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THE OTTAWA NATURALIST.

VOL. XIV. OTTAWA, JULY, 1900. No. 4

SOILS AND THE MAINTENANCE OF THEIR FERTILITY THROUGH THE GROWTH OF LEGUMES.

By FRANK T. SHUTT, M.A., F.I.C., F.C.S., F.R.S.C.,
Chemist, Dominion Experimental Farms.

(*Continued.*)

The chief value of green manuring, as the system of ploughing under a growing crop of clover is called, lies in the addition of nitrogen, otherwise unobtainable. By the subsequent decay in the soil of the turned-under clover, this nitrogen is set free and converted by nitrification into available food for future crops of grain, fruit trees, roots, etc., as the case may be. The growth and harvesting of the nitrogen-consumers leave the soil poorer in nitrogen, the growth of clover and other legumes—even when the crop has been harvested and the roots only left—leaves the soil invariably richer in this constituent. But there are other advantages, though of less importance, to be obtained by this method. Humus in large amounts is formed in the soil from the organic matter of the clover. To the great value of this constituent we have already referred to in detail. All that we have said respecting its functions and importance might be repeated with emphasis for this method of manuring with clover. There is the mechanical as well as the chemical improvement of the soil, the addition of food materials, and the enccuragement of microbic life within the soil.

Further, considerable amounts of potash, phosphoric acid and lime are during the growth of the clover absorbed and built up into its tissues. These, in part at least, are obtained from depths of the soil not reached by the roots of other farm crops,

and, therefore, the turned-under clover crops can be considered as adding largely to the mineral supply of the superficial soil layer. But the feature specially worthy of note in this connection is that this mineral food now offered as humates for the use of succeeding crops, is much more available than before the clover appropriated it; it is, as it were, already digested and, therefore, the more easy of assimilation. To these benefits must be added the good work that clover does as a "catch" crop, preventing the loss of soluble nitrates and other plant food through the leaching action of autumn rains.

Though it has been long known in a vague and indefinite way that clover, unlike other crops, benefited rather than impoverished the soil, that the yield of grain after a crop of clover was greater than it would have been without such a previous seeding of clover, there has not been until lately any intelligent appreciation or application of the truth involved. The practice of soil enrichment by means of clover has only received anything like general attention on the part of our farmers in Canada during the last few years, though since the announcement of Hellriegel and Wilfarth in 1886, furnishing proof that the legumes appropriated the uncombined nitrogen of the air, there has been more or less interest evinced in the subject by those who were keeping abreast of the times.

Since the spring of 1893 systematic investigatory work to determine the fertilizing value of the clover crop has been prosecuted on the Central Experimental Farm, Ottawa. Experiments on the branch experimental farms commenced in 1896.

In most of our trials the clover has been sown with grain, wheat or barley, in the spring. This has always resulted in a good stand of clover before the close of the season, as it grows rapidly after the grain is harvested. If the land is intended for grain, the ploughing under of the clover is done late in the autumn; if a crop of potatoes or Indian corn is to be grown the next season, the clover is left till the following spring, when about the second or third week of May the clover will be quite heavy and furnish a large amount of material for turning under. Our first experiment, the clover having been sown in the spring with grain and the estimations made in the following May, showed the nitrogen contained in the crop of one year's growth, including the roots taken

to a depth of four feet, to be 172 pounds. A similar trial with the second year's growth gave 117 pounds. The details are set forth in the following table:

NITROGEN IN CLOVER CROP.

Clover cut and roots dug on 25th May, 1895.	Weight of material in grammes per square foot.	Weight of material in pounds per acre. (Calculated.)	Percentage of "dry matter."	Weight of "dry matter" in pounds per acre.	Percentage of Nitrogen in fresh material.	Pounds of Nitrogen per acre in fresh material. (Calculated.)
One year's growth—						
Leaves and stems (green)..	209.0	20,070.0	13.29	2,667.30	.505	101.3
Roots, to a depth of 4 feet.	119.5	11,476.0	16.19	1,857.96	.423	48.5
Semi-decayed material on surface of ground.....	32.0	3,073.0	23.53	723.07	.732	22.5
Total	.....	34,619.0	.....	5,248.33	.....	172.3
Two years' growth—						
Leaves and stems (green)..	117.0	11,235.0	19.51	2,191.95	.447	50.0
Roots, to a depth of 4 feet.	193.0	18,535.0	18.85	3,483.85	.354	61.5
Semi-decayed material on surface of ground.....	13.0	1,248.0	35.73	445.91	.410	5.1
Total	.....	31,018.0	.....	6,121.71	.....	116.6

In the same year Dr. Saunders, Director of the Dominion Experimental Farms, instituted a course of experiments to ascertain if the growth of clover, using from two to ten pounds of seed per acre, sown with grain, lessened the yield of the latter. The results did not indicate any diminution in the weight of grain, nor in any subsequent trial—and this experiment has been repeated many times—have we found the yield to be materially affected from the presence of the growing clover.

In the following year an investigation to ascertain the relative merits of certain clovers as "cover" crops for orchards was begun. The seed was sown in July, and the analyses were made on plants collected in October of the same year, the roots being taken to a depth of two feet. The chemical data are given in the subjoined table:

ANALYSES OF CLOVERS, 1896.

