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A LANDSLIDE ON THE LIEVRE RIVER.

By ALFRED ERNEST BARLOW.

(Published by permission of the Acting-Director of the Geological Survey of Canada.)

The people of the city of Ottawa and surrounding country were shocked and alarmed by reading in the early morning paper of Monday, October 12th, 1903, that a landslide of very large proportions had occurred in the vicinity of Poupore Post Office on the Lièvre river, nearly twelve miles north of the town of Buckingham in the Province of Quebec. Many of the details of this catastrophe, as gleaned from the newspaper reports, are no doubt well remembered by most of those who will read this article, which is written in order to describe with greater technicality than is usual in a newspaper contribution, some of the more salient features, furnishing what are considered the main reasons determining and even favoring this wholesale movement of mother earth. The accompanying reproductions, from actual photographs will serve, in a measure, to illustrate the general appearance, two days after the landslide occurred, of the portion affected. An inspection of these will, it is believed, convey a much more adequate idea than is possible by mere words of the great havoc and ruin wrought to what had previously been the scene of peaceful and happy homesteads, whose inmates harbored no suspicion of disaster. The first intelligence reaching Ottawa that such a calamity had overtaken this peaceful community, in the grey dawn of that Sunday morning, was conveyed in a telephone message sent to Dr. Henry M. Ami, by the Rev. William Patterson of Buckingham. This news was received about 10 o'clock, five hours after the movement

had ceased. All the first reports were, of course, of a rather vague and contradictory character, but ignorance of the details of the situation did not prevent the spreading of greatly exaggerated statements, not only in regard to the extent of the damage inflicted, but also as to the consequences that were sure to follow. It was greatly feared, and firmly believed by many, that the release of the dammed-up waters threatened the safety not only of all the residents in the Lièvre valley below the slide, but also of the town of Buckingham. The urgent necessity for more accurate and detailed information was fully appreciated by Dr. Whiteaves, who, in Dr. Bell's absence, was acting as Director of the Geological Survey. Dr. R. W. Ells, who had previously examined and reported upon the geology of the district in which the slide had occurred, was given charge of the examination, while Mr. LeRoy and the writer accompanied him, to make any necessary surveys and secure such photographs as would fully illustrate the occurrence. The Summary Report of the Geological Survey Department for 1903 contained Dr. Ells' official account of the landslide, accompanied by a small plan showing the position and extent of the area affected. This map, on a scale of twelve chains to one inch, was prepared by Joseph Keele from surveys made by James White, O. E. LeRoy and the writer.

Like the proverbial policeman, the Government geologists were early on the scene after the catastrophe, leaving Ottawa by the evening train of Monday, October 12th, for Buckingham. During the journey, all sorts of rumors were afloat as to the danger threatening the mills, and even the town of Buckingham itself, by the backing-up of the waters caused by the filling up of the channel of the river by the debris from the landslide. On our arrival at Buckingham, however, we were reassured by the report that the water had surmounted these clay barriers, about four o'clock that afternoon, and was flowing over this uneven surface of accumulated material, by a series of small channels, which would certainly deepen during the night. We, therefore, retired to rest at the hotel, with a sense of tolerable security, feeling that the crisis had passed. The morning broke bright and clear and we made an early start for the scene, driving up the road on the west side of

the river as far as Brazeau's house. Leaving our horses there, we immediately began our examination, walking around and across the whole area, taking such photographs as would illustrate fully the phenomena witnessed and making such surveys as were necessary to show the position and extent of the area affected.

