in keeping with the purposes of this apparatus than the simple spiral discussed above.

9. *Summary.*—For the measurement of activity by the above simple methods one would therefore couple the instrument's figures 5 and 6 in series to the same shaft and read both dials. It is conceivable however that the propeller blades *pp* of figure 6 may replace the friction pulley *p* of figure 5, particularly if provision is made for rotating the propeller in a liquid instead of in air. Suppose therefore that the dial and index of figure 6 has been standardized both with reference to the twist corresponding to one in degree of deflection and to the speed corresponding to the deflections. Then in an instrument of the type of figure 6, *a single reading would at once give the activity of the motor.* This is the final outcome of the method sketched in the above paragraphs.

Washington, D. C., May, 1894.

ART. II.—*On the occurrence of a large area of Nepheline Syenite in the Township of Dungannon, Ontario; by*
FRANK D. ADAMS.

WHILE engaged during the past summer in making a geological reconnaissance of a portion of Eastern Ontario previous to a detailed mapping of the district for the Geological Survey of Canada, a large area of nepheline syenite was unexpectedly discovered.

The district in question lies between Lake Ontario and the Ottawa River, near the southern edge of the Archean protaxis, in the counties of Victoria, Peterborough and Hastings, in the province of Ontario, and comprises 3500 square miles, being sheet number 118 of the series of geological maps of Quebec and Ontario now in course of preparation by the Geological Survey of Canada. This tract of country which up to the present time has been, geologically speaking, a *terra incognita* was found to be occupied almost exclusively by rocks of the Laurentian system. The Grenville series with numerous heavy bands of crystalline limestone is extensively developed in the southern portion of the district, while to the north great tracts are underlain by what is believed to be the fundamental gneiss. In the extreme southeast corner of the district certain rocks occur which have been referred by Mr. Vennor to the Hastings Series.

The stratigraphical relations of these several series in this district have not as yet been determined, but will it is hoped, be worked out as the detailed mapping is proceeded with.*

* See "Preliminary Report on the Geology of a portion of Central Ontario." Ann. Rep. of the Geological Survey of Canada, 1891-92-93. Part J.

It is in the southeastern portion of this district in the townships of Dungannon and Faraday, in the county of Hastings that the nepheline syenite was discovered.

The mass is crossed by the well known Hastings Road, near the village of Bancroft, and is—roughly speaking—about eighty-five miles in a straight line northwest of Kingston, Ontario.

The area is a large one but its exact limits have not as yet been determined. It has however been traced in an easterly direction from a point in the township of Faraday, some distance west of Bancroft, to the York River on lots 12 and 13 or range XI of the township of Dungannon, a distance in a straight line of over seven miles. It also has a very considerable width.

As occurrences of nepheline syenite are rare, and this is the first one which has been found in the Laurentian system of Canada, and as, moreover, the rock presents a number of striking petrographical peculiarities, it has been thought that a preliminary notice of it at this time would be of interest.

Mode of occurrence and macroscopical character.—The mass occurs in the Laurentian and is flanked on the south, along a considerable part of its course by crystalline limestone. It is in many places intimately associated with a fine grained reddish biotite granite resembling aplite in appearance and which is apparently intrusive. The nepheline syenite is frequently massive in character, but usually possesses a somewhat streaked appearance, in places developing into a distinct foliation or gneissic structure, coinciding with that of the associated rocks. On the weathered surface little cavities are occasionally observed which are probably miarolitic druses. It is usually rather coarse grained, but in places becomes very coarse, as at the York River above mentioned, where nepheline individuals two and a half feet across were observed, with feldspar and mica crystals of corresponding size, while individuals one foot in diameter are numerous. On the weathered surface the nepheline and plagioclase which compose the great bulk of the rock can be readily distinguished, the former apparently dissolving away under the influence of the weather and presenting smoothly rounded surfaces of a gray color, like those so frequently seen in coarsely crystalline limestone. From these surfaces the plagioclase stands out in white chalk like grains or masses, while the other essential constituents of the rock are also readily recognized.

Microscopical character.—Under the microscope the essential constituents of the rock are seen to be nepheline and plagioclase, together with either a brown mica or a dark green hornblende. As accessory constituents, seldom absent and in

some cases present in large amount, are scapolite and calcite, and as less important and less abundant accessory constituents are garnet, zircon, sodalite, magnetite, pyrite and apatite. These latter, with the exception of garnet, always occur in very subordinate amount. Two or three other minerals occur in small amount in individual slides, or can be seen on the weathered surface of certain specimens, as these however could not be determined with certainty, without prolonged investigation their true nature is as yet doubtful.

The rock is usually very fresh and has a true hypidiomorphic granular structure. Evidences of pressure are in most cases entirely wanting. In a few slides however slight strain shadows and bending of twin lines are to be observed, and in one specimen distinct cataclastic structure was seen.

