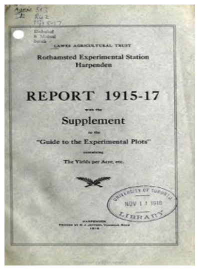
Report 1915-17 With the Supplement to the Guide to the Experimental Plots Containing the Yields per Acre Etc.


Rothamsted Experimental Station
Harpenden

REPORT 1915-17

Supplement

"Guide to the Experimental Plots"

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Plant Nutrition Problems

Rothamsted Research

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Under the most favourable conditions, four mgms. of nitrogen is fixed per gram of dry matter present in the fæces.

Nitrogen fixation also takes place in bullock fæces, but to a smaller extent than in horse fæces. Here also it depends on the diet, as it occurs only when animals are fed with cake, and not when they receive grass alone.

Evidence is adduced to show that fixation is brought about by a mixed culture of *Azotobacter* and *B. lactis aerogenes*. Of these the latter is normally present in fæces; *Azotobacter* is not, but readily comes in by infection. Both organisms are present in the soil.

XVII. "*Some Experiments on the House Fly in relation to the Farm Manure Heap.*" H. ELTRINGHAM. Journal of Agricultural Science, 1916. 7, 443-457.

The possibilities of the manure heap as a breeding ground for flies were investigated. Heaps were made up and left for a certain period to allow of infection; they were then covered over completely with gauze frames fitted with fly traps, and the flies as they emerged were collected, identified, and counted.

Manure heaps near to dwelling houses form a prolific breeding ground for the ordinary house fly; heaps remote from the house, however, are but little frequented, and then only later in the season when the flies have become numerous and widely dispersed. It is shown that the flies do not live in the heap, but only use it as a convenient breeding place; they travel backwards and forwards to the house for their food. Care should be taken, therefore, to place the manure heap so far from the kitchen that it is no longer possible for them to continue feeding in the kitchen and breeding in the manure heap.

Even when this is done, the heap may still remain a prolific source of the biting fly, *Stromoxys calcitrans*, a blood sucking insect, harmful to man and beast, and of *Musca autumnalis*, which closely resembles the house fly, but swarms in the open and only enter houses in autumn. Where these are sufficiently numerous they are harmful, and the heap should be treated with an insecticide.

PLANT NUTRITION PROBLEMS.

XVIII. "*Studies of the Formation and Translocation of Carbohydrates in Plants.* I.—"*The Carbohydrates of the Mangold Leaf.*" WILLIAM ALFRED DAVIS, ARTHUR JOHN DAISH and GEORGE CONWORTH SAWYER. Journal of Agricultural Science, 1916. 7, 255-326.

Starch is entirely absent from the leaf after the very earliest stages of growth and disappears entirely as soon as the root begins to develop and receive the sugars formed in the leaf. Maltose is entirely absent from the leaf, mid-ribs and stalks at all stages of growth and at all times of night and day.

During the early stages of growth of the mangold, when leaf formation is the principal function, saccharose is present in the leaf tissues in excess of the hexoses. The reverse holds good later in the season, when sugar is being stored in the root; hexoses then largely predominate in the leaf.

In the mid-ribs and stalks the hexoses always predominate and they vary widely in amount during day and night and throughout the

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season, whilst the saccharose remains practically constant. In passing from leaves to mid-ribs, from mid-ribs to the tops of the stalks, and from the tops of the stalks to the bottoms, the ratio of hexoses to saccharoses steadily increases. As the season advances the predominance of the hexoses in leaf, mid-ribs and stalks becomes more and more marked.

The proportion of hexoses to saccharose in the leaf tissue follows the temperature curve closely during the day time.

The facts brought forward can apparently be best explained by Brown and Morris' view that saccharose is the primary sugar formed in the mesophyll of the leaf under the influence of the chlorophyll ; it is transformed into hexoses for the purpose of translocation. This transformation occurs in the veins, mid-ribs and stalks, the proportion of hexoses increasing more and more as the root is approached. The sugar enters the root as hexose and is therein reconverted into saccharose ; once in this form the saccharose is not able to leave the root until it is put under contribution for the second season's growth.