This remarkable and extensive landslide occurred on the southwest bank of the Lièvre River, in the early morning of Sunday, October 11th, 1903. The first disturbance was felt at 4.45, while it was yet dusk, and with the exception of some minor disturbances, the whole movement was completed by 5 o'clock. It was not attended by any noise, except that produced by the straining and cracking of the timbers of the various barns and structures affected. The simultaneous transportation of such a large amount of material into the bed of the stream at once completely choked it up, forcing the water to either side, thus flooding the banks, the water reaching to the lower windows of the farm houses. (Plate III.) In all, about 100 acres were affected by the movement, and the larger portions of three farms were rendered practically useless, at least for some time to come. Time will efface many of the inequalities, but the area will never present the same beautiful, sloping farm-land which was looked upon as one of the most desirable agricultural sites in the whole of the Lièvre valley. The excavation caused by the landslide, for most of it is from 25 to 30 feet below the original level, comprises portions of lots 25 and 26, con. XI, of the township of Buckingham, and lots 7 and 8, con. I, of the township of Portland East. The farms which suffered belonged to Alexandre Clèment, Maurice Brazeau and Duncan McMillan. Only one residence, that belonging to Clèment, was moved. This house, originally situated about 100 feet south of the road which here formed the boundary between the two townships (Buckingham and Portland East), and thus within the former township, was moved about 100 feet north of the road into the township of Portland East, while, at the same time, the area of land, immediately surrounding the house, was lowered *en bloc* about 20 feet. The disturbed area has a somewhat irregular outline, extending back a distance of about 700 yards from the river to the base of the hills of gneiss and granite, which here form the southeastern edge of

the valley. (Plate V, Fig. 1.) Along the river front, the length of the landslide was nearly 600 yards, but near its eastern end a small wooded knoll rises above the general level to a height of about 35 feet, which must be either underlain by rock or made up of a very homogeneous and impervious clay. This small hill, forming a rudely triangular buttress, with the apex towards the land and a base measuring about 100 yards along the river, remained unaffected by the movement. The slide thus divided into two parts, by far the larger amount of material reaching the river to the west of the small hill already mentioned. The greatest excavation is as usual along the base of the hill and at the western or upper end of the slip, while the crevasse, marking the eastern limit has been concealed, to a large extent, by the piling up of material into a series of hills, rising from 12 to 30 feet above the clay plain, and made up of loose material derived from the rest of the area. This crevasse, which originally marked the eastern limit of the slip, ran with a gentle curve immediately to the west of Brazeau's residence, the movement overturning his barns and some outhouses, although the residence, carpenter-shop and milk-house were not affected in the general commotion. There were likewise no cross fractures produced in the area on which the house stood, for the water in the well, which is about 12 feet deep, showed no signs of any disturbance. The western limit passed close to the east of Duncan McMillan's house and outbuildings, some of the latter being on the verge of the crack thus produced, while the southeastern edge reached to the slope of the hills of gneiss and granite which here mark the limits of the valley. The Government dam, which was completed some years ago, was pushed about 100 yards from its original position and now points up instead of across the stream ; while the locks, constructed at great expense, were filled almost completely with the debris from the slide. A barn, full of hay, situated near the middle of lot 7, con. I of Portland was carried down the stream, on a huge block of clay, and now occupies an island in the river, nearly half a mile from its original location. Happily not a single life was lost, though, in the circumstances, it seems miraculous that all escaped. About ten head of cattle were killed and some of these were completely entombed by the overturned clay. Only one man was an

eye witness of the whole of the scene, and at the time of our visit it was believed that his mind was permanently unbalanced by what he saw. Alexandre Clèment, standing on the threshold of his front door, saw the slow and deliberate differential movement of the huge blocks of land, which tilted his barns, smashing many of the timbers and boards in the commotion. (Plate V, Fig. 2.) On the opposite side of a large crevasse, which he saw open slowly almost at his feet, a huge block of land appeared to rise to a height of perhaps twenty or more feet. Subsequent examination shows this to have been an optical illusion, for in reality, this land which appeared to rise, remained practically stationary, while, on the other hand, the portion on which his house rested, slowly sank from 20 to 30 feet below its original level. In addition, the whole farm and adjoining district seemed to him to be slowly, but surely, moving towards the river and, after what appeared an eternity, the whole commotion subsided. So gradual and uniform was the motion in the vicinity of Clèment's house, that a glass of water, which was filled and standing on the ledge of the front window, was still in the same condition, when the landslide was complete. The water in the well, which was about 12 feet deep also remained at its normal level, showing that no crack was formed in this part of the block of land.

