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Field Survey Troops: Their Work at the Front

Draughtsmen, Photographers, Lithographers and Topographers Assisted Artillery Commanders—Typical Reduction of Survey of Observation Post—Flash-Spotting and Sound-Ranging—Paper Read at Annual Meeting of Dominion Land Surveyors' Association

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IN the warfare of positions it became necessary to have large scale maps showing minute detail as a key to the tangled maze of trenches and other defence works. The development of aerial photography made it possible to secure the necessary information. The modern practice of artillery firing from concealed positions at unseen targets was only possible when the required data were available for orienting and ranging the guns. These were among the reasons for the formation of the field survey troops.

At first there was a company attached to each of the five British armies. These were later increased to battalion strength. Each company consisted of four groups: (1) Draughtsmen, photographers, lithographers, etc.; (2) topographers; (3) flash-spotters; (4) sound-rangers.

Ordnance Survey Maps

A sketch of the various duties of each group follows, but first it is necessary to refer to the maps supplied by the Ordnance Survey, which were the basis of all field work. These were divided into two classes: Small scale, under 1: 40,000; and large scale, 1: 40,000 and over.

The small scale maps were on scales of six miles to an inch, with relief shown to hundred-metre intervals by layers of color; 1: 250,000, with 50-metre contours; and 1: 100,000, with contours at intervals of 10 metres. The small scale maps showed clearly all routes by rail and road, and the quality of these. They also contained a good deal of detail of towns and villages and other features. It is with the large scale maps, however, that we are chiefly concerned.

The latter were issued on scales of 1: 40,000, 1: 20,000 and 1: 10,000. The area covered by Belgium and Northern France was plotted on Bonne's projection. The central meridian passed through Brussels (longitude 2°02′4″.03 east of Paris) and the standard parallel was 50°24′ north. The map was divided into sheets 32 kilometres by 20 kilometres in the case of the 1: 40,000 scale. The sheet edges were respectively parallel and perpendicular to the meridian of Brussels. At the corner of each sheet were printed the distances of the sheet lines from the origin.

For purposes of reference, the sheets were divided into rectangles by grid lines parallel to the sheet edges. The larger divisions represented 6,000 by 5,000 yards in the case of the northern and southern tiers of a sheet and 6,000 yards square for the two central tiers, and were designated by the capital letters A to X successively from the N.W. to the S.E. of the sheet. These lettered divisions were further subdivided into squares of 1,000-yard sides, numbered 1 to 30 for the rectangles A to F and S to X, and 1 to 36 for the two central rows of squares. The 1,000-yard squares were split by dotted lines into quarters, designated a, b, c and d, respectively. The capitals and numbers were printed on the map, but the small letters were usually omitted.

Any point was described by its distance east and north of the S.W. corner of the smallest subdivision, in units of one-hundredth of the side of one of these squares—i.e., 5 yards. Thus, a point referred to as "K.16.d.25.02," would be 125 yards east and 10 yards north of the S.W. corner of the S.E. quarter of section 16, square K.

As the grid system measured 35,000 yards by 22,000 yards, there was some overlap around the sheet edges. The area covered by one sheet on a scale of 1: 40,000 was represented by four sheets on the 1: 20,000 scale, the same areas being indicated by the same grid notation in every case.

As the meridians and parallels of Bonne's projection were curved lines, it followed that the difference between true and grid north increased with the distance from the origin. Everything was referred to grid bearings, however, so this caused no inconvenience. Lists of rectangular co-ordinates, referred to the origin of the projection, of points that had been fixed trigonometrically either before or during the war, were also furnished to the survey troops. These were in metres. For convenience in converting metre co-ordinates to grid co-ordinates, conversion tables were used, one table giving the metre co-ordinates of each line of the grid, and a further table reducing the residue in metres to decimals of a square side.

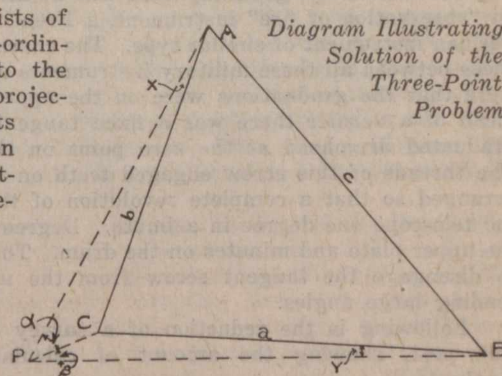

FIG. 1—*A*, FOUQUIERES, FOSSE 14; *B*, BREBIERES CHIMNEY; *C*, BAILLEUL CHURCH; *P*, OBSERVATION POINT

The material used in compiling the maps seems to have been collected from various sources. Among these were French civil and military maps, cadastral maps prepared by the commune, and the plans and surveys of canals, railways and mining areas. A large part of the field was also resurveyed by the British.

Draughtsmen, Photographers and Lithographers

At the headquarters of the field survey company was located a complete organization for producing maps. The ordnance maps were overprinted in colors with the latest information secured from every available source. Aeroplane photographs furnished the means of plotting details of the trenches with great accuracy. The flash-spotters and sound-rangers reported daily the positions of active enemy batteries. Intelligence was received from kite balloons and other observers.

Photographical experts of the field survey company, either working at headquarters or attached to an aerodrome produced the "mosaics" and other prints. New information secured from these was transferred to the map by the *camera lucida*.

Special maps were prepared for the different branches of the service, emphasizing only the particular features required. Thus, the counter battery map, issued twice a month, showed which hostile gun positions had been active and which silent during the previous fortnight. The harassing fire map brought out distinctly the main arteries of traffic used by the enemy. The organization map gave the locations of trenches, aerodromes, hospitals, dumps of ammunition, provisions and material, etc. The bulk of this work was done by men who had formerly been architectural draughtsmen, and the results were admitted by enemy literature to be superior in accuracy and clearness to anything produced on the German side.