These views are in accord with de Vries' micro-chemical observations as to the nature of the sugars in the different tissues, but entirely in contradiction to those of Strakosch, which are considered to rest on no secure foundation.

They also agree with Parkin's results with the snowdrop, with Pellet's analyses of the sugar cane, with Collins' results with the sugar beet, and the authors' observations on other plants, such as the vine (*Vitis vinifera*), potato, dahlia, etc., which store carbohydrates in other forms (dextrose, starch, and inulin).

As regards the mechanism by which saccharose is synthesised from the hexoses, it is improbable that this change is effected by invertase by a process of reversible zymo-hydrolysis. The entire absence of invertase from the root is against this view.

XIX. "*Studies of the Formation and Translocation of Carbohydrates in Plants.*" II.—"*The Dextrose-lævulose Ratio in the Mangold.*" WILLIAM A. DAVIS. Journal of Agricultural Science, 1916. 7, 327-351.

Previous observers have always found more lævulose than dextrose in the leaves of plants and, as they have assumed that the two sugars are formed in equal proportions from the inversion of cane sugar, it seemed to follow that dextrose was more readily put under contribution for the respiratory processes of the cell than is lævulose. The value of the analytical results, however, depends entirely on the readings of the rotatory power, and any small error is considerably magnified in the final calculation.

The author shows that the readings are completely falsified by the presence of optically active substances other than sugars, which are not entirely removed by the preliminary purifying processes.

At present it is not possible to determine with accuracy the proportions of dextrose and lævulose in different plant tissues, nor is it possible to draw any conclusions as to their functions in the plant. Some tentative determinations have been made which, while not entirely correct, probably show the type of variation which the sugars undergo. The results agree with the assumption that dextrose and lævulose occur in equal proportions in the leaves, stalks and roots, being formed by inversion of the saccharose in the leaf ; they then

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travel in equal proportions to the root, where they are reformed into saccharose. Where the rotatory power seems to suggest a difference in amount of the two sugars, it is shown that other optically active substances are present which might account for the results obtained.

XX. "*Studies of the Formation and Translocation of Carbohydrates in Plants.*" III.—"*The Carbohydrates of the Leaf and Leaf-stalks of the potato. The Mechanism of the Degradation of Starch in the Leaf.*" W. A. DAVIS and G. C. SAWYER. Journal of Agricultural Science, 1916. 7, 352-384.

The potato leaf differs from the mangold leaf in that it contains considerable quantities of starch. Previous investigators had found maltose also, but the authors could not. They attributed the discrepancy to the circumstance that in other investigations the leaves had been dried prior to analysis, and during this process the enzyme diastase had continued to form maltose, but the enzyme maltase, which in the living leaf breaks down the maltose, had been destroyed, thus causing an accumulation of maltose in the tissues. Instead of drying the leaf they dropped it into boiling alcohol containing a little ammonia, thereby destroying all enzymes and putting an end to further action; in these circumstances analysis gives a faithful representation of the substance in the living leaf.

The general results clearly resemble those obtained with the mangold leaf. Saccharose is greatly in excess of the hexoses in the leaf, but not in the stalks. All the evidence indicates that saccharose is the sugar first formed in the mesophyll tissue; it is then broken down in the veins, midribs, and stalks, and reaches the tubers in the form of hexoses; there it is built up into starch. In the leaf any excess of sugar is converted temporarily into starch, and reconverted into sugar when necessary.

As in the case of the mangold accurate values could not be obtained for dextrose and lævulose individually, owing to the presence of optically active impurities which are not removed by lead acetate; the sum of these two sugars was readily determined.

XXI. "*The Estimation of Carbohydrates.*" IV.—"*The Supposed Precipitation of Reducing Sugars by Basic Lead Acetate.*" W. A. DAVIS. Journal of Agricultural Science, 1916. 8, 7-15.

Previous workers have found that loss of lævulose occurs when basic lead acetate is added to a solution containing a mixture of sugars, and have generally supposed that precipitation occurred. The author finds that the decomposition of lævulose undoubtedly occurs when the lead acetate acts fcr a long time, but not otherwise. There is no precipitation, but the lævulose is transformed into another sugar, apparently Lobry de Bruyn's glutose, which is optically nearly inactive and has only half the reducing power of dextrose.