Such landslides are by no means of infrequent occurrence along the banks of rivers which flow through similar clay flats, but, for the most part, only small areas, in the more immediate vicinity of the river, are affected. Several landslides have, however, occurred, within the last sixty-five years, along some of the tributaries of the St. Lawrence river, which were of such magnitude, and attended with such direful results, as to warrant special examinations being made, with a view not only of determining the extent and nature of the damage inflicted, but also, if possible, to reach a definite conclusion as to the causes which bring about such wholesale and profound disturbance of areas, hitherto considered more than ordinarily secure and solid.

The first landslide in the Province of Quebec of which we have any record occurred on the Maskinongé river in 1840,

and was described, in some detail, by Sir William Logan.* The point at which the landslip occurred is nine miles from the granite hills, and where the river is 10—20 yards wide and changes its direction from south to west for 700 yards. The movement commenced about 8 o'clock on the morning of the 4th April, 1840, when the snow was still on the ground. The marly clay first detached was about 200 yards in breadth, and 700 yards in length; it was followed at intervals of a few minutes by four other movements. The whole of the area thus affected amounted to about 84 acres, and the total length was 1,300 yards. The breadth varied, the narrowest part being nearest to the river and the widest, equalling 600 yards, a considerable way from it. The moving mass first crossed the stream and then splitting against the opposite bank, where it averaged a thickness of 75 feet, one-half turned up the valley for about three-quarters of a mile and the other half down it for an equal distance, forming a dam half a league in extent. The whole operation was completed in about three hours. No lives were lost, but two farms were destroyed, while cattle and other live stock perished with the falling buildings.

The St Albans landslip, described by Mgr. Laflamme† of Laval University, occurred on the 27th of April, 1894, on the west bank of the Ste. Anne de la Pérade, about four miles above the village of St. Albans, or seven miles distant from the Rivière Blanche. Here the surface deposits, made up of Leda clay and Saxicava sand, slid down into the valley of the river for the space of three miles and a half. The landslip was in three parts, the first movement being at the northern end where it was about ten feet deep. This was followed after some hours by another which took place immediately to the south and finally a third descended just below the second, leaving a pit 175 feet deep. The average depth of the whole chasm was not less than 100 feet below the general surface of the ground and its width about a mile. The mass of material thrown into the valley of the Ste. Anne permanently changed the course of the river. The Rivière Blanche

* Proc. Geol. Soc. Lon., Vol. III, 1838-1842, pp. 767-769.

† Trans. Roy. Soc. Can., Vol. XII., 1894, Sect. IV., pp. 63-70.

landslip described by Dr. Chalmers was closely simliar to that of the Maskinongé river described by Logan. It took place on the east bank of the Blanche, a tributary of the Ste. Anne de la Pérade at St. Thuribe, about 3 miles north of St. Casimir village. The chasm remaining from this landslip is also irregularly oblong in shape, like that of the Maskinongé valley with the narrowest end towards the Rivière Blanche. At this point the breaking down of the beds began and through this opening the whole of the material of the landslip was discharged. The length of the pit, east and west, is about 1,050 yards; extreme width 600 yards; maximum depth about 28 feet; total area 86 acres. The descent of the bottom throughout its whole length is approximately about 27 feet or about 10 inches to the hundred feet, and the gradient is comparatively uniform from the eastern end to the present bottom of the river. Indications of a movement of the clays was first seen on the evening of the 6th of May, 1898, in a small hollow in the bank, down which a trickling stream ran; but no attention was paid to it. About 5 o'clock on the morning of the 7th, the breaking away of the clay beds began where some slipping had been noticed on the previous evening. The softer material flowed out from beneath, while the upper and more coherent clay split off in vertical sheets and columns which were borne away in the sliding, surging mass. This continued for upwards of three hours, when the transporting power seemed to have spent itself, and the great masses of clay, which had become detached from the walls of the chasm, were stranded in its bottom and at the time of examination were seen standing in various positions, some of them resembling cones, pyramids, etc.‡

The causes operating in the production of all these landslips may be summarized under two general headings:—

1. The presence of silty, sandy, or gravelly portions or layers in these stratified clays, renders these and some of the adjacent portions capable of absorbing and retaining a large amount of water. According to Mr. R. A. A. Johnston, of the Geological Survey, who made an analysis of the clays obtained from the

‡Ann. Rep. Geol. Surv. Can., Vol. XI., 1898. Part J, pp. 65-69.