Topographers

The principal duty of the topographers was to determine, by survey on the ground, the map locations of battery positions for the artillery, and of observation posts and reference points for the artillery, flash-spotters and sound-rangers. In the case of observation posts this was always done by resection, or the "three-point problem." It was the most accurate method available, because it was usually impossible to occupy a trigonometrical station, and it would have been highly impolitic to have erected, at the point whose location was desired, a signal sufficiently conspicuous to admit of intersection from two such stations. The primary reference points were church-spires, head-works of mines and similar prominent land-marks whose position was given in the lists of metre co-ordinates previously mentioned in connection with the ordnance maps.

The instrument generally used was a "Mark V" director, an "observation of fire" instrument, a French or a captured German instrument of similar type. The characteristic differences between all these military instruments and a theodolite were that the graduations were on the upper plate and instead of a vernier there was a fixed tangent screw with a graduated drumhead at the zero point on the lower plate. The threads of this screw engaged teeth on the upper plate arranged so that a complete revolution of the drum moved the telescope one degree in azimuth. Degrees were read on the upper plate and minutes on the drum. There was a lever to disengage the tangent screw from the upper plate for reading large angles.

Following is the reduction of a survey of an observation post, showing the amount of calculation that was involved:—

Data from list of metre co-ordinates:—

A, Fosse 14, Fouquières Puits, W103908.5 N4079.1.
B, Factory chimney, Brebières, W 96184.6 S6138.3.
C, Bailleul, highest point of ruins of church .... W107989.4 S5678.8.

Angles read at observation post, P (see Fig. 1):—

$\alpha = 49° 48'$ $\quad\beta = 11° 56'$

Formulae:—

$x+y = C-(\alpha+\beta)$.

$\tan \tfrac{1}{2}(x-y) = \tan \tfrac{1}{2}(x+y) \tan (\phi-45°)$.

$\tan \phi = a \sin \alpha / b \sin \beta$.

Solution of bearings and sides of triangle, $A\ B\ C$:—

(Side b)

Log 4080.9 =	3.6107560	
" 9757.9 =	3.9893564	
" tan 22° 41′ 43″ =	9.6213996	(Bearing b).
" 9757.9 =	3.9893564	
" cos 22° 41′ 43″ =	9.9649993	
" 10576.9 =	4.0243571	(Length b).

(Side a)

Log 11804.8 =	4.0720586	
" —459.5 =	2.6622855 n	
" tan 92° 13′ 45″ =	1.4097731 n	(Bearing a).
" sin 92° 13′ 45″ =	9.9996712	
" 11804.8 =	4.0720586	
" 11813.7 =	4.0723874	(Length a).

(Side c)

Log 7723.9 =	3.8878366	
" —10217.4 =	4.0093404 n	
" tan 142° 54′ 44″ =	9.8784962 n	(Bearing c).
" cos 142° 54′ 44″ =	9.9018472 n	
" —10217.4 =	4.0093404 n	
" 12808.4 =	4.1074932	(Length c).

$\therefore A = 59° 46' 59''$
$B = 50° 40' 59''$
$C = 69° 32' 02''$

$\alpha+\beta = 61° 44'$. Therefore, $(x+y) = 7° 48' 02''$, and $\tfrac{1}{2}(x+y) = 3° 54' 01''$.

(Auxiliary Angle, ϕ)

Log a =	4.0723874
" sin 49° 48′ =	9.8829774
	3.9553648
" b =	4.0243571
" sin 11° 56′ =	9.3154947
	3.3398518
" tan 76° 22′ 32″.5 (ϕ) =	0.6155130

(Angles x and y)

Log tan 3° 54′ 01″ $\{\tfrac{1}{2}(x+y)\}$ =	8.8336445
" tan 31° 22′ 32″.5 (ϕ—45°) =	9.7852020
" tan 2° 22′ 51″ $\{\tfrac{1}{2}(x-y)\}$ =	8.6188465

$\therefore x = 6° 16' 52''$ $\quad y = 1° 31' 10''$

Solution of triangle $A\ P\ B$ for side PA:—

$APB = (\alpha+\beta) = 61° 44'$
$PAB = (A+x) = 66° 03' 51''$
$PBA = (B+y) = 52° 12' 09''$
$PA = c \sin (B+y)/\sin (\alpha+\beta)$.

Log 12808.4 =	4.1074932
" 52° 12′ 09″ =	9.8977270
	4.0052202
" sin 61° 44′ =	9.9448541
" 11491.2 (PA) =	4.0603661

Grid bearing of CA =	22° 41′ 43″
Angle x =	6° 16′ 52″
Grid bearing of PA =	28° 58′ 35″

Latitude and departure, A to P:—

Log 11491.2 =	4.0603661
" sin 28° 58′ 35″ =	9.6852482
" cos 28° 38′ 35″ =	9.7419184
" 5566.9 =	3.7456143
" 10052.7 =	4.0022845

Metre co-ordinates of A =	103908.5W.	4079.1N.
Lat. and dep., A to P =	5566.9W.	10052.7S.
Metre co-ordinates of P =	109475.4W.	5973.6S.
Metre co-ordinates (from tables) E by B.20.d =	109601.2W	
Metre co-ordinates (from tables) S by B.20.d =		6360.2S
Differences (metres) =	125.8	386.6
Differences (from tables) in terms of sides of a map square ....=	0.28	0.85

Map location of observation post = B.20.d.28.85

Bearings to Fosse 14, Fouquières =	28° 58′ 35″
" " Bailleul church =	78° 46′ 35″
" " Brebières chimney =	90° 42′ 35″

For long-range guns the position of a reference point or aiming post was determined in the same way with a surveyor's transit, and the distance and grid bearing from this point to the pivot gun were measured. In the case of field batteries the locations were usually obtained by reading the angles with a box sextant, and the solution was made graphically if time did not permit working it out analytically. The plane table was also extensively used for the positions of the shorter range guns. Sometimes, in the case of forward positions, all trigonometrical points in the vicinity had been obliterated; the location had then to be obtained by a traverse with plane, table and tape, or by some other device.