XXII. "*The Distribution of Maltase in plants.*" I.—"*The Functions of Maltase in Starch Degradation and its Influence on the Amyloclastic Activity of the Plant Materials.*" W. A. DAVIS. Biochemical Journal, 1916. 10, 31-48.

Some 500 analyses of the sugars of leaves have been made in the laboratory, but in no case could maltose be detected. Many different plants were examined, some of which, such as potatoes, turnips, *Tropæolum*, and sunflowers, elaborate large quantities of starch in the leaf during the daytime to be used as a reserve during the night; while others, such as mangolds, dahlias, and the grape vine, store reserve carbohydrates other than starch (saccharose, inulin, and glucose).

Unless we decline to accept the view that the starch breaks down in the usual way to maltose we must suppose that the enzyme maltase is present, which decomposes the maltose as quickly as it is produced. Evidence is adduced in favour of this supposition, and the view is put forward that the transformation of the starch proceeds on the following lines :

Starch—soluble starch and dextrines (by Liquefying enzymes.)
Dextrines—maltose (by Dextrinase).
Maltose—glucose (by Maltase).

The failure of other workers to find maltase is attributed to its instability, it being readily decomposed by alcohol or chloroform, and to the circumstance that it is endo-cellular and therefore not easily extracted by water. Beyerinck's results indicate that the maltase s mainly localised in the aleurone layer of the endosperm.

XXIII. "*The Distribution of Maltase in Plants.*" II.—"*The Presence of Maltase in Foliage Leaves.*" ARTHUR JOHN DAISH. Biochemical Journal, 1916. **10**, 49-55.

The crushed pulp of all the leaves examined (*Tropæolum*, potato, dahlia, turnip, sunflower, and mangold) acts upon soluble starch or gelatinised starch and forms reducing sugars; of these the greater part consists of glucose and the rest is maltose. It seems clear that the pulp contains the enzyme maltase which acts on maltose, converting it into glucose. By reason of the instability of maltase it is necessary to avoid the use of heat or chloroform in preparing the pulp.

XXIV. "*The Distribution of Maltase in Plants.*" III.—"*The Presence of Maltase in Germinated Barley.*" ARTHUR JOHN DAISH. Biochemical Journal, 1916. **10**, 56-76.

Previous observers have shown that the action of malt extract on starch gave rise to maltose, but not to glucose. It has, therefore, been supposed that maltase is absent from barley. The author finds, however, that the extract had usually either been treated with chloroform, or heated to 50-60°, by either of which treatments the maltase is destroyed. By allowing the finely powdered germinated barley grain to act on starch or maltose at 38° a large amount of glucose is formed, and, as the proportion of glucose increases, that of maltose falls. It seems evident that maltase is present and is acting on the maltose.

XXV. "*The Use of Enzymes and Special Yeasts in Carbohydrate Analysis.*" W. A. DAVIS. Journal of the Society of Chemical Industry, 1916. 35.

The analytical methods elaborated by the author at Rothamsted for the estimation of saccharose, raffinose, maltose, starch, and the mixture of dextrose and lævulose are summarised. The necessary working details are given.

XXVI. "*Organic Plant Poisons.*" I.—"*Hydrocyanic Acid.*" WINIFRED E. BRENCHLEY. Annals of Botany, 1917. **31**, 447-456.

Experiments have been carried out to test the action of hydrocyanic acid on plants when applied to the roots in water culture, and comparisons were made of the effects of formic acid and sodium cyanide. The results showed that prussic acid is very toxic to peas and barley. All strengths up to and including 1/100,000 kill peas outright, either immediately or after a short interval of poor growth. All strong concentrations kill barley, but with 1/100,000 a period elapses during which no growth occurs, after which a little progress is made, though the plants never attain any size.

The peas killed by prussic acid shrivel from the cotyledons upwards and the roots contract so intensely that they are often completely withdrawn from the nutrient solution. Barley roots decline to enter strong solutions at all, but often put out laterals, which stop short at the surface of the solution and develop the bunchy habit characteristic of growth in the presence of poison.

