical Climates. (268 pp.) London : Constable, 1921, 19s. [63(024) ; 63.13.]

Malden, W. J.—Physical Culture in Farm Work. (92 pp.) London : Wyman, 1921, 5s. [331 ; 371.]

Martin, J. N.—Botany with Agricultural Applications. [2nd Edition Revised.] (604 pp.) New York : J. Wiley & Sons ; London : Chapman & Hall, 1920, 21s. net. [58(02).]

Harshberger, J. W.—Pastoral and Agricultural Botany : Injurious and Useful Plants. (294 pp.) Philadelphia : P. Blakiston's, Son & Co., n.d. [58.(02) ; 63.255 ; 63.3(02).]

Emerson, F. V.—Agricultural Geology. (319 pp.) New York : J. Wiley & Sons ; London : Chapman & Hall, 1920, 16s. 6d. net. [55.]

Geological Survey, Memoirs of the.—Water Supply of Norfolk from Underground Sources, *by W. Whitaker.* (185 pp.) London : H.M. Stationery Office, 1921, 10s. [628.7]

Collins, S. H.—Chemical Fertilizers and Parasiticides. (273 pp.) London : Baillière, Tindall & Cox, 1920, 10s. 6d. [63.16(02) ; 63.295.]

Taylor, H.—Farm and Estate Book-Keeping. (3rd Edn.) (285 pp.) London : Simpkin, Marshall & Co., Ltd., 1920, 6s. 6d. net. [657.)

Field Crops.

University of Leeds and Yorkshire Council for Agricultural Education.—No. 116 :—Report on a Test of Varieties of Wheat, 1920, at Manor Farm, Garforth. (15 pp.) Leeds, 1920. [63.311(04).]

East Malling Research Station.—3rd Report on a Trial of New Varieties of Hops, by *E. S. Salmon.* (19 pp.) E. Malling, Kent, 1920. [63.3451.]

U.S. Department of Agriculture.—Farmers' Bull. 1162 :—Proso or Hog Millet. (15 pp.) Washington, 1920. [63.319.]

U.S. Department of Agriculture.—Farmers' Bull. 1151 :—Alsike Clover. (25 pp.) Washington, 1920. [63.33(b).]

South Australia, Department of Agriculture.—Bull. 146 :—The Use and Making of Ensilage. (30 pp.) Adelaide, 1920. [63.1985.]

Horticulture.

Cecil, The Hon. Mrs. Evelyn.—A History of Gardening in England. (3rd Edition.) (393 pp.) London : John Murray, 1910, 18s. net. [63.5(42).]

University College of N. Wales, Bangor : Department of Agriculture.—Varieties of Potatoes immune to Wart Disease. (11 pp.) Bangor, 1920. [63.512-194.]

New York Agricultural Experiment Station.—Bull. 474 :—Experiments on Spacing Potato Plants. (32 pp.) Geneva, 1920. [63.512(04).]

Plant Diseases.

Smith, F.—Bacterial Diseases of Plants. (688 pp.) Philadelphia and London : W. B. Saunders Co., 1920, 50s. [63.23.]

Royal Soiiety.—Reports of the Grain Pests (War) Committee. No. 10 :—Final Report to the Council of the Royal Society and the Ministry of Agriculture and Fisheries on the Work of the Committee. (16 pp.) London : Harrison & Sons, 1921, 1s. 6d. [63.27-31.]

University of Leeds and Yorkshire Council for Agricultural Education.—No. 118 :—Common Scab of Potatoes. [*Actinomyces scabies (Thaxter) Güssow.*] (22 pp.) Leeds, 1921, 6d. [63.24-33.]

U.S. Department of Agriculture.—Bull. 872 :—Insect Control in Flour Mills. (40 pp.) Washington, 1920. [63.27-31 ; 664.6.]

Plant Diseases—*cont.*

Missouri Agricultural Experiment Station.—Research Bull. 37 :—Varietal Resistance and Susceptibility of Oats to Powdery Mildew, Crown Rust and Smuts. (41 pp.) Columbia, 1920. [63.24-31.]

U.S. Department of Agriculture.—Bull. 915 :—Toxicity of Barium Carbonate to Rats. (11 pp.) Washington, 1920. [63.269.]

Live Stock.

Wilson, James.—The Breeding and Feeding of Farm Stock. (152 pp.) London : Methuen & Co., 1921, 6s. net. [63.603; 63.604.]