Rivière Blanche landslip, they contained, when saturated, from 22 to 25 per cent. of their own weight of water.

2. Increased or unusual precipitation, which furnishes the great excess of water necessary to produce that condition of supersaturation of certain portions of the clay which eventually brings about unstable equilibrium of the beds. Thus, certain layers or portions of the clay are in a semi-liquid condition, and examination of the Lièvre occurrence shows a considerable portion of the clay to have about the same consistency as ordinary thin porridge. The extra weight of the overlying material, due to the unusually large amount of contained water, results in the displacement of those portions or blocks of land which are underlaid by the supersaturated or liquid clay. Movement once begun gathers force and quickly extends the area affected, and the existence of even a very gentle gradient imparts an irresistible movement towards the lower ground in the vicinity of the river.

The flats which border the Lièvre river in the neighborhood of the recent landslip are principally made up of very thick and uniform beds of a stiff, impervious bluish-gray clay, with small and subordinate layers of silty, sandy or gravelly material. This drift material forms a plain, which, with very occasional minor depressions, occupied by small marshes or creeks, extends to the base of the rocky hills. Between this clay and the solid rock beneath, along the base of the hills, there generally intervenes a considerable layer composed of boulders or coarse gravel. Most of the surface drainage from the rocky hills flows out along the top of this plain, reaching the river through one or two small brooks. A large proportion, however, of this surface water flows downward through the coarse gravel and boulders, finding its way into the various sandy or silty layers and thus feeding the wells which are located on one or other of these layers. The introduction of this water serves to produce the necessary degree of saturation. During extreme wet seasons, like the summer of 1903, the amount of water thus flowing into and along these permeable layers must be very large, and with long-continued and unusual precipitation the saturated clay is being constantly increased, until the limit is reached and the necessary conditions of unstable equilibrium are produced. As a result it occasionaliy

happens that the stiff and more coherent masses of clay are broken down and mix with the softer material, the whole mass of clay, sand and mud being tumultuously and irresistibly moved forward and downward into the basin of the river.

According to Mr. R. F. Stupart, Director of the Meteorological Office, Toronto, (see accompanying table,) the average rainfall at Ottawa for the five months commencing June and ending in October, for the past nineteen years, was 14.62 inches. The rainfall during the summer of 1903 for a similar period was 19 44 inches. This abnormal precipitation doubtless contributed in no small measure to the catastrophe.

Sir William Logan, commenting on the cause of the Maskinongé landslip, was of the opinion that it was induced by "pressure on an inclined plane assisted by water;" and though he was not able to determine the nature of the subsoil, he believed, from a survey of the surrounding country, that it consists of Silurian limestone, the dip of which is, where visible, in the direction of the river.

At no point, so far as our examinations extended, did the Lièvre landslide reach the underlying solid rock surface, the gliding plane being in every case composed of the underlying impervious clay or hard-pan. This very smooth and striated surface, as shown in the accompanying illustration (Plate IV), was visible at several points along the base of the hills, as also on the western side of the wooded knolls situated near the river and which were not affected by the movement.

The motion must have been primarily determined by the presence of rather contiguous and extensive sheets of the supersaturated or semi-liquid clay; for it is obvious that no very steep gradient existed throughout the entire distance. In fact, the observations made seemed to warrant the belief, that the gliding plane was only steep in very close proximity to the rocky hills, while a short distance away, it was more or less undulating with only a gentle pitch outwards and downwards to the river. The original level of the plain, at this point, averages about 25 feet above the river, while the river itself is only about 20 feet in depth. Much of the debris which eventually reached the river was material once situated about 20 feet below the original

surface and it was the sudden removal of this underlying material which produced the caving-in of the surface layers, at the same time moving them a considerable distance forward. Most of the trees, except in the vicinity of certain cracks, remained in their original upright position. The motion was spasmodic or halting, owing, doubtless, to the obstruction on the part of the harder and more impervious portions of the clay, so that a number of anticlinal and synclinal folds were produced, while much of the disturbed material showed very excellent samples of block faulting. In many places, owing to this retardation in movement, huge blocks of the hard and impervious clay were shoved up almost on edge through the overlying loam or soil at the surface.