Nepheline.—This is by far the most abundant of all the constituents of the rock. It always forms the greater part of the rock and in many places, over considerable areas, the rock is composed of this mineral associated with a little mica or hornblende. The mineral is clear and colorless and is usually free from inclusions. It has a low double refraction and parallel extinction. On basal sections it is seen to be uniaxial and negative. It is easily etched by hydrochloric acid in the thin sections and can then be stained with fuchsin. In a few cases it was observed to be altered to muscovite. In hand specimens the mineral is seen to possess a luster which is vitreous rather than oily, so that it has been referred to as nepheline rather than as eleolite. An analysis of it is given by Dr. B. J. Harrington in the accompanying paper.

Plagioclase.—The rock contains no primary orthoclase, but feldspar though seldom very abundant is in most cases present, often in considerable amount. It is twinned polysynthetically, the bands being usually narrow and often indistinct. When cut at right angles to an optic axis it is seen to be biaxial. Its specific gravity, determined on two fragments taken from the very coarse grained variety of the rock at the York River, is 2.6207 and 2.625, while in a separation of the constituents of a specimen of the rock from lot 25 of range XIV of Duggannon, it was found to have a specific gravity of not over 2.623. The extinction on either side of the twinning line, measured on a cleavage fragment from the York River was $21\frac{1}{2}^{\circ}$. These facts prove it to be an albite, with probably a very small percentage of lime.

Mica.—This constitutes the iron-magnesia constituent of the rock in three out of the five localities from which specimens were examined. In these cases it occurs alone, while in the other localities where hornblende is present the mica is absent. It is nearly black when seen in the hand specimens and in the

sections shows a very strong pleochroism, from pale yellow to a very deep brown. In basal sections it is seen to be distinctly biaxial but the axial angle is very small. It is usually quite subordinate in amount.

Hornblende.—Like the mica this constituent is usually present in comparatively small amount. It is always green in color and frequently presents more or less perfect crystalline outlines, with faces of the prism, clinopinacoid and domes. The prismatic cleavages at angles of about 124° are well seen. Two varieties have been observed. One of these from near the York River has a large axial angle and shows a pleochroism in tints varying from deep green to pale yellow, the absorption being $c > b > a$. Before the blow-pipe it fuses with intumescence to a black glass, giving at the same time a strong soda flame. This variety probably contains a considerable quantity of soda, but approaches common hornblende in composition. The second variety, which occurs in an exposure about two miles east of the village of Bancroft, has a much stronger pleochroism in tints varying from very deep bluish-green to a yellowish-green and has a small axial angle and a high extinction. Hornblende is not common in nepheline syenite and the only occurrence in which I have seen this particular variety is that which forms part of the Montreal mountain. Here what appears to be exactly the same hornblende occurs intergrown with augite. It has a very high specific gravity and is probably rich in soda and allied to arfvedsonite. A chemical examination of this hornblende will be made by Dr. Harrington.

Scapolite.—This mineral is present in about one-half of the slides and occurs in large clear colorless grains. It has the appearance of an original constituent. Basal sections present the usual double set of cleavages crossing at right angles while sections in the prismatic zone show a single set of cleavages with extinction parallel to them. In convergent light it is seen to be uniaxial and negative. The double refraction is much stronger than in the case of nepheline, the interference colors being tints of red, blue and yellow. The two minerals are therefore easily distinguished. As the occurrence of scapolite in such a rock is very unusual and in order to make sure that the mineral was not cancrinite, a thin section was treated with concentrated hydrochloric acid at first in the cold and subsequently with hot acid. The nepheline was strongly attacked and when the slide was subsequently treated with fuchsine became deeply colored. The scapolite however remained quite unaffected, even after the acid had been actually boiled upon the section. In another section also in which, under the action of the weather, the nepheline was quite de-

composed the scapolite was found to be still quite fresh. The uniaxial and negative character of the mineral together with the position of the cleavages, the strong double refraction, the parallel extinction and the deportment with acid, proves that the mineral is really scapolite.

Calcite.—The presence of this mineral in such a rock, as well as its mode of occurrence is very remarkable. The rock is quite fresh so that the calcite is not an ordinary decomposition product. Its mode of occurrence is that of an original constituent. It is found in well defined, more or less rounded, individuals, often of large size, occurring with, and often in, the other constituents of the rock. It has been observed completely enclosed by hornblende, nepheline, plagioclase, and garnet, the boundaries of the several minerals being quite sharp and the enclosing mineral being quite unaltered and normal in character. It shows the usual rhombohedral cleavages, is frequently twinned and sometimes has a fairly good crystalline form. It occurs in almost every slide, though usually in comparatively small amount. Individuals of considerable size are found in the very coarse grained variety of the rock at the York River. The origin of this calcite is a point which it is difficult to determine, although somewhat similar occurrences have been described in various other igneous rocks.* It cannot be a decomposition product in the ordinary sense of the term. Its mode of occurrence does not seem to indicate that it fills miarolitic cavities as Rosenbusch has supposed similar occurrences in certain granites to do. Had it been derived from the neighboring limestones some evidence of corrosion or alteration might be expected from the action of the very acid magma. Further study in the field may throw additional light on the question.