The accurate survey of battery positions was especially important in case of heavy concentration of artillery for a surprise attack. Under such circumstances, it was obviously impossible to use the older method of registering the gun by trial shots. The positions were usually surveyed and marked with stakes the day before the guns were brought up. In reference to the work of one field survey company, the following may be quoted from the published report of Lord Cavan's despatch of November 15th, 1918, from Italy:—

"At 11.30 on the night of October 26th, the bombardment of hostile positions opened along the whole front. The fact that no single British gun had opened previous to this hour deserves special mention. Both heavy and field artillery were registered by the 6th Field Survey Section, R.E., and the fact that the bombardment and the subsequent barrage were excellent in every way, reflects the greatest credit on all ranks of this company."

Flash-Spotters

The flash-spotting group determined, by the method of intersection, the position of enemy batteries and other targets. Each group consisted of four or five observation posts placed at intervals along a front of some four miles, and a central plotting station usually some distance in the rear of the line of posts. An observation post was usually situated in a trench. It consisted of a small rough hut of wood and galvanized iron, with a shelf for the instruments and a slot in front to observe through. The essential equipment comprised a "Mark V" director or other instrument reading to minutes, a pair of binoculars graticuled in half degrees, and direct telephonic communication with the plotting office. In addition to the usual cross-hairs, the telescope of the director was provided with vertical wires spaced to cover intervals of 5 to 10 minutes. Its field was about one degree. By means of the graticules, the angular distance, right or left of the instrument setting, of any gun-flash appearing in the field of the telescope, could be estimated. This was added to or subtracted from the H.C.R., as the case required. The diaphragm and horizontal circle were provided with small electric lights and another small electric light controlled by a switch from the observation post was placed on a picket some distance in front for checking the orientation of the instrument at night. In connection with the telephone was a push button which operated a buzzer and lit a lamp in the central station.

The equipment of the plotting office was a large scaled grid, mounted on a table, covering the same front as all the posts. On this the position of every post was marked by a small hole. Centered on these holes graduated arcs were drawn for reading grid bearings from the several posts. A silk thread was passed through every hole and a weight attached to each end. The weight underneath kept the string taut and that on top of the table could be moved to place the string on any bearing required. The central station, in addition to its connection with the posts, had direct telephone communication with the counter battery officer and the Intelligence Branch.

The procedure of operation was as follows: Each post was manned day and night by two observers. As soon as the instrument was properly oriented by means of the data supplied by the topographer, a rough sketch panorama was made of the visible country. On this, bearings to prominent marks at intervals of about 5° (the field covered by the binoculars) were noted. By reference to these points, one observer with the graticulated glasses could give the other at the director a sufficiently accurate estimate of the bearing of an observed gun-flash to bring it into the field of the telescope. The next round fired would find the director trained on the battery, and the grid bearing would be telephoned to the plotting office.

By manipulating the threads on the plotting board, the operator would ascertain the approximate bearing of the enemy gun emplacement from the other posts, and warn them to look out for flashes in these directions. Then all the posts being on the alert, every observer would press his button on seeing a flash. If the connected electric lights at the plotting office came on simultaneously, it was known that all posts were observing the same flash. The various bearings were then telephoned to the plotting office where the position was fixed by intersection, the map co-ordinates scaled off the grid and immediately communicated to the counter battery officer and Intelligence Branch.

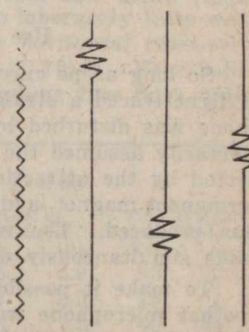

FIG. 2

In this work speed was of the utmost importance, as very often only a few rounds would be fired at one time, especially when ranging shots were being fired to register a gun in a new position. Besides gun emplacements, any other object whose position was required for any purpose, could be located in this way. Every morning when enemy captive balloons went up, their positions were reported. The posts were also used for observing destructive shoots by our own heavy artillery, the battery commander being given the co-ordinates of each shell burst within a few seconds of the time it landed.

Sound-Rangers

The methods mentioned above were effective in clear weather. In France and Belgium, however, there were days and weeks together when such a system was rendered useless by fogs. Various devices were also used to screen and blanket gun-flashes. It was for these reasons that sound-ranging was introduced. The writer has no personal knowledge of the British system, but had access to some of the enemy literature on the subject when billeted in the *Artilleriemesschule* at Wahnerheide after the armistice. The methods used on our side are believed to have been much the same.

The fundamental principle was this: If the report of a gun reached a point, A, at a certain time, and a point, B, some time later, the position of A and B being known, the difference between their distances from the unknown gun position could be determined by multiplying the difference in time by a constant for the speed of sound. We had thus the data for plotting an hyperbola of which A and B were the foci. The gun position would lie on this locus. The equation to the curve would be $(4x^2/d^2)-(4y^2/D^2-d^2)=1$, D and d being respectively the distance between the posts and the difference between the distances of the unknown from each post.

