Mr. C. E. Willis, (Canadian Rand Drill Co.), Sherbrooke.
Mr. B. F. Pearson, Halifax.
Mr. A. Dick, Halifax.
Mr. Geoffrey Morrow, Halifax.
Mr. F. H. Mason, F.C.S., Truro.
Mr. W. G. Matheson, New Glasgow.
Mr. R. E. Chambers, Ferrona.

The Summer Meeting.

MR. B. T. A. BELL.—The members of the Quebec Mining Association have arranged to hold their summer meeting at Quebec in July, when an attractive outing on the St. Lawrence is promised. Now that federation has been agreed upon, the occasion might be utilized agreeably by a united meeting, and I am quite sure our association would very heartily welcome the members of the Mining Society of Nova Scotia. I simply offer this as a suggestion for the consideration of Council.

A Curious Old Rail.

MR. BLAKEMORE.—I have brought here a piece of old cast iron rail taken out of a Cape Breton mine closed for twenty three years. There is very little iron in it. It is so light that it becomes a curiosity. I will leave it for the Society's collection, and will have a portion analyzed, and also the water which has produced such an effect. I may say that all the iron in this mine has been affected similarly. It is an extraordinary effect to be produced by water.

The members re-assembled at three o'clock, the first paper being

On Surface Surveys and the Necessity of Contour Surveys the in Gold Districts of Nova Scotia.

DR. M. MURPHY.—The surface surveys in the gold mining districts of Nova Scotia have been, so far, confined to the running of, or projection of lines over the surface to determine the boundaries of gold mining areas, or blocks of areas, as they are called. When the discovery is of sufficient magnitude to warrant a survey of the blocks, or of the areas within a district being made, the Commissioner of Public Works and Mines, under whose general supervision and guidance, the laws relating to mines and minerals are observed, will send a surveyor to run lines, showing the meetes and bounds of the properties of the respective prospectors or lessees, as the case may be.

The blocks, or their subdivision into rectangular areas of 250 feet by 150 feet, are run off from a line arbitrarily selected to follow the general direction or strike of the lead or lode, as it may appear at the surface outcrop. Such has been the practice in laying off the principal gold districts. Recently, however, this practice has been altered in laying out new districts, and the line of the magnetic meridian has been adopted instead, the general strike of the auriferous slate belt along our Atlantic border, being nearly east and west, magnetic.

It is not the purpose of this paper to offer any remarks touching the present practice, so far as the adoption of base lines or the subdivision of properties is concerned. The object in view, is to point out the desirability of extendikg the work of such surveys, not beyond the district boundaries, but within them, by utilizing the work already being performed towards the greater object in making a topographical survey over each of our gold mining districts.

All mining engineers will agree that topographical maps, if properly made to represent the configuration of the surface, are of the greatest convenience and of much value in mining work where so frequently the problem occurs to follow a strike or vein over a rough undulating or broken surface, perhaps covered by drift or boulder clay, and dipping at a high angle. In locating roads, planning drainage works, utilization of water power and some other purposes, they are also of much value.

The operations of a topographical survey are two-fold namely,—to first project a system of points upon such a tangent plane; and, secondly,—to find the distance of the same above or below the plane, or in other words, as the *Engineering Magazine* expresses it "to measure the lengths of the projecting normals." The first process is ordinary surveying, the second, levelling.

Now, in our gold mining districts, the first process has been, or is being (from time to time as occasion demands) performed, and it covers full three fourths of the entire operation and expense. Assuming the lines are run and the stakes are in place, the remainder of the work, that of levelling and marking the reduced levels on the plot of survey, is the easier and cheaper part of the operation.

Provided these operations are carried out with all possible care, the work would be a very exact one. The first and not the least desirable part of the survey, would be to connect each mining district with a common level; the sea level at half tide, for instance. This may appear difficult and expensive, but it would not be so much as it may seem to be at first sight. Many of our gold districts are within easy distance of tidal waters, others are quite contiguous to railways or railway lines of survey where levels reduced from the datum of normal tidal waters can be obtained at any convenient point. Other places more remote should be connected by instrumental surveys.

We may, considering the limited extent of our gold districts in Nova Scotia, reject the sphericity of the globe, and establish a datum level at half tide which can be easily obtained in any of the sheltered harbors that indent our sea coast. For half tide (no matter whether the tides are normal as along the coast, or abnormal, as along the littoral waters of the Bay of Fundy) the half tide level is almost the same tangental level everywhere. If then, we start from half tide, the cost of connecting the most distant district by instrumental survey, would not be more than $50.00 and most of the gold fields to be so connected would not cost half that amount.

Calling half tide level zero, and ascending *gradatum* to a convenient "bench mark" or to two or three of them, as the extent of the district may warrant, their respective elevations should be marked by painting on an exposed outcrop of rock, or on the stump of a tree or other fixed point, "B.M." in feet and decimals of a foot, such as their elevations above half tide may be.

As all sections or profiles of railway location in Nova Scotia, is in like manner connected with levels of tidal water, and changes of gradients noted thereon by "reduced levels" and by what is termed "formation level" of the finished surfacing to receive the ballast bed and also by bench marks placed by the engineers for their use and convenience and as these profiles are on file in the provincial engineer's office or in the case of lines surveyed by the engineers of the Federal Government in the offices at Moncton and at Ottawa, elevations above tide level can be readily obtained at points easily accessible, and easily found at every change of gradient on lines of railway touching or being within easy distance of the gold mining operations. For instance, the profile of the recent location of the Nova Scotia Southern Railway touches the Molega gold district. A mere glance at the profile would give the elevation on any stake (the stakes are placed 100 feet apart) above the tide level at Shelburne. Two or three hours work would extend the levels from present line of railway survey to any desirable point within that district.