As an immediate result of this landslide, the water of the Lièvre river below was so filled with the finely divided clay as to render it unsuitable for drinking or even for washing purposes. To such an extent indeed was the material held in suspension that even at Montreal, over 100 miles from the scene, the water was quite thick and turbid. The mills at Buckingham were obliged to close down for a considerable length of time as the dirty water clogged the machinery. All the water required for cooking or drinking was obtained from the few wells remaining in the town, that derived from the waterworks being unfit for use.

TABLE showing Rain and Snow Fall at Ottawa during years 1897 to 1903, inclusive.

Compiled under the direction of R. F. Stupart, Meterological Office, Toronto.

	Year.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total for Year.
		in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
RAIN.	1897	0.38	0.35	1.51	1.62	3.31	3.03	5.21	3.40	0.45	0.69	2.19	1.84	23.98
	1898	0.66	0.90	2.13	0.55	2.46	2.24	2.87	3.22	3.48	5.68	0.36	0.41	24.96
	1899	0.75	0.29	1.09	1.03	5.50	2.37	7.62	0.44	4.93	2.47	1.74	2.24	30.47
	1900	0.20	1.20	0.20	0.76	3.00	3.21	5.99	2.72	3.56	1.45	2.40	R	24.69
	1901	0.20	0.00	0.90	2.99	3.91	3.76	3.18	3.23	1.91	1.45	0.40	2.13	24.06
	1902	0.81	0.40	3.14	2.74	1.82	4.29	5.98	1.67	1.23	3.30	1.26	0.80	27.44
	1903	0.96	1.60	1.32	0.85	0.12	6.55	3.24	4.00	2.14	3.51	0.39	R	24.68
SNOW.	1897	15.5	15.7	28.6	2.0	....	....	....	....	....	....	5.8	22.9	90.5
	1898	26.4	34.3	*	2.0	....	....	....	....	....	....	10.7	27.2	100.6
	899	14.1	5.8	45.9	*	....	....	....	....	....	....	*	10.0	75.8
	1900	25.4	14.0	35.0	(10 in. snow = 1 in. water)							11.0	16.0	101.4
	1901	31.1	8.0	13.0	*	....	....	....	....	...	*	18.5	21.9	92.5
	1902	30.9	24.3	3.3	....	....	....	....	....	....	....	2.0	24.5	85.0
	1903	18.6	26.5	0.3	1.0	....	....	....	....	....	R	3.0	18.8	68.2

AVERAGE PRECIPITATION FOR 19 YEARS.

RAIN AND SNOW.	3.00	2.62	2.89	1.86	2.74	2.95	3.46	3.04	2.06	2.51	2.53	2.96	

R represents only traces of rain.

* " " snow.

REVIEW.

THE NATURE STUDY REVIEW. Published at 525 West 120th St., New York City, U.S.A. Bi-monthly. Subscription $1 per annum.

"Devoted to all phases of Nature Study in elementary schools," is the comprehensive sub-title of this new periodical, the first number of which has just been issued. In the introduction the editors say that their "plans are based upon an interpretation of Nature Study in its literal and widest sense as including all phases, physical as well as biological, of studies of natural objects and processes in elementary schools." This interpretation of Nature Study includes all the "natural science" studies of the lower grades in the public schools, and it is with Nature Study in relation to elementary school work that THE REVIEW will chiefly deal.

The Nature Study articles published in THE OTTAWA NATURALIST cover much the same field, but important features of THE NATURE STUDY REVIEW are its Book Reviews, Notes on Recent Literature, and Guide to Periodical Literature. These departments will keep both student and teacher posted as to the literature of a subject in which they must perforce interest themselves. The chief Articles in the January number are "Nature Study and Natural Science—a Symposium," "Physical Nature Study," "Nature Study and Elementary Agriculture in Canada," 'Some recent criticisms of Nature Study," "Agriculture in Southern Schools,' "School Gardens," and "Ant Nests in the Schoolroom." These titles indicate the scope of THE REVIEW, sample copies of which may be obtained by sending six cents in stamps to the publishers.

The Club's soirée season opened Dec. 16th, when Mr. Andrew Halkett lectured on "Animal Life in the Hudson Bay Region." Jan. 17th, Prof. Prince, Mr. A. P. Low and Mr. J. M. Macoun talked to the members of the Club on Mammals. Reports of these meetings will be published in the next number of THE NATURALIST.