Garnet.—This is of a pale brownish or reddish-brown color and is always quite isotropic. It occasionally has a good crystalline form but usually occurs in more or less irregular shaped grains. It is present in most slides but seldom in large quantity.

Zircon.—Occurs in many slides and occasionally in the coarser variety of the rock in crystals of considerable size.

Sodalite.—At a number of places sodalite was observed in small grains or strings, scattered through the rock and it appears in one or two of the slides.

In certain parts of the area however it occurs in large masses.

* A. E. Törnebohm, "Om kalcithalt i graniter." Geol. Fören. i Stockholm Förh., 1882, 140. G. W. Hawes, "Mineralogy and Lithology of New Hampshire," p. 207. See, also, F. D. Adams, "On some Granites from British Columbia and the adjacent parts of Alaska and the Yukon District." Canadian Record of Science, Sept., 1891.

Good specimens have been obtained from lot 29 of range XIII and elsewhere, but on lot 25 of range XIV of Dungannon it was found quite abundantly in what appeared to be veins and irregular shaped lumps. From some of these, masses of pure sodalite 10 by 10 by 4 inches in size were obtained, while considerably larger masses could probably be secured by blasting. It is probable that no other locality hitherto discovered in America affords such large masses of this mineral, with the possible exception of the nepheline syenite of the Ice River in British Columbia. The sodalite is bright blue in color and is often associated with strings of iron ore and traversed by little reticulating cracks filled with a reddish mineral which presents every appearance of a secondary origin and which Dr. Harrington finds to be orthoclase feldspar. It is believed that the sodalite may occur in sufficiently large masses to enable it to be profitably extracted and employed for ornamental purposes.

Summary.—The following points in connection with the composition of this nepheline syenite from Dungannon seem to be especially worthy of notice. Nepheline is always very abundant and in many large exposures the rock is an almost pure nepheline rock, consisting of nepheline with a little hornblende or mica. This variety of the rock is really an Ijolite* rather than a nepheline syenite. No orthoclase has been discovered in the rock, although twenty-five thin sections have been studied and some of them etched and stained. The constituents of two specimens were also separated out by means of Thoulet's solution. Its place is taken by an acid plagioclase, which in those cases where it has been examined has proved to be albite.

If the distinctive character of the variety of nepheline syenite named Litchfieldite by Bayley,† be the replacement of the orthoclase by albite, this rock is a more typical Litchfieldite than that from the original locality. The propriety of defining nepheline syenite as a rock composed essentially of nepheline and an alkali feldspar instead of one composed of nepheline and orthoclase is also rendered evident, as otherwise it would be necessary to classify this rock as a theralite from typical specimens of which it would differ greatly in composition. Like the Litchfield rock also this Dungannon rock contains neither augite nor sphene, but unlike it often holds scapolite and calcite.

Some years ago Prof. A. P. Coleman when investigating the petrographical character of the boulders of the drift in the

* W. Ramsay and H. Berghell, "Das Gestein vom Iiwaara in Finnland." Geol. Fören. i Stockholm Förh., 1891, 304.

† W. S. Bayley, "Eleolite-Syenite of Litchfield, Maine, etc. Bull. of the Geol. Soc. of America, 1892, 231.

vicinity of Cobourg on the north shore of Lake Ontario, found among these boulders a number composed of nepheline syenite. The rock composing these boulders strongly resembles in many ways that described in the present paper. Orthoclase and microcline although present are exceeded in amount by the plagioclase. Eleolite or nepheline usually forms from one-quarter to one-half of the rock, while the rock is sometimes a nearly pure eleolite. "Biotite and hornblende much outweigh all the varieties of augite." Calcite grains were found in about one-third of the slides, sometimes "in the midst of the eleolite where their existence is hard to account for. What appears to be a scapolite occupies a similar position in four specimens" and a flesh red garnet also occurs in a few places.*

Cobourg lies a little to the west of south from the townships of Dungannon and Faraday, and it is highly probable, in view of the marked resemblances between these boulders described by Prof. Coleman and the nepheline syenite occurring in these townships that the boulders have been derived from this vicinity. The presence of orthoclase and microcline in many of the boulders would indicate that all of them at least had not been derived from the actual area described in the present paper, but there is every reason to believe, from the reported occurrence of sodalite at other points in this district, that other areas of similar nepheline syenite exist here, and some of these have probably furnished the boulders in question.

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ART. III.—*On Nepheline, Sodalite and Orthoclase from the Nepheline Syenite of Dungannon, Hastings County, Ontario*; by B. J. HARRINGTON.

IN a recent report published by the Geological Survey of Canada and also in the preceding paper, Dr. F. D. Adams has called attention to a remarkable mass of nepheline syenite discovered by him in the township of Dungannon and Faraday, Ontario. The rock is in places exceedingly coarse in texture and individuals of nepheline, as much as two and a half feet in diameter have been observed. Dr. Adams has kindly placed a specimen of this nepheline in my hands for examination. It is from near the bank of the York River in Dungannon and has been found to have the following percentage composition :

* Trans. of the Royal Society of Canada, vol. viii, 1890.