The same process being repeated with respect to B and another known point, C, a second hyperbola was found and the gun position was fixed by the intersection of the two. The equations to the hyperbolas could, of course, be solved simultaneously in each particular case. In practice this took too long, as a result to be of any use had frequently to be obtained almost instantaneously. The positions of the posts were, therefore, laid out on a plotting board similar to that used for flash-spotting. On this were plotted a series of hyperbolas in different colors for posts taken in pairs, and for distances corresponding to differences of time from zero up to the limit required, at intervals of 0.5 seconds. For zero, of course, the locus was a straight line.

Certain corrections had to be made for atmospheric conditions and for wind. A sound-ranging headquarters could always be recognized by the presence of wind-gauges and other meteorlogical instruments. Various methods were used in measuring differences of time, such as stop watches and chronographs. Most of these required the presence of an observer at each post, and telephone communication between the posts. The following method, however, did not require the posts to be manned, and electrical connection with the central station only, was necessary:—

At each post was installed a microphone similar to a telephone receiver. The vibrations caused by sound waves oscillated a disk in this apparatus, making and breaking an electrical circuit momentarily. The wire of the circuit was led to the central station. Here a loop of the wire was suspended between the poles of a permanent horse-shoe magnet. On this loop was attached a mirror about the size of a pinhead. This was illuminated by an electric lamp and reflected a ray of light onto a strip of sensitized photographic paper, which was moved by clockwork.

Use of the Microphone

So long as no current passed through the wire, the ray of light traced a straight line. When, however, the microphone was disturbed by sound waves, the loop of wire momentarily assumed the properties of a magnet and was deflected by the attraction and repulsion of the poles of the permanent magnet, and an irregular zigzag line on the paper was produced. The records of three or more posts were made simultaneously on the same strip of paper.

To make it possible to measure the difference of time, another microphone was connected to a tuning fork which vibrated exactly 50 times in a second, and consequently, traced a continuous saw tooth line with points registering one-fiftieth second. The resulting record is shown diagrammatically in Fig. 2. An observer well in front of the posts was stationed to notify the operator by telephone to start the apparatus at the plotting office. As soon as a gun report was recorded, the sensitized paper was developed and the differences of time scaled. The map location was then obtained by interpretation between the plotted hyperbolas on the board.

Canadian Corps Survey Section

In March, 1918, Canadians who had been attached to English units were recalled to the corps, and a Canadian Corps Survey Section was formed. Previously there had been a force of draughtsmen and a few topographers connected with the Intelligence Branch. These were incorporated in the Corps Survey Section. A flash-spotting group was organized. There was no sound-ranging group in the Canadian unit. Among the personnel were some provincial land surveyors, members of the staff of the Geological Survey and other technical branches of the Dominion government, besides the following Dominion land surveyors: D. McCluskey, A. W. Fletcher, A. M. Perry, O. Inkster and E. W. Berry. Mr. Inkster was awarded a military medal for gallant work under shell fire.

The city solicitor of Hull, Que., has advised the city council that the municipality is liable to a fine of $100,000 for its refusal to install the mechanical water filtration plant ordered two years ago by the provincial board of health.

W. W. Pearse, business administrator of the Board of Education, Toronto, is receiving applications for the position of chief draughtsman, the board having refused to ratify a previous appointment. Only duly qualified architects will be considered for the position.

In debate on the bill introduced in the Alberta legislature under the auspices of the "Association of Professional Engineers of Alberta," Attorney-General Boyle, of that province, stated that in his opinion the bill is "a dangerous effort" to gather into one group all the branches of practical science. He thought that the engineers should confine themselves at first to legislation governing strictly civil engineering practice, and said that later, "when experience has proven such legislation practicable and desirable," that it could be enlarged to include other engineers.

ALBERTA'S BITUMINOUS SANDS

SYDNEY C. ELLS, of the Department of Mines, Ottawa, addressed the Ottawa Branch of the Engineering Institute last Thursday evening, on the bituminous sand deposits in Alberta. The investigation of these deposits was carried out under the supervision of Mr. Ells. Practically all the deposits, he said, are held as government land, and no individuals or companies have any mineral rights.

The deposits are 300 miles from the nearest railway. The chief work accomplished to date is the detailed topographical mapping of 85 sq. mi., and an extensive series of analyses of the sands, based upon samples obtained with core drills.

In order to demonstrate the possibilities of these deposits, Mr. Ells built in Edmonton demonstration areas of three standard types of asphalt surfaces, namely, sheet asphalt, bitulithic and bituminous concrete. The work was completed in 1915, said Mr. Ells, and the pavements are still in perfect condition. For the shipment of 60 tons of bituminous sands from McMurray to Edmonton, 23 teams broke a road of 240 miles to McMurray in the winter of 1915, and hauled out the entire shipment.

Even with the promised railway facilities, freight charges will be high on the bituminous sand, said Mr. Ells, unless the bitumen can be separated from the sand. While considerable research had been done in this connection, further work is necessary before it can be definitely stated that such separation is commercially feasible.

Mr. Ells was not enthusiastic about the outlook for the commercial distillation of the bituminous sands, although such distillation has been accomplished in the laboratory, obtaining fractions ranging from gasoline to heavy oils.

SASKATCHEWAN WATER SUPPLY COUNCIL

AT the first meeting of the Saskatchewan Water Supply Advisory Council, held last Friday in Moose Jaw, Maj. McPherson, chairman of the Local Government Board of Saskatchewan, presided. Other members present included City Commissioner Mackie, of Moose Jaw; City Commissioner Thornton, of Regina; City Commissioner Yorath, of Saskatoon; H. B. Blake, engineer of water supply for the C.N.R.; and G. C. Dunn, engineer of construction for the G.T.P. Thomas Lees, who represents the C.P.R. on the council, was unable to attend.