CLOVER.	COMPOSITION.			NITROGEN.	WEIGHT OF CROP PER ACRE.		AMOUNT OF CERTAIN CONSTITUENTS PER ACRE		
	WATER.	ORGANIC MATTER.	ASH.		TONS.	LBS.	ORGANIC MATTER.	ASH.	NITROGEN.
							LBS.	LBS.	LBS.
(Sown July 13, 1896, Cut Oct. 20, 1896)									
Crimson Clover –									
stems and leaves.	83.32	13.91	2.77	0.382	11	234	2,093	602	85
roots	83.89	12.92	3.21	0.304	3	201	801	199	19
Total					14	435	2,894	801	104
Alfalfa—									
stems and leaves.	71.63	23.81	4.56	0.671	5	1,192	2,664	510	75
roots	64.74	29.47	5.79	0.557	5	558	3,120	613	61
Total					10	1,750	5,784	1,123	136
Mammoth Red—									
stems and leaves.	79.13	17.05	3.82	0.620	6	1,210	2,269	508	82
roots	77.57	19.41	3,02	0.662	3	1,260	1,409	219	48
Total					10	570	3,678	727	130
Common Red—									
stems and leaves.	76.24	18.84	4.92	0.718	4	1,779	1,842	481	70
roots	71.22	25.61	3.17	0.784	2	1,445	1,394	172	47
Total					7	1,224	3,236	653	117

Similarly, it was found in 1897 that the weight of clover, leaves and stems, together with roots to a depth of nine inches, per acre, determined at the close of the season, varied from five tons to ten tons, according to variety and thickness of seeding, &c.

To find out what value this system might have in locations where clover would not live through the winter, we ascertained the amounts of fertilizing constituents found in the clover residues the following spring after winter killing. Though less than the amounts previously mentioned, the nitrogen is seen to be present in notable quantities.

ANALYSES OF CLOVER RESIDUES, 1897.
(Roots, dead stems and leaves.)

All the clovers were sown at the respective rates mentioned below, on the 5th May, 1896, with Odessa barley at the rate of 1¾ bushels per acre. The barley on all the plots was cut 27th July, 1896. The clover residues (roots, dead stems and leaves) were collected 1st May, 1897.	Composition.			Nitrogen.	Weight of Clover Residue per acre.		Amount of certain constituents per Acre.		
	Water.	Organic Matter.	Ash.		Tons.	Lbs.	Organic Matter	Ash.	Nitrogen.
	p.c.	p.c.	p.c.	p.c.			Lbs.	Lbs.	Lbs.
Mammoth Red Clover sown 14 lbs. per acre.	71.51	24.45	4.04	.903	3	636	1,622	268	59
" 12 "	69.73	25.28	4.99	1.109	3	976	1,762	349	77
" 10 "	59.43	33.19	7.38	1.417	2	1,955	1,978	439	81
" 8 "	70.00	26.18	3.82	1.123	3	976	1,783	258	76
" 6 "	72.00	24.00	4.00	1.041	3	806	1,634	272	70
" 4 "	63.34	31.74	4.92	1.260	2	594	1,458	226	58
Common Red Clover, sown 10 lbs. per ac.	72.50	23.61	3.89	1.016	3	125	1,446	238	62
Alsike Clover, sown 6 lbs. per acre.. .	71.58	22.63	5.79	1.020	1	1,233	732	187	33
Alfalfa, sown 14 lbs. per acre	61.54	34.79	3.67	1.075	1	212	772	79	26
Crimson Clover, sown 24 lbs. per acre...	62.82	33.01	4.17	.827		1,322	478	60	12

In 1898 further examinations were made of a somewhat similar character. The average weight per acre of clover, including roots to a depth of nine inches, obtained at the close of the first season's growth, *i.e.*, in November, was between five and six tons. On another series of plots the clover was allowed to remain until there was a strong growth the following spring (May 21), and the average weight per acre, including roots to a depth of nine inches, was found to be between thirteen and fifteen tons. On all these plots the clover had been sown with grain. As a rule,

the weight of clover material of the first season is greater than that of the second year's growth, but, as the data just recited show, this is not always the case. Favourable climatic influences have much to do with a productive luxuriant growth of clover, and consequently as seasons differ so greatly it is only to be expected that any rule as to yield would be subject to many exceptions. The practical question as to the best time, from a manurial standpoint, to turn under the clover, must, necessarily, take many factors into consideration, and is capable of several answers, according to conditions of soil and crop requirements. I may add, however, that the practice now generally in vogue for some years past is one that receives support and commendation alike from labratory and field results It consists of sowing eight to ten pounds of clover seed with the grain crop of the rotation ; if the crop of the succeeding year is to be Indian corn or potatoes, the clover is allowed to remain until, say, the second or third week in the May following (when there is usually a strong growth, the plants reaching a height possibly of two feet) and then ploughed under; if another crop of grain is to follow, the clover is turned under at the close of the first season of growth, say in October or November.

It would be impossible to place before you in this address any detailed account of all our experiments—field and laboratory—and I have, therefore, made the following estimate, based upon our published results. The data may be interpteted as showing, approximately, the manurial value of the clover crop :—

AVERAGE AMOUNTS, estimated per acre, of Nitrogen, Phosphoric Acid and Potash, in Clover Crop, including roots to a depth of nine inches.