NATURE STUDY—No. XX.

NATURE STUDY AT THE MACDONALD INSTITUTE.

By D. J. DOYLE, Guelph, Ont.

Perhaps no more important educational problem has been attempted in recent years than that which was presented in the Nature Study department of the Macdonald Institute at Guelph to the late Dr. W. H. Muldrew, whose unexpected death on Oct. 7th, 1904, at the very beginning of the first term in which a regular Nature Study class had been enrolled, has proved a serious loss not only to the Macdonald Institute, but to educational progress generally in Canada. Prof. Lochhead, who next assumed charge of the Nature Study department, setting to work with a definite aim, has ably carried forward the work of his predecessor.

Regarding the psychological value of the new study in the development of child intellect, there is, I think, a general measure of unanimity among educational workers. It is when we turn from this phase of the question to the necessity of the teacher's knowledge of Nature and the simpler elements of Science extending far beyond that of the child, in order that the efforts of the latter may be best stimulated and directed, that the first note of discord arises; and we find our educators quietly taking sides. On the one hand are arrayed those who assert that a knowledge of child-nature is by all odds the primary requisite for the equipment of the teacher of Nature Study. On the other—and here are embattled the staff of the Macdonald Institute—stand those who believe that a knowledge of child-nature, while an element of very great importance in itself, must still yield precedence to a knowledge of that other nature which is to be met with in the out-of-doors, and upon the regular working of whose laws the welfare of the human race inevitably depends.

Imbued with this conviction, the staff early directed their efforts towards placing the students as much as possible in direct contact with Nature, and particularly with those objects and phenomena which lay readiest to hand. This was secured in two ways, (1) by field excursions, (2) by laboratory work and lectures. The field work proved in many ways perhaps the most in-

structive feature of the work at the Institute. Here for the first time were the students placed face to face with Nature. To the keen observer how much do the field and wood reveal on an autumn day? How seriously is he handicapped whose knowledge, brought to the interpretation of Nature, has been limited to the casual observances of a few leisure hours! The distant gleam of white on the alder bough, the flitting glimpse of a grey wing in the bush, the patch of green on the old beech trunk pass unheeded by under the eye of the nature amateur. But when under the direction of a skilful naturalist, the white upon the alder has been examined and reveals itself as a mass of fuzzy living aphids; when the peculiar squeaky bird-call has been sounded and the grey wing resolves into a nervous, shy, little ruby-crowned kinglet; when the patch of grey on the beech has revealed one of the many lichens, and one's laboratory practice tells him that this little mass of grey represents a life far down in the scale of plant development, then the fields and woods take on an added interest, and the simple and obscure claim equal rank with the gaudy and the beautiful.

The best methods of correlating the new Nature work with the old subjects on the curriculum was a matter demanding particular attention. For an illustration of recent earth history it was shown that no better spot could be selected than a gravel pit. Here the pupils may examine the shape and nature of the gravel-stones, the resemblences or differences between these stones and the bed rock, the arrangement of the layers of gravel, the dip of these layers, etc., showing the action of water. Subsequent lessons may include observations of the surrounding country, evidence of the action of ice or water, changes in the beds of lakes and rivers, etc., from which the pupils may deduce much of the past history of the locality. In history, a beginning may be made in the life of the district, its trustees, its forms of government, the township council, leading men and women of the township, stories of early settlement, etc. In literature certainly, a knowledge of nature is necessary for an understanding of the passages to be studied. Let the pupils go out to the meadows and observe the bobolink there before taking up such a selection as Bryant's "Robert of Lincoln." Only in this way can they appreciate the

truth and structural adaptability of this little poem. In composition, descriptions of journeys in the fields and woods, of birds and trees and animals observed, may be found subjects on which the children will write interestingly and naturally. Taken altogether, Nature Study need not be considered a new subject, but rather as a vitalizer of the old.