Letters were drafted to be sent to all municipalities included in the proposed scheme, requesting that data be furnished regarding the water requirements at present, and the estimated maximum requirements in five years and ten years.

A consulting engineer from some other province will be asked to examine any scheme that the council may formulate. Should the consulting engineer approve of the council's scheme, it will then be voted upon by the people, after which legislation will have to be secured, enabling construction.

After discussion as to rates that would have to be charged for the water, Maj. McPherson stated that the water would be wholesaled to each municipality, and that it could be disposed of to individual consumers upon any basis which the individual municipality might establish.

Questioned regarding the extent of the area to be covered by the scheme, Maj. McPherson replied that it is not intended to include Weyburn and Estevan in the original scheme, but the possibility of extending the pipe line to those municipalities would be kept in view.

Commissioner Mackie and Mr. Dunn were of opinion that the pipe line should be large enough to supply the needs of the municipalities for the next 10 years. A discussion followed regarding the kind of pipe that should be used.

A town planning expert will be engaged by the directors of the Canadian National Exhibition, Toronto, to prepare a plan for the future development of the exhibition grounds.

PRESSURE OF CONCRETE AGAINST FORMS*

By E. B. Smith
Senior Assistant Testing Engineer, U. S. Bureau of Public Roads

In many cases the cost of forms for concrete work constitutes a rather large percentage of the total cost of the finished structure, and this cost can only be kept low by rationally studied design methods. Often the form is not designed, but is merely laid out by guess and constructed by the carpenter, with the result that an unwarranted amount of lumber has been used to prevent failure or spreading. The dimensions and the spacing of the supports and braces should have careful attention to secure sufficient stiffness and ample strength. The sheathing and bracing should be so proportioned as to secure ample stiffness against springing and misalignment. Mere strength without ample stiffness and rigidity is not sufficient for good work.

The proper design of forms cannot be concluded without knowing the lateral and vertical pressures of plastic concrete against the forms. To secure this information the U.S. Bureau of Public Roads has made a few tests which seem to accord in general with the results obtained by others, but which go further in indicating the values of some of the factors influencing the results. At the present time sufficient data has not been obtained to make any final statement as to the law of pressure of concrete and the effect on each factor, but rather than hold this data longer with the expectation of making it more complete at some future time, it is now offered with the desire that it may serve to make a little more definite the usual practice in the design of concrete forms; also that it may suggest a needed field of investigation for other experimenters.

Table 1—Laboratory Tests of Pressures of Concrete Against Forms

Mix	Consistency	Temperature Degs. Cent., Air	Water	Rate of Pouring Ft. per Hr.	Maximum Pressure, Vert.	Lat.	Head at Max. Press., Vert.	Lat.	Time at Max. Press. (Mins.), Vert.	Lat.
1:2¼:3¾		23		1.5	1.15	.68	2.5	2.0	90	90
1:2¼:3¾		26		2.7	1.45	.90	3.7	2.5	78	61
1:2¼:3¾		..		3.3	1.65	.73	3.3	2.5	49	44
1:3:6	Quaky*	19	21	1.63	13.5	.52	2.77	1.70	79	61
1:3:6	Quaky*	15	18	3.32	1.05	.43	4.15	2.53	70	50
1:3:6	Quaky*	19	20	6.72	1.07	.21	6.59	3.80	57	37
1:3:6	Quaky*	17	19	14.26	1.33	.41	10.00	5.12	48	29
1:3:6	Quaky*	17	21	9†	.86	.35	9.28	8.78	10	10
1:3:6	Quaky‡	21	19	1.73	.98	.90	1.71	2.08	36	66
1:3:6	Quaky‡	18	20	3.46	2.02	.85	3.72	3.22	57	57
1:3:6	Quaky‡	16	19	7.08	2.53	1.40	5.50	5.00	49	49
1:2:4	Quaky 14" dia.	19	18	1.75	2.27	1.50	3.46	2.68	96	86
1:2:4	Quaky 13" dia.	24	18	3.60	2.35	1.46	4.50	3.40	66	56
1:2:4	Quaky 13" dia.	23	23	7.32	1.73	1.21	4.55	4.05	37	37
1:1½:3	Quaky	21	24	1.86	2.75	1.89	3.99	3.49	106	106
1:1½:3	Quaky 12" dia.	20	17	3.84	3.49	2.40	4.79	4.29	66	66
1:1½:3	Quaky 13" dia.	17	17	7.50	4.60	3.16	7.10	6.60	60	60
1:2:4	Quaky 10½" dia. (6½" Sl.)	25	18	1.78	1.75	.98	2.09	1.87	46	56
1:2:4	Dry 11½" dia. (6½" Sl.)	27	18	7.35	2.41	1.93	3.33	2.83	28	28
1:1½:3	Sloppy 12½" dia. (3" Sl.)	16	15	1.84	2.37	1.17	3.05	2.55	75	75
1:1½:3	Sloppy 15" dia. (8½" Sl.)	17	15	7.66	3.31	2.05	4.80	4.30	38	38
1:2:4	Sloppy 17" dia. (9½" Sl.)	18	17	1.86	2.75	1.63	3.38	2.88	85	85
1:2:4	Sloppy 16" dia. (9½" Sl.)	19	17	7.44	1.97	1.19	3.33	2.83	27	27

*Forms dry. †In one batch. ‡Forms wet.

The series of tests presented in this paper were carried out by W. E. Rosengarten in the laboratory of the research section of the Bureau of Public Roads located at the Arlington Experimental Farm, near Washington. The field tests were made during the construction of the walls and columns of a reinforced concrete building.