	NITROGEN.			PHOSPHORIC ACID.			POTASH.		
	Foliage.	Roots.	Total.	Foliage.	Roots.	Total.	Foliage.	Roots.	Tl.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
First year crop	90	48	138	30	16	46	75	40	115
Second " "	50	60	111	17	20	37	45	51	96

The fertilizer universally used is barnyard or stable manure. Such contains, if of good average quality, about ten pounds of nitrogen per ton. It is evident, therefore, that by this clover method we can furnish the soil with at least as much nitrogen as would be supplied by a dressing of ten tons of manure per acre. And in addition to this nitrogen—the greater part of which is obtained from an otherwise unavailable source--there are, as we have already pointed out, considerable amounts of potash, phosphoric acid and lime, liberated in the decay of the clover, in forms much more valuable as plant food than they were originally, and therefore in a very true sense to be considered as a distinct addition to the soil's store of available mineral plant food.

It might be urged that the burying of such a large amount of rich food material as is contained in a crop of clover is wasteful and bad farming practice. This, in a certain measure, is true if the farmer has the stock to consume it, for by feeding it there is the opportunity of converting a part into high-priced animal products and returning to the soil by far the larger portion (practically 75 per cent.) of the fertilizing elements of the crop in the waste product of the animal economy. On too many farms, however, there is not sufficient stock for this purpose. We have indeed in this fact the reason for many of our exhausted soils in the older provinces, where farming in certain districts has consisted in growing grain, or oats, or hay, year after year. For such districts, even where stock is now kept in greater numbers, we strongly advocate the growing of clover for recovering fertility, for we know of no fertilizer or manure of equal value that can be so cheaply purchased. The benefits that I have enumerated are to be procured from sowing eight to ten pounds of clover seed per acre, costing $1 to $1.25. The lowest price for nitrogen in fertilizers is ten cents per pound. Since, as we have seen, practically 100 pounds, can be obtained by this method of green manuring, a moderate estimate of the manurial value of the clover would be $10 per acre.

But nearly one-half of the fertilizing value of clover is in the roots, so that when the crop is harvested and sold off the farm there is still a large addition to the soil's store of available plant food and the land is considerably enriched.

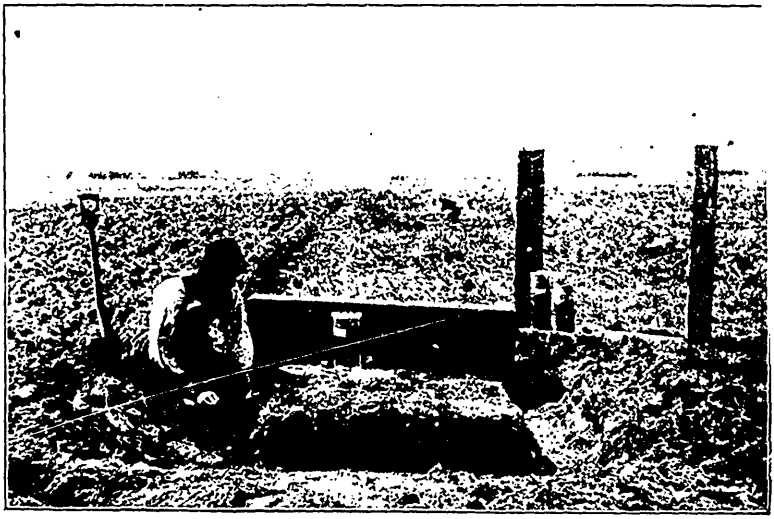
It only remains for me to say in this connection that clover requires, comparatively speaking, large amounts of the mineral constituents, potash, phosphoric acid, and lime. These being present in sufficient quantities, the clover plant with the aid of the germs I have referred to will obtain its own nitrogen. This points to the economy, where the soil is poor in these mineral elements, of supplying a certain amount of them either as wood-ashes—our own special product, and one that we are parting with to farmers in the United States at a price much below their true value —or some form of German potash salts supplemented by superphosphate or basic slag, to encourage the growth of the clover.

In conclusion, I propose to present some of our field results, showing the beneficial effects upon grain and other crops from this system of manuring by clover. They are of an exceedingly striking character, and furnish ample corroboration of the claims I have made for the clover crop as a means for increasing the soil's productiveness. These field experiments, I should add, were all conducted by Dr. Saunders, Director of the Experimental Farms.

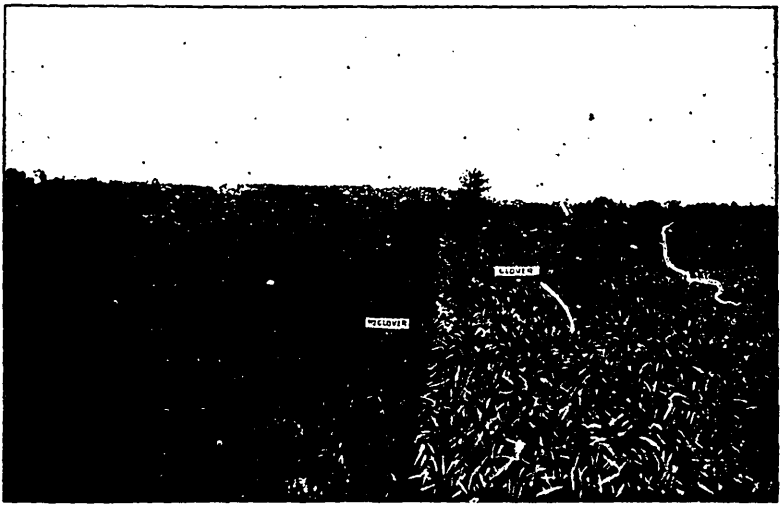
GRAIN AFTER CLOVER.