Formic acid is comparatively harmless to barley, except in very strong concentrations, whereas sodium cyanide is quite as toxic as prussic acid.

No trace of stimulation in peas or barley has been obtained with any of the compounds tested.

XXVII. "*Organic Plant Poisons.*" II.—"*Phenols.*" WINIFRED E. BRENCHLEY. Annals of Botany, 1918. **32**, 259-278.

Experiments on similar lines were carried out with various phenols, phenol itself, the three cresols, resorcinol, pyrocatechol, pyrogallol, phloroglucin, and orcinol.

The general action of these various phenols upon barley and pea plants grown in water cultures is very similar, though the individual substances exercise specific actions at somewhat varying concentrations. In every case a solution containing one per cent. of the molecular weight in grams per litre (M/100) of the phenol proves to be fatal, death usually occurring within a very short time after the plant comes in contact with the solutions. Occasionally, as with resorcinol and orcinol on peas, the shoots continue to make a certain amount of growth for a few days, even though the roots are killed. Apparently the toxin in these cases is not conveyed to the leaves at once, so that they are able to grow for a time at the expense of the food stored up in the seeds. More usually, however, the growth of the shoots is checked simultaneously with that of the roots, though the leaves retain their green colour for a long time before they wilt.

The difference in the relative toxicity of the phenols is well shown by the action of solutions one-fifth as strong as the above (M/100 x 1/5). Marked toxic action is evident at first in every case, and the roots are often killed and discoloured. *o*-cresol, pyrocatechol and pyrogallol kill peas outright at this strength, but with the other substances the roots make an attempt to right themselves after some time has elapsed. New laterals are pushed out, which frequently refuse to enter the solutions, so that the recovery is only partial. Peas make only very slight recovery from the effects of *m*-cresol, rather more from those of *p*-cresol, phenol and phloroglucin ; while in presence of resorcinol and orcinol good root development is ultimately able to take place, and there is a corresponding improvement in the shoot growth. Barley is more sensitive than peas, as recovery seldom takes place, and even with resorcinol and orcinol the roots make very little improvement.

The lower strength M/100 × $\frac{1}{5}$ 2 also shows clearly the difference in the action of the phenols, the range of variation being considerable. In nearly every case an initial check is produced, but the degree of injury varies very much. Resorcinol at this strength has very little effect on peas as growth is fairly good from the beginning, and with orcinol also strong growth is made. Phenols cause the roots to become bunchy through the development of short laterals, but recovery from the toxic effects is so complete that the plants make nearly as much dry weight as the controls. Recovery from the effects of most of the other substances is variable in amount, but pyrocatechol is so poisonous that very little growth is made up to the end. Barley behaves in much the same way as peas, though owing to its sensitiveness the recovery is not always so complete as in the case of peas.

Lower concentrations of all the poisons seem to exercise no injurious action on growth.

The root recovery observed in strong solutions suggests that in these cases the poison acts largely by suspending the activities of the plant, paralysing it without killing it outright. Consequently, when the paralysing effect wears off or the concentration of the solution is somewhat reduced by oxidation the plant reasserts its vitality, struggles to put out lateral roots, and frequently succeeds so well that fairly good growth is eventually made.

No signs of stimulation have been observed in the case of any of the phenols tested, except that barley plants in the dilute solutions of orcinol looked better than the controls before they were cut. This appearance was not corroborated by the dry weights.

When the plants were killed or badly injured by high concentrations of the phenols, moulds appeared very rapidly on the dead roots and in the solutions, except only in the strongest solutions of phenol and the three cresols. With the latter no mould formation set in during the whole course of the experiment, but with phenol the antiseptic action ceased after some time and moulds eventually appeared. Where no root injury was caused no moulds grew in any case.

XXVIII. "*Effect of the Concentration of the Nutrient Solution on the growth of Barley and Wheat in Water Cultures.*" WINIFRED E. BRENCHLEY. Annals of Botany, 1916. **30**, 77-90.

For some years past much discussion has taken place as to whether the concentration of the nutrient solution has any appreciable effect upon plant growth, and at the present time the controversy is far from settled.