The apparatus used to measure the concrete pressures were cells and gauges similar to those described in the proceedings of the American Society for Testing Materials, 1917, page 641, and used for the past few years by this laboratory in measuring earth pressure behind retaining walls and under fills. The instrument consists essentially of an air-tight metal cell having a circular weighing face 10 sq. ins. in area. The concrete pressures against the face of the cell are balanced by admitting compressed air to the inside of the cell. When the pressures are balanced, an electrical contact is broken, which extinguishes a light and indicates that the pressure shown on the gauge connected with the air pipes is equal to the pressure of the concrete. Tests on these cells show them to be accurate considerably beyond the degree necessary for these tests, and that the movement of the face is less than one ten-thousandth of an inch to break contact, thus making the cell admirably suited for tests on pressures exerted by granular materials, soils, mud and concrete.

Several other experimenters have attempted to obtain such data, but some have been greatly handicapped by not having a suitable apparatus for determining the concrete pressures. Any scheme for determining the pressure values that depends upon a movement of the concrete at the time of making the readings is evidently not reliable. The values desired are the static pressures of concrete against an immovable surface, and not the pressures necessary to stop a moving mass of concrete; to start a movement of the mass before making the pressure readings is also undesirable.

The concrete form used during the laboratory tests was built of 2-in. planks, giving an inside horizontal cross-section of 7.8 by 9.4 ins., and a height of 10 ft. Four cells were placed in the form, with the weighing face flush with the inside of the forms. Cell No. 1 was placed in the centre of the base and indicated the vertical pressure. Cell No. 2 was set in the centre of the rear wall of the form. Cells Nos. 3 and 4 were placed in the centre of the right and left side walls of the forms respectively. The centres of these cells for obtaining the lateral pressure were all 6 ins. above the base. Air control pipes leading from all cells were arranged in order, with connections and nipples conveniently located for taking the readings on the four cells very quickly.

The materials for the concrete used in the tests were carefully weighed and mixed by hand. Immediately upon completing the mixing, the concrete was shoveled into buckets and dumped into the top of the forms. The mixing floor and the wood forms were well wetted before the test was begun. The concrete was tamped on top by the use of a long stick having a 2 by 6-in. foot on the lower end. The outside of the forms were also vibrated by striking with a heavy hammer.

The height to which the concrete stood in the column form was then measured, and the pressures on the bottom and three side cells were immediately read and recorded. The batches were varied in size, so that when a new batch was added each 10 mins., the head of concrete in the form would increase at the rate desired. Readings were taken on

*Paper presented at annual meeting of American Concrete Institute. Published in advance of proceedings copyrighted, 1920, by American Concrete Institute.

the pressure cells immediately after placing the concrete, and again about 5 mins. later, or shortly before placing the next batch of concrete.

The air and the mixing water temperatures were recorded each day tests were run. Slump tests of the concrete were made to determine the consistency used in each test, and were recorded as inches slump; or where very wet, as inches diameter of the mass. Fresh batches of concrete were added every 10 mins. until after the pressures on the cells had passed a maximum, and indicated a decided decrease in pressure. The tabulated data and results of these laboratory tests are shown in Table 1.

Several field tests were run, in addition to the laboratory tests described above, during the construction of a reinforced concrete building at the Arlington Farm. The pressure cells were inserted in the wall and column forms, and pressure readings taken at the time the concrete was being poured. The concrete was machine mixed, raised in an elevator and directed into the forms through a system of chutes. It was then spaded or tamped with a stick having a small blade on the end. The concrete was a 1:2:4 mix, river gravel being used for the coarse aggregate, and the consistency rather sloppy, flowing readily around the steel reinforcing. The results from these field tests conform favorably with those obtained from the laboratory, and are shown in Table II.

The results shown by these experiments indicate that the fundamental pressure of concrete against the form is

TABLE 2—FIELD TESTS OF PRESSURES OF CONCRETE AGAINST FORMS

All mixes 1:2:4, sloppy consistency.

Temperature, Degs. Cent., Air	Water	Rate of Pouring, Feet per Hour	Distance (Inches) Cell to Opp. Side of Form	Maximum Pressure, Lat.	Head at Max. Press., Lat.	Time at Max. Press., (Mins.), Lat.
14	13	12.0	8	1.95	3.25	17
..	..	12.0	8	2.45	3.25	17
14	15	20.0	*	2.45	4.62	23
..	..	20.0	18	3.90	4.62	23
23	23	9.0	†	2.2	3.0	20
23	23	12.5	9½	1.85	2.3	11
23	23	10.6	9½	1.45	2.3	13

*3 ins. to reinforcing. †18 by 28-in. hole.

about one pound per square inch for the first one foot of head. However, this is by no means all that should be said. A study of the results reported by others, and those obtained from this series of tests show that the following factors have an influence upon the pressure: (1) Rate of filling the forms; (2) cross-sectional area of the forms; (3) consistency of the concrete; (4) amount of cement in the concrete; (5) temperature of the concrete and the time of set of the cement; and (6) character of the fine and the coarse aggregate.

Sufficient data is not yet available to make final statements as to the law by which each of these factors influences the pressure of the concrete against the form. The results do show that the initial pressure under small heads is equal to the hydrostatic pressure of a liquid having the approximate density or weight of the concrete; that is, approximately one pound per square inch, or 144 lbs. per sq. ft., for the first foot head. As pouring is continued, however, this pressure soon falls below the straight line hydrostatic pressure, and the amount of this deviation depends upon one or more of the factors mentioned above.