In 1897, eight plots were sown with grain, four with the addition of clover seed at the rate of 10 pounds to the acre, four without the addition of clover. In October of the same year the crop of clover was turned under, the adjoining "no clover" plots being ploughed at the same time. The grain sown on these plots were: Preston wheat, Banner oats, Bolton barley, and Odessa barley. This land without any application of manure was sown in 1898 with Banner oats. Regarding the appearance of the growing crops on these plots, Dr. Saunders speaks as follows:—"The difference in the growth of the grain on these plots was soon very noticeable, and, as the season advanced, especially just before the heads appeared, the difference in height and vigour of growth in favour of the plots where the clover had been grown was very remarkable. So clearly was this manifest, that the difference could be distinctly seen at a considerable distance, and the outline of those plots on which no clover had been sown could be readily traced by the manifestly shorter and less vigorous growth. After the grain was fully headed, the difference in appearance was not so clearly seen at a distance, but by careful examination it could be easily traced." The plots were cut and threshed separately, and weighings made of the grain and straw from each plot obtained. The results showed an average increase in the yield of grain from the four clover plots of more than 11 bushels per acre over that on the plots on which there had been no clover sown.

PLATE I.



Showing the method of collection of Clover roots for analysis.



Crop of Oats photographed July 4th, 1899, after Brome grass and clover, respectively. The oats after clover are 20 inches taller than on land previously sown with Brome grass.

To ascertain what manurial value there might be from the clover the second year after ploughing under, these same plots, without the addition of any manure or fertilizer, were sown in 1899 with Mensury barley. Again a great difference on the plots that had grown clover in 1897 was noticed, and the harvested results showed the average yield on the four clover plots over that of the four "no clover" plots amounted to almost nine bushels per acre.

The weights of grain and straw harvested from these plots in 1898 and 1809 are given in the subjoined table :

GRAIN AFTER CLOVER—Results showing fertilizing effect of Clover (a) first year, and (b) second year after being ploughed under.

Plot.	Nature of Crop sown in 1897.	1898—1st Year. Banner Oats.			1899—2nd Year. Mensury Barley.		
		Straw per acre. Lbs.	Grain per acre. Bus.	Lbs.	Straw per acre. Lbs.	Grain per acre. Bus.	Lbs.
1	Preston wheat and clover ..	3,770	56	6	3,120	40	20
2	" " no clover....	2,160	37	2	1,740	25	20
	Increase due to manurial effect of clover	1,610	19	4	1,380	15	0
3	Odessa barley and clover ..	2,180	37	12	2,620	32	29
4	" " no clover	1,450	30	10	2,440	27	44
	Increase due to manurial effect of clover	730	7	2	180	4	33
5	Bolton barley and clover	3,180	51	26	2,470	33	26
6	" " no clover	2,090	44	24	2,000	29	28
	Increase due to manurial effect of clover	1,090	7	2	470	3	46
7	Banner oats and clover	5,110	55	0	3,270	44	38
8	" " no clover.....	2,260	44	4	2,320	33	36
	Increase due to manurial effect of clover	2,850	10	30	950	11	2
	Average increase on four clover plots.....	1,570	11	1	745	8	32

Another experiment in which equally striking and important results were obtained may be described as follows :—In 1897 two plots adjoining each other and uniform as regards size and character of soil, were selected : No. 1 was sown with barley and a grass mixture containing clover seed ; No. 2 was similarly sown, with the exception that there was no clover seed in the grass mixture. In 1898 two crops of hay were taken off each plot. In the spring of 1899 they were ploughed and sown with Bavarian oats. The yield per acre on No. 1 was 46 bushels 4lbs. ; that on No. 2, 36 bushels 6 lbs., an increase of 9 bushels 22 lbs. of grain to the acre on the plot which had grown clover over that on the plot sown with grass seed only. This increase was practically due to the fertilizing constituents set free by the decay of the clover roots only, for in 1898 two crops of hay had been taken off.

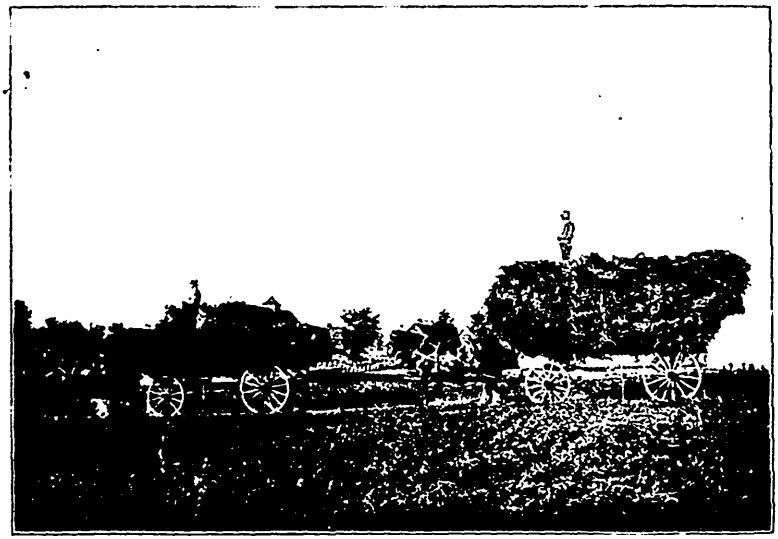
INDIAN CORN AFTER CLOVER.