Assuming the levels above tidal water to be established and noted on the plan or survey as well as on the bench marks within each district, the next course to adopt would be, to instruct any party sent to extend boundary lines to connect the levels on every boundary, or dividing point, at which he would set or place a stake, and to mark on the stake and on the plan of survey the reduced level of that stake, showing the height in feet and decimals of a foot that their position would be above tidal water. In the interests of all concerned it might be deemed advisable to place levels at every stake within the gold mining district, where lines of survey have been run and where stakes have been already placed, or at least in such districts as the mining operation now being carried on might warrant the expenditure of having it done.

Now, with respect to the expenditure that would be required to carry out the work suggested by this paper to successful completion. Any ordinary engineer, or fairly educated land surveyor should with the assistance of one man to hold the levelling rod, run three miles of levels each working day, and if he would not be capable of performing this service in a reliable manner, he should not be employed. There are men connected with the Mines and Works Office, with the Crown Land Office and with the Provincial Engineer's Office, quite capable of performing such work. If we place the rate of progress (for levelling over lines already cleared, chained and marked by stakes) at two miles per day, and the wages of the surveyor and his assistant at seven dollars per day, the cost per mile for running levels would be three dollars and fifty cents, say four dollars per mile. The extent to be levelled over in each district, can be readily and quickly ascertained by the mining engineer, conversant with the surveys already made, or by inspection from the map of the district, so that, if we take the data given as factors of cost,—and we know from long experience the figures are ample—one can easily estimate the outlay required to develop from the ordinary surveys at present customary in our gold fields, to the more desirable and modern method of topographical surveying. The system proposed, would, as before stated, be a very correct one—the work would check itself.

Firstly, because the boundary lines of property and their sub-division into rectangular areas, must necessarily check at the point of departure.

Secondly, because the levels repeated from stake to stake and closing on the completion of the circuit, must also check, and, because long distances cannot with the same degree of accuracy, be taken by a transit with the so-called stadia wires, and a telemeter or stadia rod. The errors, by this stadia method, may be estimated by feet, whilst by the method proposed by this paper the error could not with any degree of care be computed by so many inches.

Although the new stradia methods of topographical work, such as described by Mr. George J. Specht, C.E., Prof. A. S. Hardy and others in the "Van Nostrand Science Series," have found much favor and is the best known system, where the configuration of the ground over extensive surface areas is required for examination and research. Nevertheless, taking into account what work, from ordinary line surveying, is at present available in our gold fields, and that the method suggested by these remarks would more directly connect and could more conveniently be adapted to local requirements, being less expensive and more expedient than the stadia method, we might be led to infer it would be the more advisable to adopt.

A good example of this form of stadia surveying may be seen in the Mines and Works Office here, by a plan of survey made by Mr. W. B. Dawson, west of Halifax, under the direction of Dr. Gilpin in 1882. The map is only 18 miles by 12, its only fault being that there is not more of it. Since then it has been frequently consulted by the author of this paper, for estimating the area of water-shed, receiving rain fall, for water supply, and in selecting the most suitable lines of railway location. It has recently been a guide to the engineers of the Intercolonial Railway, in finding the most desirable location of the line of railway now being constructed between Halifax and Windsor Junction, and if consulted by the mining engineer it may be found no less useful. One can truly say, its use has already well warranted its cost.

Within and around the city of Halifax, contour lines of level at elevation of 25 feet, have been carefully embodied in a map, by the survey corps of Royal Engineers for defensive purposes, with such precision, that without previous reconnoissance I was able by mere inspection of the topography to make a plan and profile in the office and with the data thus obtained to walk over an ascending line of gradient and railway location from Richmond station to the cotton factory. The instrumental railway survey that followed, showed no perceptible deviation on the ground. These lines of contour are projected in the same manner as suggested by this paper; their connection would, however, be more convenient having stakes, as fixed points, marking the respective elevations in the gold mining districts.

If the lines of survey pass over such hilly or undulating ground, that considerable differences of level are necessarily encountered in its path, valuable aid may be derived from a pocket aneroid barometer. This instrument consists of a flat cylindrical box exhausted of air, the top of which is thin metal corrugated in concentric circles, so as to render it quite elastic. As the atmosphere pressure increases, the elastic top of the box is forced in or down, and as it decreases it is forced out or up. This movement in the top of the box (due to changes in the atmospheric pressure) is conveyed by multiplying levers and a small chain, to an index needle, moving over a circular scale, graduated to correspond with the standard mercurial barometer. The spiral spring by its tension raises the long arm of the lever when the pressure on the top of the box is lessened, thus keeping the short arm of the lever constantly in contact with the fulcrum. The aneroid is used by the following rule: The sum of the reading at two stations, is to their difference, as 55,000 (or twice the height of the atmosphere in feet) is to the elevation required. Thus, if the reading at the foot of a hill is 30.05, and at the top 29.44, we have the following: 59.49; 0.61; 55,000 feet; 564 feet. Generally speaking, the fall of one inch in the barometer indicates a rise of about 900 feet in elevation, and the intermediate tenths and sub-divisions of tenths, are in proportion to the rise.

917	feet above sea level the barometer falls			1 inch.
1860	"	"	"	2 inches.
2830	"	"	"	3 "

By the intelligent use of this barometer, the scope of enquiry may frequently be much narrowed at the outset, and labor and expense greatly abridged. If, as we have so far considered the blocks of areas are marked by stakes on their respective corner boundaries (according to the present practice) and their elevations above the sea level also indicated thereon and referred to on the plan of survey, so that these data can be readily ascertained by inspection, contour lines may be run between them by the barometer with a sufficient degree of accuracy for all practical purposes. Suppose, for example, that stakes have been so fixed at the points a, b, c, d, e, etc., etc.