It is important to notice that the results prove that if filling is continued indefinitely the lateral pressures near the base of the form finally reach a maximum value and then decrease gradually to zero, regardless of the fact that fresh concrete is continually added above. The vertical pressures are in all cases greater than the lateral pressures; they decrease in value after a maximum has been attained, but not to zero. The total weight of the concrete mass in ordinary construction is not supported entirely upon the bottom of the form, but because of the roughness and friction against the sides, the planking takes part of the weight or vertical pressure. Of course, for wide and shallow masses of concrete, such as floor slabs, the vertical pressure is equal to the weight of the concrete.

A summary of the data at hand seems to lead to the following conclusions regarding the effect of the various influencing factors:—

Conclusions from Test Data

(1) The maximum pressure exerted upon the forms increases as the rate of filling increases. At a slow rate of about one foot per hour the pressure is, approximately, one pound per square inch, but as the rate increases beyond this value, the pressure increases approximately as the 0.3 power of the rate.

(2) Field tests which were made in places where the distance between the form walls differed, indicate that the maximum pressures obtained increase slightly with the mass of the concrete when the consistency is wet and sloppy. This conclusion, probably, does not hold in the case of dry mixes. Reinforcing just inside the form tends to slightly decrease the pressures, but probably this effect would be neglected in determining the final pressures for use in design.

(3) The results show in general that the maximum pressure was increased as the consistency of the concrete was made drier within the limit of workability. This is probably different from what might be expected, but the tests show it to be the case. It is probably due to the fact that under the usual conditions of placing dry concrete, it requires more tamping, which, because of its dryness, seems to develop a permanent wedging action between the particles. In the case of wet or sloppy concrete, this wedging action does not exist, as we have approximately a static fluid pressure. For low heads, the dry concrete (when tamped as usual) will give the greater lateral pressure, but for heads of 4 ft. or more and within the time when initial set becomes an influencing factor, the sloppy mixtures give the greater pressure. The average increase of pressure due to the effect of dry mixtures seems to be 0.3 lbs. per sq. in. for each inch decrease in the standard slump test, less than a 5-in. slump.

(4) The richness of the mix also affects the maximum pressures obtained. The richer the mix the greater the maximum pressure, the average increase being 0.12 lbs. per sq. in. for each 1% increase in the ratio of the cement to the aggregate, beyond 12%.

(5) A decrease in the temperature of the concrete retards the set of the cement, and it is natural to suppose that this is the limiting factor in the maximum pressure obtained, since the pressure increases with the head until the cement takes a sufficient set to begin to support the overlying concrete. Therefore, as the temperature is reduced and the time of the set of the cement is increased, the height of fill may be increased and thus produce or make possible a higher total pressure. Since the cement begins to set and stiffen in about 30 mins., the maximum pressure is attained under whatever head of concrete may exist at this time. The value for H, the head of concrete, to be used in the formula given below should not be greater than one-half the rate of fill, except where agitation is vigorous and continuous in a sloppy mix; then this ratio may be taken up to three-fourths.

Imperical Formula

An imperical formula giving the lateral pressures required for use in the design or the invesstigation of the strength of concrete forms, and taking into account the above numerical factors, is

$$P = H^{0.3}R^{0.3} + 0.12C - 0.3S,$$

P being the resultant lateral pressure in lbs. per sq. in.; H, the head of concrete fill; R, the rate of fill in feet per hour; C, the per cent. by volume of cement to the combined fine and coarse aggregate; and S, the consistency in inches, or slump.

The vertical pressure is obtained by adding $0.25H$ to the value of P as found above, except when the inside distance between the vertical sides of the form is greater than one half the depth of fill; then the value should be taken as equal to the weight of the concrete.

In the practical application of this formula, as with all other formulas, there is abundant opportunity for the exercise of common sense and good judgment. The formula will give pressures somewhat higher than exact values. It shows the effect of continuous and vigorous agitation of the concrete mass only as this is introduced through good judgment in selecting the value for the head of concrete, *H*. For usual conditions *H* may be taken as not greater than one-half of *R*. For ordinary cement in cold weather, or when continuously and well agitated, *H* may be three-fourths of *R* when the filling is continuous beyond one hour. A second pouring on top of concrete that has been in place for 45 mins. or more does not add to the pressures already existing at the bottom of the fill.

The values for *C* may be taken as the next higher whole number in the per cent. of cement by volume, as the required accuracy does not justify fractional per cents. Values for *S* may also be taken only as whole numbers, since the slump test is not accurate closer than one inch.

The value of *P* obtained by the formula is the lateral pressure against the form at the lowest point of the fill. Since the pressures are not uniform from top to bottom, but vary approximately as the ordinates of a parabola, the centre of pressure, or point of resultant pressure, may be taken at 0.6 of the height of fill, *H*, from the top.

The following examples may serve to show the use of the above formula:—

Example 1.—For reinforced mass concrete. Mix to be 1:3:5; consistency rather sloppy, or 9-in. slump; the rate of fill, *R*, to be 8 ft. per hour. The total height of concrete filled within one hour, 7 ft. Since this concrete is placed from a chute in a large form, and men are continually walking around in it, the value to be chosen for *H* is 6, or three-fourths of *R*. Then, substituting in the formula,

$$P = 6^{0.2}8^{0.3} + (0.12\times13) - (0.3\times9).$$
$$= 1.53 \text{ lbs. per sq. in.}$$

The vertical pressure = 7 lbs. per sq. in.

Example 2.—For reinforced concrete column. Mix to 1:2:4; consistency, 8-in. slump; rate of fill to be 24 ft. per hour. Total height of column and final fill, 11 ft., made in one pouring; since this is done in less than 30 mins., the value for *H* is 11. Substituting in the formula,

$$P = 11^{0.2}24^{0.3} + (0.12\times17) - (0.3\times8).$$
$$= 3.83 \text{ lbs. per sq in.}$$

Vertical pressure = $P + 0.25H$ = 6.58 lbs. per sq. in.