In 1897 a number of plots were sown with grain and clover, check plots being left throughout the series upon which grain only was grown. The clover was allowed to remain through the winter, and on May 25rd., 1868 (at which date there was a heavy mat of growth), ploughed under. It was planted with Indian corn. The yields in detail are to be found in the report of the Experimental Farms for 1898. I will now merely state that the average yield from three plots that had previously grown clover was 16 tons 240 lbs. of fodder corn, while that from the plots on which there had been no clover was 13 tons 380 lbs.

POTATOES AFTER CLOVER.

The following experiment shows that, as with grain and fodder corn, an increased yield of potatoes was obtained by preparing the land with clover.

Plots Nos. 1 and 2, of similar size and character of soil, and adjoining each other were selected in the spring of 1898. No. 1 was sown with grain and clover ; No. 2 with grain only. In May, 1899 (there being an excellent growth of clover on No. 1), the plots were ploughed and planted with potatoes. The yield of potatoes was, on No. 1, at the rate of 146 bushels 27 pounds per acre ; on No. 2, 104 bushels 57 pounds per acre.



OATS, 1899.—Wagons contain yield from adjoining plots of uniform size; that to the left is crop after grass, yield 36 bus. 16 lbs. per acre; that to the right shows crop after grass mixture containing clover, yield 46 bus. 4 lbs. per acre.

OATS, 1899.—To the left are seen four shocks of oats grown second year after ploughing clover under; yield 53 bus. 13 lbs. per acre. To the right are seen three shocks of oats grown on an equal area of land not so treated; yield 41 bus. 6 lbs. per acre.

The data which I have just cited—obtained by careful experiments over a number of years, employing the cereals, Indian corn and potatoes as test crops—are, in my opinion, of such a striking character as to leave no doubt as to the conclusion to be drawn therefrom. They unmistakably assure us that the clover crop has a most marked effect in increasing a soil's productiveness, and confirm in the most emphatic manner the chemical results.

We have referred to the fact that in certain of the western provinces of the Dominion we find extending over very large areas some of the richest wheat soils in the world. To support this statement we have not only our own analyses, but those of European chemists. Where these soils are being cultivated the system of continuous cropping with wheat is in vogue, and practically nothing is being put back into the soil. From what has been stated in this address it will be apparent that not only are such soils becoming poorer in available plant food constituents by the amounts removed yearly in the crops, but that much organic matter and nitrogen is necessarily oxidized and lost by the indispensable cultural operations. When a short time ago in Portage la Prairie, one of our very best wheat areas, I was told by several careful and observant farmers that already a diminution in the yield other than that which could be ascribed to climatic influences (for it was a more or less steady decrease) was to be observed on the older lands, that is, on those that had been consecutively cropped with wheat for twenty or twenty-five years. Thus it comes about that the farmers in many districts of the Northwest are now recognizing the necessity of adopting some plan for the maintenance of soil fertility, and interested and encouraged by the results obtained through the use of clover in Eastern Canada, have already commenced a trial of this method.

If it behooves the Western farmer who has tilled but for a quarter of a century one of the most fertile soils of the world, to pay attention to this matter of the restoration of the nitrogen, humus and available mineral food, how much more important is this subject for the farmers of Eastern Canada, where for the most part the soil has been much longer tilled, and where originally it was not of that extreme richness as in the Northwest! In my opinion, the average yield in all our Eastern provinces would be

considerably raised by the more extensive and regular growth of one of the legumes.

You must not imagine from what I have said in this address that there are any grounds for considering our cultivated soils and their productiveness as seriously impaired ; such is not the case, save in a few localities in restricted areas. I do, however, say that in many parts of Canada we have, either through ignorance or carelessness, or both, practised a very foolish and irrational system of farming, one in which much has been taken out of the soil and little or nothing returned, a system which has necessarily resulted in diminished yields—the first and most serious step towards unprofitable farming. Since it is almost impossible to *materially lower within a few years what I have termed the* "total" stores of mineral plant food in the soil, it is evident that our one-sided system of farming has exhausted the land of those very small, but nevertheless most valuable, supplies of soluble available constituents which go to nourish crops. It is to restore these economically, to add humus and nitrogen, that this method of manuring by the clover is strongly advocated. I trust sufficient evidence has been brought forward to show that theory and practice alike justify us in recommending this system as one of the most effective, and certainly the cheapest for soil restoration.

We may well consider our soils as a natural resource of great and permanent value. They are a resource which should increase rather than deteriorate in value as time goes on, and I have no doubt that such will be the case. Of the capabilities and possibilities of agriculture in Canada we cannot as yet form any adequate conception, for little more than one-tenth of our agricultural lands is as yet tilled. Thousands upon thousands of acres of fertile soil yet await the husbandman to yield their quota of wealth. We may be said to be only beginning farming, but nevertheless we have sufficient evidence to show that Canada is pre-eminently a food-producing country. It is all important, therefore, that no pains should be spared in the investigation of agricultural problems and in the dissemination of information arising therefrom. Every year marks an advance, and the most encouraging sign of all is that our agricultural work is being more

and more prosecuted on rational lines, a result no doubt of the fact that the scientific principles underlying the practice of agriculture are becoming more widely known. Of improved methods based upon scientific truths that the Experimental Farm system has been instrumental in introducing, none give more promise of fruitful results than the one which I have brought before your attention in this lecture : The maintenance and increase of soil fertility through the growth of legumes.