Cameron, J.—Shorthorns in Central and Southern Scotland. (335 pp.) London : W. Blackwood & Sons, 1921, 12s. 6d. net. [63.62.]

U.S. Department of Agriculture.—Bull. 905 :—Principles of Live Stock Breeding. (67 pp.) Washington, 1920. [575.4; 63.603.]

Ministry of Agriculture and Fisheries.—Census of Pedigree Live Stock. (24 pp.) London : H.M. Stationery Office, 1921, 1s. [63.6 : 31.]

South Australia, Department of Agriculture.—Bull. 132 :—Notes on the General Management of Draught Horses on the Average Farm. (16 pp.) Adelaide, 1920. [63.61(04).]

U.S. Department of Agriculture.—Farmers' Bull. 1186 :—Pork on the Farm : Killing, Curing, and Canning. (44 pp.) Washington, 1921. [664.91; 63.752.]

Veterinary Science.

Hammond, J., and Holnan, E. T.—A Course of Practical Physiology for Agricultural Students. (106 pp.) Cambridge : University Press, 1920, 4s. 6d. net. [612; 619(02).]

Michigan Agricultural Experiment Station.—Division of Bacteriology.—Technical Bull. 32 :—Transmission of Bacterium Abortus (Bang) to New Born Calves through the Ingestion of Milk. (22 pp.) E. Lansing, 1916. [619.2(*a*).]

U.S. Department of Agriculture.—Farmers' Bull. 1150 :—Parasites and Parasitic Diseases of Sheep. (52 pp.) Washington, 1920. [59.169.]

Dairying and Food, General.

Saker, Dora G.—Practical Dairying. (123 pp.) London : Methuen & Co., 1921, 6s. net. [63.70(02).]

Clayton, W.—Margarine. (187 pp.) London : Longmans, Green & Co., 1920, 14s. [63.729; 664.3.]

Walker-Tisdale, C. W.—Milk Testing. (87 pp.) London : J. North, "Dairy World" Office, 1920, 3s. 6d. net. [543.2.]

University of Leeds and Yorkshire Council for Agricultural Education.—No. 119 :—Factors influencing the Cost of Production of Milk. (46 pp.) Leeds, 1921, 6d. [63.714.]

National Physical Laboratory, Metrology Department.—Tests on Volumetric Glassware used in Dairy Chemistry. (14 pp. + 5 illus.) April, 1921. Single copies free of charge on application to The Director, Metrology (Glass Testing) Dept., The National Physical Laboratory, Teddington, Middlesex. Additional copies 6d. each, plus postage.

Birds, Poultry and Bees.

Powell-Owen, W.—Poultry Keeping on Small Lines. (144 pp.) London : Newnes, 1920, 2s. [63.651(02).]

U.S. Department of Agriculture.—Farmers' Bull. 1115 :—Selection and Preparation of Fowls for Exhibition. (10 pp.) Washington, 1920. [63.651(04).]

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Phillips, R. R.—The Book of Bungalows. (160 pp.) London : "Country Life" Offices, 1920, 8s. 6d. [69(02).]

U.S. Department of Agriculture.—Bull. 852 :—The Flow of Water in Concrete Pipe. (100 pp.) Washington, 1920. [63.13.]

U.S. Department of Agriculture.—Bull. 910 :—Experience of Eastern Farmers with Motor Trucks. (35 pp.) Washington, 1920. [388; 63.17.]

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BREEDERS' ANNOUNCEMENTS.

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MACAINSH, JOHN, Congash, Grantown-on-Spey, N.B.—Pure-bred Aberdeen-Angus Cattle.—Particulars on application.

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CATTLE—*continued.*

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GREENSLADE, W. R. J., 3, HAMMET STREET, TAUNTON, AND WELLINGTON, SOMERSET.—Sales of Devon Cattle, Dorset Horn Sheep, &c.

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DENNY, E. H. M., STAPLEFIELD PLACE, STAPLEFIELD, SUSSEX.—Large White Yorkshire Pedigree Pigs. Station: Haywards Heath. Telegrams: Handcross.

GREENALL, SIR GILBERT, BART., C.V.O., WALTON HALL, WARRINGTON. The Walton and Worsley Herd of Pedigree Large White Pigs. Selections of all ages for sale at moderate prices. Apply to the Manager, The Office, Bridge House, Higher-Walton, Warrington. Station: Warrington. Trains met by appointment.

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