A number of water culture experiments have been made to see if further information could be obtained on the effect of varying concentrations of nutrient solutions upon growth, barley being used as the test plant in three series of experiments, and wheat being grown in a fourth.

Four strengths of solution were used ; N, ordinary strength (called N.) containing 3 grms. of nutrient salts dissolved in one litre of water), N/5, N/10, N/20. In each experiment with barley 120 plants were grown in units of ten :—

1.—All concentrations (N, N/5, N/10, N/20), the solutions being changed regularly every four days.

2.—All concentrations, the solutions being changed once, half way through the experiment.

3.—All concentrations, the solutions never being changed.

An examination of the figures and curves of dry weight shows that in all cases there is a steady decrease in the dry weights of the plants as the strength of the nutrient solution becomes less. This decrease in weight is very considerable and always outside the limits of experimental error. The results run in the same direction in all the experiments, the differences being accentuated in the sets grown later in the year, when growth is more rapid. The falling off in dry weight, as the concentration of the solution falls from N to N/5, is far less when the solutions are changed frequently, and in some cases there is very little difference in the two cases. This suggests that the N/5 solution might be as favourable to growth as the N solution if it were sufficiently frequently renewed. There are, however, indications that toxic effects would set in under these circumstances in the N solution, as some of the constituents might be present in so great a quantity as actually to check plant growth. In the N/5 solution, on the other hand, this action is less likely, and the plants could continue to make full use of the food salts, thus approximating in growth to those in the N solution. If this supposition be correct, it is not true to say that the plant is indifferent to the variation in the strength of these two solutions, but that up to a certain limit it responds to increased strength by increased growth.

With the highest concentration, however, another factor, toxic action, comes into play, counterbalancing the increased growth and reducing it to the level attained with the lower concentration.

XXIX. "*Recolonisation of Cultivated Land allowed to revert to Natural Conditions.*" WINIFRED E. BRENCHLEY and HELEN ADAM. Journal of Ecology, 1915. **3**, 193-210.

Broadbalk and Geescroft Wildernesses were originally under arable cultivation, but they have been left untouched for many years and allowed to recolonise themselves. Careful observations of the herbage have been made from time to time, and for at least twelve months in 1914-1915 the changes in each flora were noted every month. Broadbalk wilderness is in a relatively dry situation and the soil contains calcium carbonate ; Geescroft is wetter and there is practically no calcium carbonate present.

Broadbalk wilderness consists of two distinct parts :—

1. an area which has been left untouched and has developed into an oak-hazel wood ;
2. an area from which the trees and shrubs have been grubbed out at regular intervals and is now colonised by a great variety of herbs,* notably *Arrhenatherum avenaceum* with a good deal of *Centaurea nigra*, *Poa trivialis*, *Agrostis sp.*, *Heracleum spondylium* and many others.

* Using the word in its strict botanical sense, to comprise all plants except shrubs and trees.

During the season, 1913-1914, 79 species of plants (herbs, shrubs and trees) came under notice, of which 40 per cent. are included in the three orders, Graminaceæ, Leguminosæ and Compositæ, and a further 20 per cent. are in the Umbelliferæ and Rosaceæ. The herbage is fairly well mixed, as several of the species are plentifully represented, but the dominant species during the early summer months is *Arrhenatherum avenaceum*, whereas later on in the summer *Centaurea nigra* is the most conspicuous and dominant plant.

Geescroft wilderness is densely covered with tufts of the very coarse grass, *Aira cæspitosa*, studded with a few small trees and shrubs of various kinds. At one end the *Aira* dominates the situation almost to the exclusion of other plants, whereas at the other end many species have a firm footing in spite of the domination of this grass.

Altogether at the present time 88 species (herbs, shrubs, and trees) are to be recognised, of which nearly half are included in three orders (Graminaceæ, Compositæ, Leguminosæ), and a further 10 per cent. are in Rosaceæ and Umbelliferæ.