NOTES ON RARE BIRDS OCCASIONALLY BREEDING IN EASTERN ONTARIO.

By REV. C. J. YOUNG, B.A., Wolfe Island, Ont.

From time to time very interesting local lists of birds have appeared in THE OTTAWA NATURALIST, but I have not recently noticed any additions to the Ottawa list, published in Vol. V, 1891. If the radius of the district covered by that list is a little extended, so as to take in parts of the counties of Leeds and Frontenac, several birds may be added.

For instance, Brunnich's Murre has been seen in numbers and shot on the River St. Lawrence several times during the past five years, and last winter (1900) a specimen was captured in a field near the village of Lansdowne, Ont., which the writer saw alive.

2. The American Merganser breeds occasionally, selecting a hole in a tree. One such location was at Bobs Lake, near Sharbot Lake, Ont., where the same nesting site was resorted to for several years. This bird also breeds in trees near the head of Wolfe Island, Ont.

3. The Red-breasted Merganser is a common species and breeds both at Charleston Lake, County Leeds, and on small islands at the foot of Lake Ontario. There was a nest last year on Pigeon Island, Lake Ontario.

4. The Wood Duck is unfortunately becoming quite uncommon, and seldom breeds now.

5. The Old Squaw (*Clangula hyemalis*) is very common this year about Kingston, and many are flying over the water at this date, May 15th.

6. The Green Heron (*Ardea virescens*) is a regular summer visitor to the neighbourhood of Kingston and Charleston Lake, and last year (1899) I saw three nests with eggs. It might probably be met with nearer Ottawa, most likely along the Rideau. I may say that I thought I had found a permanent nesting home of these birds in Eastern Ontario. Last year, as stated above, we found three nests; this year (1900) I visited Charleston Lake on the 31st May, two days later than last year, and did not see any new nests, nor a sign of any birds. The three old nests were as we left them last year, close to the lake, and wonderfully preserved, considering what frail structures they are, but as for new ones there was not a sign of one. This appears very strange, for I think birds, if not killed in the interval, as a rule always return to their former nesting localities.

7. A very fine specimen of the King Rail was caught by Mr. Stratford, taxidermist, of Kingston, during the past winter. It is now in his shop, and was secured by him in Cataraqui Marsh, December, 1899.

8. The Bartramian Sandpiper is by no means a rare species. It breeds from Kingston eastwards as far as the neighbourhood of Brockville. I frequently see it, and on May 21st saw, about five miles from Kingston, a nest with two eggs in. Many pairs bred this year.

9. The Buff-breasted Sandpiper I believe breeds in the same district, but I have no certain knowledge of this; though I have seen the bird in the summer, and saw one May 21st.

10. The Red-shouldered Hawk is the commonest hawk in this district, though stated to be very rare nearer Ottawa.

11. On the other hand, the Broad-winged Hawk is quite rare, seldom breeding, though it is a common hawk in the Ottawa valley. A nest was seen near Lansdowne in 1898.

12. The Bald Eagle is rapidly becoming rare. This year (1900) on the 28th April, a nest was located within a few miles of Kingston, and two eggs secured, one of which is in my possession.

13. The Scarlet Tanager breeds sparingly in the township of Lansdowne. I saw a nest with four eggs June 5th, 1898.

14. The Rose-breasted Grosbeak and Towhee Bunting also

occasionally breeds in this district, and I have seen the nests of both in 1898 and 1899.

15. I shot a specimen of the King Eider in December, 1896, among the Thousand Islands, near the Fiddler's Elbow. The bird was in very poor condition, and probably came from the Hudson Bay region, where I believe the Brunnich Guillemots, that have visited the St. Lawrence recently, come from, and not from the Gulf.

16. A specimen of the Horned Grebe in full summer plumage was shot by Mr. Stratford, of Kingston, in April last, in Cataraqui Marsh.

17. The Least Bittern spends the summer in the marshes between Kingston and Brockville, and last year I saw eggs that were taken near Kingston in June.

18. Cooper's Hawk occasionally nests in the same district, but is not common.

19. The Saw-whet Owl very rarely breeds. I have seen one that was caught among the Thousand Islands in June.

20. The Screech Owl (*Scops asio*) is becoming quite common, and the young are met with every year.

21. Two specimens of the American Barn Owl have recently been obtained near Kingston. One of them was caught alive by D. Breakey, of Wolfe Island, and is now in his possession.

22. The Black-billed Cuckoo.—This bird is very common in the vicinity of Kingston, as it also appears to be down the St. Lawrence. It frequents moist and marshy locations, and is not often met with far from water. This year I met with two nests each containing one egg on the 8th and 9th of June respectively. The nest was the frailest affair possible. With regard to the nest of the 9th June, I visited it again on the 12th, and to my surprise it contained five eggs, whereas only four could have been expected. In addition to this the nest was greatly improved and strengthened since the visit of June 9th, and showed plainly that the bird had added to it after laying her first egg.