Here also may properly be mentioned the lectures and field work in gardening conducted by Prof. Hutt, of the College staff. During a spring or summer term this work should be made to constitute one of the most important features of the course. But the nature of the weather this fall seriously interfered with the carrying out of any extensive field work. What was possible, however, was done. Following a series of lectures on the subject, advantage was taken of the first fine day to stake off, level, plant, and label a series of plots, each student having one in charge. The lateness of the season prevented the germination of the seeds, but this work was carried on within doors by means of germinating boxes and blotting pads, a series of drawings being made to illustrate the stages of development in the plants.

Roughly speaking, the work in the laboratory was divided into three parts: (1) an examination into the stages of plant evolution as revealed by the common algæ, fungi, lichens, mosses, ferns, etc., of the locality; (2) experiment in plant physiology, elementary physics, and organic chemistry; and (3) elementary entomology.

If to any subject, surely the old adage that "seeing is believing" is applicable to Nature Study. Here, if never before, the child must get rid of books and hearsay, and reach down to the very facts of Nature itself. The pictured object which some one else has seen and depicted, will not suffice here; much less the word description. The child must come in contact with the actual object and develop through his experiences with that. And yet, how much of the teaching of the past has practically been hearsay, those who have passed through our elementary and high schools within comparatively recent years can sadly testify

It was Plato, I believe, who instanced the position of a man who had grown to maturity in some dark place and then been brought suddenly forth to the light of day and the world of nature around him. He pictures the wonder of that man, his *realization* of the facts before him. He has not seen these things pictured in books and grown up with them. To him they are new, and real, and divine. In a somewhat similar position is the child who has grown up in personal contact with Nature. How does the crude sap in the soil rise in the stems of plants? The child knows it does rise, for he has seen the watery juice in the stems and leaves.

But how? Two simple laboratory experiments reveal the facts: (1) that given certain conditions, liquid will rise in a glass tube through an osmotic membrane, which may represent a root fibre, and (2) that colored liquid will rise in a cut stem placed with its end in the liquid, and further that, in rising, it follows certain, well defined passages. The child sees this before his eyes. It has become a real fact in his consciousness. He has had a new experience. And these are only a few of the many simple experiments by which a realization of the working of Nature may be brought home first hand to the pupil.

With younger pupils, no doubt these broad and pleasant stimuli which appeal to the æsthetic side of the child's nature must be largely depended upon for development of sense activity. But to the child whose years at school are limited, a practical knowledge of those features of Nature with which his life-work will be most closely connected is of many times the value. With this object in view, the attention of the class was directed towards the collection and study of weeds and weed seeds, and the rusts, smuts, and other parasitic growths which at times have proved so serious a menace to agricultural success. To this work were appended brief descriptions of the best methods of fighting these enemies of the farmer. The collection of specimens of injurious insects and their work, also placed the class in possession of much valuable information regarding another element of danger to the farmer's crop.

In the Manual Training department a successful attempt has been made at the correlation of Nature Study and woodwork, cardboard work, drawing, design, color work, and modelling. In the wood and cardboard work only such models have been selected as would prove of practical value in the Nature work, as, plant labels and garden stakes, spreading-boards, terraria, bird-houses, etc., in wood, and seed-boxes, etc., in cardboard. In drawing, no pencils were used, brushes taking their place. A beginning was made in blob work and moss drawing in ink. This was followed by color work, the construction of charts, drawing of objects in colors, and natural and conventional designing. Of this work perhaps the most important feature was the drawing of natural objects in colors. Anything—a bird, a butterfly, a twig—was selected and worked out with a brush in its natural colors. Prof. Evans, who has charge of the Manual Training department, advises the introduction of this work into even the lowest grades and its continuance throughout the School. In this way it is hoped we may be able to cut adrift from the conventional, expressionless drawing work of the past, and do something towards the development of those artistic instincts which have hitherto been left dormant in the child. Poets may be born, but artists must be developed.

View looking down (east) Lièvre river from McMillan's house, showing submerged portion of the flat caused by the damming up of the river by the material from the landslide.

The gliding plane of clay striated by the gravel contained in the bottom of the moving mass of supersaturated clay.

View looking southwest from near Clément's house showing the base of the Laurentian hills along which the landslide took place.

PLATE V. FIG. 2.

View looking west, showing Clément's house and outbuildings and the uneven surface of the disturbed area.

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