At the present time the great majority of species are common to both wildernesses, but certain species are peculiar to each. One noticeable point is the abundance of *Anthoxanthum odoratum* and *Holcus lanatus* in Geescroft, and their scarcity on Broadbalk. The plants peculiar to Geescroft are characteristic of damp land. Some of them, *e.g.*, *Phalaris* and *Aira*, are characteristic of marsh or fen associations ; while those peculiar to Broadbalk are characteristic of dry meadows. *Hedera Helix* has probably spread from the thicket. *Brachypodium sylvaticum*, which is fairly abundant in the meadow, is also a woodland grass. The most abundant grasses, *Arrhenatherum* and *Dactylis*, are recorded as abundant in the undergrowth of the " damp oak wood " types, as are many of the other plants in the meadow portion, *e.g.*, *Veronica Chamædrys*, *Nepeta hederacea*, *Stachys Betonica*.

XXX. "*The Effect of Weeds upon Cereal Crops.*" WINIFRED E. BRENCHLEY. New Phytologist, XVI, 1917. 53-76.

Wheat and barley were grown in pot cultures and water cultures in conjunction with certain common weeds, including poppy, charlock (or white mustard), spurry and black bent. Various combinations of the test plants were made over a period of four years.

When poppy, black bent and spurry were grown with wheat they developed less than when grown alone, showing that they had suffered from the competition of the wheat. The wheat, on the other hand, made more growth per individual plant than when the weeds were replaced by an equal number of wheat plants, indicating that the competition of the wheat with itself when thickly sown is more severe than that of weeds with thinly sown wheat plants. On the other hand, when equal numbers of wheat plants were grown, both with and without weeds, the weedless wheat made much better growth. In these experiments spurry proved more harmful than the others, smothering the young wheat by its straggling growth; giving the plant a bad check from which it never properly recovered. The effect of charlock was rather different from that of the other weeds, possibly on account of its habit. The competition between charlock and wheat seems to be nearly equal, and the two plants settled down to some sort of equilibrium, neither gaining the mastery over the other. Barley, on the other hand, suffered more severely from the presence of poppy, spurry or charlock than it did from the same number of barley plants, whereas black bent was not nearly as powerful a competitor.

So far as could be seen, however, the effect was solely one of competition for food, and it made no difference to the individual wheat plant whether its competitor was another wheat plant or a plant of some wholly different order. The phenomena could all be explained by supposing that the number of plants the soil could carry depended on the amount of food present in the soil and the amount of space available for growth ; if the food and space are to be shared by many plants each individual will get a smaller share and therefore make less growth than if there are fewer plants to participate.

XXXI. "*Buried Weed Seeds.*" WINIFRED E. BRENCHLEY. Journal of Agricultural Science, 1918. 9, 1-31.

A number of samples were taken from different grass fields by means of a sampling iron, 6 inches by 6 inches by 9 inches. This was driven into the ground, and the soil was carefully removed inch by inch, each inch being placed in new paper bags and carefully labelled to indicate the depth from which it was taken. The iron was driven far enough in to permit of sampling to a depth of 12 inches, and special precautions were taken that no crumbs of soil from the surrounding areas fell inside the sampling iron. The samples were then placed in clean sterilised pans or boxes in a glasshouse, kept watered, and left undisturbed for a time. Seeds soon began to germinate, and as soon as the young plants were large enough to be recognised they were noted and removed from the soil. A striking difference exists between the buried seed flora of permanent grassland and of land that has at one time been under the plough, even though nearly 60 years have elapsed since grassing down. The buried seeds of permanent grassland include species of grasses and miscellaneous plants which are definitely associated with pasture and never with arable land. Land that was originally arable, however, contains a large number of buried seeds, such as *Centaurea nigra*, *Cerastium vulgatum*, *Stellaria media*, *Plantago lanceolata* etc., which are common to both arable and grassland. This may indicate that these species are really arable weeds, but being able to accommodate themselves to grassland conditions they can persist when once they are established on an area, whether the cultivation be arable or pasture.