23. The Yellow-billed Cuckoo occasionally nests around Lansdowne, Ont., but is rare. Three eggs appear to be the usual number laid. I saw nests in 1898 and 1899.

ORNITHOLOGY.

BIRD NOTES.

The following observations on the arrivals of birds were practically all made by Mr. Geo. R. White. All members of the Ottawa Field-Naturalists' Club having notes of observations of birds and their habits are asked to send them to me at the Experimental Farm, that they may be compiled and published in THE NATURALIST. During the remainder of the season many interesting facts may be noted regarding the nesting of birds, and these would be especially welcome. Notes should be sent in between the 15th and 20th of each month.

1900.

April 24—RED-SHOULDERED HAWK, *Buteo lineatus.* Mr. Geo. R. White.
24—FLICKER, *Colaptes auratus.* Mr. White.
27—CHIMNEY SWIFT, *Chætura pelagica.* Mr. White.
27—FOX SPARROW, *Passerella iliaca.* Mr. White.
29—WHITE-THROATED SPARROW, *Zonotrichia albicollis.* Mr. White.

May 1—BARN SWALLOW, *Chelidon erythrogaster.* Mr. White.
2—RUBY-CROWNED KINGLET, *Regulus calendula.* Mr. White.
3—AMERICAN OSPREY, *Pandion haliaëtus carolinensis.* Mr. White.
4—SPOTTED SANDPIPER, *Actitis macularia.* Mr. White.
4—HERMIT THRUSH. *Turdus aonalaschkæ pallasi.* Mr. White.
5—CLIFF SWALLOW, *Petrochelidon lunifrons.* Mr. White.
5—PURPLE MARTIN, *Progne subis.* Mr. White.
6—BROAD-WINGED HAWK, *Buteo latissimus.* Mr. White.
7—BANK SWALLOW, *Clivicola riparia.* Mr. White.
10—KINGBIRD, *Tyrannus tyrannus.* Mr. White.
10—OLIVE-BACKED THRUSH, *Turdus ustulatus swainsonii.* Mr. White.
10—MYRTLE WARBLER, *Dendroica coronata.* Mr. White.
10—PARULA WARBLER, *Compsothlypis americana.* Mr. White.
10—WHITE-CROWNED SPARROW, *Zonotrichia leucophrys.* Mr. White.
10—AMERICAN SPARROW HAWK, *Falco sparverius.* Mr. White.
10—WILSON'S THRUSH, *Turdus fuscescens.* Mr. White.
11—CAPE MAY WARBLER, *Dendroica tigrina.* Mr. White.
11—YELLOW WARBLER, *Dendroica æstiva.* Mr. White.
11—BLACK AND YELLOW WARBLER, *Dendroica maculosa.* Mr. White.

11—YELLOW PALM WARBLER, *Dendroica palmarum hypochrysea.* Mr. White.

11—HOUSE WREN, *Troglodytes aedon.* Mr. White.

11—BLACK-THROATED BLUE WARBLER, *Dendroica cærulescens.* Mr. White.

11—CRESTED FLYCATCHER, *Myiarchus crinitus.* Mr. White.

11—CEDAR WAXWING, *Ampelis cedrorum.* Mr. White.

12—AMERICAN BITTERN, *Botaurus lentiginosus.* Mr. White.

12—GREATER YELLOW-LEGS, *Totanus melanoleucus.* Mr. White.

12—SOLITARY SANDPIPER, *Totanus solitarius.* Mr. White.

13—BALTIMORE ORIOLE, *Icterus galbula.* Mr. White.

13—SAVANNAH SPARROW, *Ammodramus sandwichensis.* Mr. White.

14—CATBIRD, *Galeoscoptes carolinensis.* Mr. White.

14—OVEN-BIRD, *Seiurus aurocapillus.* Mr. White.

15—BLACK-POLL WARBLER, *Dendroica striata.* Mr. White.

15—AMERICAN REDSTART, *Setophaga ruticilla.* Mr. White.

15—BAY-BREASTED WARBLER, *Dendroica castanea.* Mr. White.

16—NASHVILLE WARBLER, *Helminthophila ruficapilla.* Mr. White.

17—BLACK-THROATED GREEN WARBLER. *Dendroica virens.* Mr. White.

17—AMERICAN WOODCOCK, *Philohela minor.* Mr. White.

18—CHESTNUT-SIDED WARBLER, *Dendroica pennsylvanica.* Mr. White.

18—BLACKBURNIAN WARBLER, *Dendroica blackburniæ.* Mr. White.

18—PINE WARBLER, *Dendroica vigorsii.* Mr. White.

19—AMERICAN HERRING GULL, *Larus argentatus smithsonianus.* Mr. White.

19—BLACK AND WHITE WARBLER, *Mniotilta varia.* Mr. White.

20—NIGHT HAWK, *Chordeiles virginianus.* Mr. White.

20—SCARLET TANAGER, *Piranga erythromelas.* Mr. W. T. Macoun. Mr. White, 23rd.

21—RUBY-THROATED HUMMINGBIRD, *Trochilus colubris.* Mr. White.

24—MOURNING WARBLER, *Geothlypis philadelphia.* Mr. White.

24—CANADIAN WARBLER, *Sylvania canadensis.* Mr. White.

24—LEAST FLYCATCHER, *Empidonax minimus.* Mr. White.

