# NATURE STUDY—No. XXXIV.

## A CEMENT SIDEWALK.

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In glancing over the topics that have been dealt with in this series of Nature Study articles in THE OTTAWA NATURALIST I find that more than half of them have been of a general pedagogical treatment, while twelve have been practical studies in plants, insects, birds, rocks and school gardens.

It is to be noted that this series portrays in a general way the history of the adoption of Nature Study in our school courses. At first, concern was about the need, the treatment, the courses, the practical value or the pedagogical value of it; latterly the tendency is towards practical, helpful directions for the teachers who have to work at the subject in our common schools. Nature Study stands to-day, with our progressive teachers, accepted as the leavening that will bring large vitality to worn out methods and subjects; what they are asking is for guidance to the recognition and the proper using of the materials,

With the purpose of emphasizing the proposition that the study is not limited in its field to biological or geological things, an outline of a lesson we had with our summer class is here submitted and worked out. A sidewalk had been in process of building for several days. No one had paid much attention to the work, the workmen or the process. This was, in part, owing to a multitude of other interests—chiefly biological—and, in part, to an unconcern that familiarity had bred.

When, however, attention was drawn to the subject, many propositions were opened up for investigating; the investigation was made by daily observation and inquiry. An engineer's work had been done in staking out the walk and making it level—the stakes were driven firmly in the ground and the top level marked with notches or nails. The top soil had been removed until a firm, gravelly bottom was reached; for most of the length of the trench a depth of a foot had been sufficient but where the ground was springy a greater depth was excavated. Into this trench, coarse gravel and broken brick was dumped and packed down. A plank

curb or mould to allow for a four foot walk was set firmly on this foundation · it was built high enough to hold four inches of cement composition.

The work itself well exemplified the principle of division of labor ; each man had his own particular part to play. There were ten men in the gang ; the foreman had a general oversight of all the work and workmen, and shared in the labor when opportunity or necessity arose ; wagons were employed in hauling gravel or sand from pits on the farm and also the cement from the railway car.

The first layer was a "grout" three inches in thickness. It was composed of one part of cement and eight parts of good clear sandy gravel. The largest stones permitted was of about a two inch diameter. Measurement of the proportions was not made with exactness but estimated in wheelbarrow loads. A layer of the gravel was spread on a "mixing-board" with a layer of cement over it, and a large pile built up in this way. Four men then shovelled it back and forth until it was thoroughly mixed. Preparatory to adding the water, it was shovelled into a large concave ring. Sufficient water was added so that after it was well mixed in the wet state, a handful would retain its form after squeezing. It was now shovelled into the moulds and packed firmly. It was not however allowed to lie in one continuous mass ; a large bladed knife was used for making a one-half inch cut every five feet, and this was filled with clear sand.

In the meantime, another cement mixture was being made on another "mixing-board". It was made of one part cement and two parts of clean gritty sand, and after complete mixing and proper wetting was quickly thrown in the mould to the depth of one inch, spread, packed, levelled off with a "straight-edge" and "floated" or smoothed with a wooden "float", a tool like a steel trowel in form. As a precaution against heaving by frost an indentation was made by means of a "divider" every five feet and immediately over the corresponding cut in the grout layer. This completed the sidewalk building, but in order to protect it against too rapidly drying it was covered with canvas for a few days.

The cement cost about $1.85 a barrel at the mill. Freight and cartage were added to this cost. It was all shipped in bags,

as it was for immediate use ; the bags weighed ninety pounds and four of them constitute a barrel. Some of the gravel was hauled by men who received $3.50 a day for themselves and teams; being near the pit, eleven loads were hauled in a day's work ; where the road was good and the haul out of the pit not difficult, a wagon box of one and one-half cubic yards' capacity was used. An estimate of the cost is made at a rate of 12 cents a square foot, although this particular walk however was built by day labor.