A fair number of true arable weeds appeared from soil that has been grassed over for 58 years (Laboratory House Meadow), many of which may certainly be regarded as survivors of seeds left in the soil when it was under arable cultivation. The proportion of grassland plants, however, is large compared to that of the arable weeds. Geescroft has been under grass for a shorter period of time, and the number of arable seeds is greater, while the proportion of grassland seeds has decreased. This tendency becomes more marked as the period in grass becomes less, and on New Zealand field, only ten years under grass, the arable weeds bear a heavy proportion to the grassland plants, particularly if the clovers (which might have been derived from buried seeds of a sown crop), are left out of consideration.

The changes in the proportion of the arable and grassland plants derived from buried seeds are so consistent and so regularly associated with the history of the land that one is irresistibly forced to the conclusion that, when arable land is grassed over a certain number of seeds

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are able to retain their vitality for many years. Many of the seeds die comparatively soon after burial, and as time goes on the number of living seeds gradually becomes less, though the evidence shows that some seeds will survive burial for at least 58 years. Usually most of the older arable seeds survive in the lower depths of the soil where the conditions are less variable, whereas the shorter the time that land has been under grass the greater the proportion of arable seeds found near the surface. While the stock of arable seeds is diminishing with the lapse of time, the supply of grassland seeds is being augmented by fresh seeds ripened by the surface vegetation and gradually carried down into the soil. Naturally the greater proportion of these seeds are found in the upper inches of soil, comparatively few penetrating below the eighth inch.

TECHNICAL PAPERS.

XXXII. "*West Country Grasslands.*" WINIFRED E. BRENCHLEY. Journal of Bath and West and Southern Counties Society, 1917. 11, 85-112.

During the summer of 1916 a survey was made of some of the grassland in Gloucester and Somerset with special reference to the weed flora. In this paper an account is given of the association of some of the chief grassland weeds with alluvium, clay soils, peat, calcareous and non-calcareous sandy soil, and also of the effect of herbage on stock in some special cases.

Some weeds were found to be specially obnoxious because they tainted the milk or had bad effects upon the animals themselves. Garlick, ramsons, hemlock, moon-daisy and woodwax were all accused of tainting the milk. Horsetail has a bad reputation for causing scour, and huffcap is disliked by animals and is regarded as being very detrimental to them.

Besides these directly harmful weeds a number of plants require special attention; these include nettles, creeping thistle, black-bull thistle, yellow rattle, bindweed, hardhead, and others.

Some parts of the fields were characterised by a special flora. Round the gates and along paths where the soil becomes much trodden, greater plantain, silverweed and rough meadow grass were common. The site of an old manure heap was marked by arable weeds derived from seeds carried in the manure, as knotgrass, groundsel, fat hen and shepherd's purse; and on the site of old ricks strong growths of broad dock, dandelion and nettle were often seen.

Under the shadow of trees the herbage takes on a distinctive character, particular species growing in definite association. Cocksfoot, foxtail and rough meadow grass are the three most marked species in these situations, but a few others are found occasionally, as buttercups, dock, sorrel and pignut.

Bindweed = *Convolvulus arvensis.*
Black Bull Thistle = *Cirsium lanceolatum.*
Broad Dock = *Rumex obtusifolium.*
Buttercup = *Ranunculus sp.*
Cocksfoot = *Dactylis glomerata.*
Dandelion = *Taraxacum vulgare.*
Dock = *Rumex crispus.*
Fat Hen = *Chenopodium album.*
Foxtail = *Alopecurus pratensis.*
Garlic = *Allium vineale.*
Greater Plantain = *Plantago major*
Groundsel = *Senecio vulgaris.*
Hard-head = *Centaurea nigra.*
Hemlock = *Conium maculatum*
Horsetail = *Equisetum arvense.*
Huffcap = *Aira caespitosa.*
Knotgrass = *Polygonum aviculare.*
Moon-daisy = *Chrysanthemum leucanthemum.*
Nettle = *Urtica dioica.*
Pignut = *Conopodium denudatum.*
Ramsons = *Allium ursinum.*
Rough Meadowgrass = *Poa trivialis.*
Shepherd's Purse = *Capsella bursa-pastoris.*
Silverweed = *Potentilla anserina.*
Sorrel = *Rumex Acetosa.*
Thistle = *Cirsium arvense.*
Woodwax = *Genista tinctoria.*
Yellow Rattle = *Rhinanthus crista-galli*