24—RED-EYED VIREO, *Vireo olivaceus.* Mr. White.

27—RED-HEADED WOODPECKER, *Melanerpes erythrocephalus.* Mr. Macoun.

W. T. MACOUN.

BOOK NOTICES AND REVIEWS.

CANADIAN SURVEYS AND MUSEUMS, AND THE NEED OF INCREASED EXPENDITURE THEREON. Proceedings of the Canadian Institute. (Issued as a separate pamphlet, 15 pp.) By B. E. Walker, Esq., F.G.S., President.

Following up the remarks made by Dr. G. M. Dawson in his inaugural address as President of the Royal Society of Canada in 1894, Mr. Byron E. Walker, of the Canadian Institute, Toronto, (a Society which has now reached the 51st year of its existence,) draws attention to two very live practical questions of the day, viz., National Surveys and Museums. The place that these occupy in the economy or government of a country like ours, their value and the extent to which they ought to be supported and fostered, has been treated in a masterly way in the above paper read before the Institute last November.

Mr. Walker first reviews the work of the early explorers and surveyors of British North America, in which he notices the names of Admiral Bayfield (1814), Lieut. Baddeley and Sir Richard Bonnycastle (1829), Prof. A. Lockwood, Major Samuel Holland (1748) and his grand-nephew Lt.-Col. Joseph Bouchette (1832), Dr. J. J. Bigsby (1819), Samuel Hearne (1769-1772), Sir Alexander MacKenzie (1789), Capt. George Vancouver (1790-1795), David Thompson (1784-1850), Sir John Franklin (1819-1822), Capt. John Palliser, Blakiston, Hector and G. Gladman (1857-9), Henry Youle Hind, W. H. E. Napier and S. H. Dawson (1857), John Keast Lord (1868-82) and Dr. G. M. Dawson (1874-75).

Mr. Walker then calls attention to the United States surveys and explorations carried on by the Federal Government before the establishment of a regular geological survey. He then describes in broad general outlines the geological and survey work carried on in the old Province of Canada under Sir William Logan, Alexander Murray, James Richardson, Robert Bell, E. Billings, A. Michel and Thos. Macfarlane. Referring to work done in other provinces he notices that of Dr. Abram Gesner (1838-1844), J. F. W. Johnston (1850), L. W. Bailey (1864), G. F. Matthew, L. W. Bailey and C. F. Hartt (1865). Work in Labrador (1861) by

Prof. H. Y. Hind is then recorded, also his work in 1864 in New Brunswick published 1865. The labours of Charles T. Jackson and F. Alger (1832), together with those of Sir William Dawson in Nova Scotia (1855-1878), are also referred to, as also those of Prof. H. A. Nicholson (1874-5) for Ontario, and later, reports of the Mining Bureau of Ontario, under Mr. Archibald Blue, and those of British Columbia by the various officers of that province. Mr. Walker, who, from his high scientific attainments and accurate knowledge of geology—with special reference to that captivating department, palæontology—and from his practical experience as a financier, has watched the work carried out by the Geological Survey in Montreal, and later, in Ottawa, can speak intelligently on this subject. He then goes on to describe the present work of the Geological Survey, with its natural history departments, as at present constituted. He points out that "we should have the Dominion and Provincial surveys working out the topography in a far more minute manner, and on a greatly larger scale than at present." He points out also that no surveying party is complete without a trained geologist and a trained naturalist attached thereto, to record the economic resources of the district surveyed.

As to Public Museums, Mr. Walker has a word in season, knowing as he does, the value of Canada's mineral resources, being also well acquainted with the hundreds of thousands of the specimens that have been examined, reported upon, and analyzed by the Canadian Geological Survey, which specimens are now stored in the tottering and inadequate building, the so-called National Museum on Sussex street, Ottawa. After describing what a National Museum should contain (p. 14), he goes on to say: "The necessity of a new building at Ottawa is admitted. The crime of leaving exposed to fire, in a wretched building never intended to protect anything of value, the precious results of over fifty years of collecting, has been pointed out in a recent official report; but the Government seem deaf to such claim. I can only repeat that we are rich enough to bear the cost with ease, but we are not intelligent enough to see our own interest in spending the money."

Such a statement ought to awaken the attention and consideration of our legislators.

I am led to understand that the Canadian Institute has distributed a copy of Mr. Walker's most valuable memoir to each member of the Senate and House of Commons of Canada,

In face of the statements made, of their strict accuracy, and of the great necessity of a new building, it is earnestly hoped that the Government will see its way clear to place a sum in the estimates for a National Museum, wherein to properly house the invaluable national collections in geology and natural history. Such a building would enable the department to carry on its work in a much more efficient manner.—H. M. A.

A PRIZE FOR MOSQUITOES.

In view of the important bearing mosquitoes are now known to have upon the spread of certain diseases among human beings, a more complete knowledge of these little-studied insects is thought to be very desirable. The subject was vividly brought before a large Ottawa audience by Dr L. O. Howard, the United States Entomologist, at the recent meeting of the Royal Society of Canada, and the Council of the Ottawa Field Naturalists' Club have decided to offer a prize to the member of the club who makes during the present season the largest collection of species of mosquitoes. These collections are to be exhibited on the Entomological evening in next winter's lecture course and may be made in any part of Canada.

The specimens must be pinned and each one labelled with the locality and date of capture.

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