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|---|---|---|---|---|---|
| 285½ | ft. length of | 4 | ft. walk | = | 1,142 sq. ft. |
| 17½ | " | 9 10/12 | " | = | 229 4/9 " |
| 10 | " | 6½ | " | = | 65 " |
| | | | Total, | | 1,436 4/9 sq.ft. at 12 c. = $172·37¼. |

These measurements were made with a tape line ; by "stepping-off" the length, and averaging one's pace, a close approximation of the actual cost was reached.

We afterwards secured some of the cement and examined for fineness, alkalinity, effect on skin, etc. Tests were made, too, of the strength of mixtures of different proportions. Some successful object and map modelling was done with it by some of the students. And in this connection it might be suggested that its use is so simple that some repair work on broken walls might be instituted in some schools as a legitimate Nature Study lesson on cement.

A word on the chemical constitution and action of Portland cement might be of interest and use. In general terms it is a combination of lime (CaO), silica ($SiO_2$), alumina ($Al_2O_3$). The lime is furnished by marl and the other two by clay. For good setting qualities certain proportions are essential : 55 to 60% lime; 22 to 25% silica ; 7% alumina. Sufficient and no excess of lime to combine with the other ingredients is the desideratum. Water permits the union and crystallization. In a simple form of equation it might be represented thus :

*Base.* *Acid.* *Salt.*

$CaO$ (Lime) + $SiO_2$ (Silica) = $CaSiO_3$ (Calcium Silicate).

$CaO$ (Lime) + $Al_2O_3$ (Alumina) = $CaAl_2O_4$ (Calcium Aluminate).

So that the artificial stone substance is a mixture of calcium, silicate and aluminate.

In the last report of the Bureau of Mines, part I, recently published by the Department of Lands and Mines of Ontario, there is a very complete account by Mr. P. Gillespie of the cement industry in this province. Some facts are here included from that report, not for the purpose of informing teachers of matters to be retailed to children, but rather to awaken interest in this line of

industry to the end that closer observation may be obtained in an increasing important method of building, which is one of the features of modern life. The report would make a valuable addition to any school library. Senior scholars, especially, would be interested in its accounts of the mineral and agricultural possibilities of New Ontario; they would also learn of the care taken by our Governments to furnish accurate information concerning our resources. Supplementing this, some of the classes might be directed to write, under the name of an appointed secretary, on some industrial or scientific matter that has been unanswered in class and which the authorities at Ottawa or Toronto are, as a rule, able and pleased to help in solving.

There are several brands of cement made in Canada as the "Star," "Hercules," "Saugeen," "Imperial," "Monarch," "National," "Giant," "Samson," "Raven," "Sun." The children might be led to observe what brands were being used in their district, and to enquire as to their origin. A cement map of Ontario, or indeed, one showing the cement structures of the locality might be made. And here it might be said the same line of observation and recording might be practiced in regard to agriculture, implements, waggons, buggies, wind-mills, sewing machines, bricks, shingles, graniteware, clocks, tools, etc.

This article has not been written for information, but as suggestive treatment of this or similar industries and employment of men. Many exercises will suggest themselves to one awakened to the "new teaching" that finds exercise for training children's powers of observation, for awakening wholesome sympathies and interest, for inciting to useful manual operations in the common things lying about us. Here are a few:—measuring a waggon box to find capacity; by weighing a cubic foot of gravel, estimate weight of load; consider how cities issue debentures for new sidewalks and how property owners pay for them; incorporating into their arithmetics questions which were *real* arithmetic questions because actually *worked* out by themselves; drawing a map and estimating the cost of any sidewalk, fence, drain or road in which the individual child or the school has an actual interest; drawing the tools used in the operation; getting figures from practical men regarding the area of walk that one barrel will make and making up arithmetic problems for class work; setting a mud foot-scraper in a cement block for school use; making a drinking trough for the birds. Indeed, the trouble to the teacher is in the great number of exercises and interests that arise and claim attention rather than in their fewness. It is in the proper selection of studies, that the Nature Study teacher shows her skill, no less than in her methods of presenting them.

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McCready, Samuel Broadfoot. 1906. "Nature Study No. 34 - A Cement Sidewalk." *The Ottawa naturalist* 20(2), 45–48.

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