Example 3.—For thin curtain walls and reinforced bulkheads. Mortar mix, 1:5; consistency, 8-in. slump; rate of fill, 20 ft. per hour. Total height of fill in one pouring, 14 ft. The value to be selected for *H* should be 10, since that is the height of fill at 30 mins., when the effect of stiffening and set begins. Substituting, we have

$$P = 10^{0.2}20^{0.3} + (0.12\times20) - (0.3\times8).$$
$$= 3.89 \text{ lbs. per sq. in.}$$

Vertical pressure = $P + .25H$ = 6.39 lbs. per sq. in.

Example 4.—For dry mix, mass concrete. Mix to be 1:3:6; consistency, 3-in. slump; rate of fill, 6 ft. per hour; distance between sides of form, 3 ft.; total height of fill within 30 mins., 4 ft. Then

$$P = 4^{0.2}6^{0.3} + (0.12\times11) - (0.3\times3).$$
$$= 2.68 \text{ lbs. per sq. in.}$$

Vertical pressure = 4 lbs. per sq. in.

A conference of the road foremen of the county of Elgin, Ont., was held last week in St. Thomas, Ont., under the direction of County Road Superintendent Frank Pineo and County Clerk W. McKay. Eighty foremen and members of the county council were in attendance. The meeting took the form of a round table conference and short addresses by Messrs. Pineo and McKay, and by John McCallum, road superintendent of Lambton County; James A. Bell, county engineer of Elgin; and other officials. Mr. Pineo was so pleased with the success of the conference that he has decided to hold one every spring.

QUEBEC BRIDGE REPORT

COMPILED under the direction of C. N. Monsarrat, chief engineer of the Government Board of Engineers of the Quebec Bridge, the board's final report is now off press and ready for public distribution. It is published in two volumes, both bound in stiff cloth covers. The page size of each volume is 14¾ by 12 ins. Vol. 1 is profusely illustrated with half-tone reproductions of photographs of the structure during and after erection, and contains the text of the report. Vol. 2 contains the plans of both substructure and superstructure.

Vol. 1 is printed on heavy coated paper, and Vol. 2 on high-grade bond paper. Vol. 1 contains 260 pages, many of them being full page illustrations. Vol. 2 contains 61 plates, many of which are long, folded drawings. Vol. 1 is in 9 chapters, as follows:—

(1) Order-in-council; (2) historical; (3) general narrative; (4) dimensions, weights and general data; (5) substructure; (6) tenders; (7) design; (8) fabrication; (9) erection.

The chapter on "Design" includes: (a) Preliminary considerations; (b) the board's design; (c) the contract design of the St. Lawrence Bridge Co.; (d) the St. Lawrence Bridge Co.'s design as built; (e) calculation of stresses.

The chapter on "Erection" includes: (a) Travellers; (b) loading and handling; (c) approach spans; (d) inside staging; (e) outside staging; (f) main shoes; (g) bottom chords, anchor arm; (h) lower web members, anchor arm; (i) upper web members, anchor arm; (j) main posts; (k) erection of cantilever arms; (l) erection stresses.

The appendix to Vol 1 gives the list of officials, engineering organizations and staffs; calculations of the main piers; main shoes; secondary stresses; temperature stresses; stresses in suspended span arising from unsymmetrical loads on the two tracks; hangers at end of suspended span; expansion joints and traction trusses; lattice bars; tie plates and their rivets; lateral connection plates; tests of nickel steel riveted joints; tests of nickel steel eyebars; column tests, series 1910; tests of carbon steel compression members, series 1912; column tests, series 1913; elongation of eyebars under working loads; tests of eyebars under elongated pin holes; tests of cross-loaded and counterpoised eyebars; tests of hangers for raising the suspended span; friction on pins; tension tests,—plates and built members; specifications of substructure and superstructure.

On account of the large cost of printing this report, the edition has been limited, and a charge of $6 per set of two volumes is being made. Applications for copies of the report should be sent to the Department of Railways and Canals, Ottawa, and should be accompanied by remittance.

At the annual meeting of the Regina branch of the Association of Building and Construction Industries, R. J. Lecky was elected president for the coming year, and A. E. Long, vice-president.

Geo. C. Anderson, irrigation engineer, California, who was asked by the Alberta government to report upon irrigation in the Lethbridge Northern District, states that 97,531 acres can be irrigated at a cost of about $40 an acre.

Premier Stewart, of Alberta, granted an interview recently to representatives of a number of municipalities in that province, who requested that the provincial government investigate the hydro-electric resources of Alberta. Arthur J. Cantin presented a project for the construction of generating station on the Athabasca, North Saskatchewan, Red Deer, Bow and South Saskatchewan rivers. He claims that 315,000 h.p. could thus be developed as follows: Athabasca, 170,000; North Saskatchewan, 50,000; Red Deer, 7,000; Bow river, 48,000; South Saskatchewan, 40,000. The delegation desired the inauguration of a publicly owned hydro-electric power system. No promise was made by the government, but the premier stated that the matter would receive consideration.

Alberta Bill for Registration of Engineers

Complete Text of Bill No. 9, Session of 1920, Now Being Debated by Alberta Legislature—Almost Identical Bills Introduced in Several Other Provincial Parliaments—Standard Form of Act Recommended by Engineering Institute's Legislation Committee

UNDER the direction of members of the Engineering Institute of Canada, bills providing for the registration and licensing of engineers are now being introduced in several provincial parliaments. In every case the standard form of legislation recommended by the legislation committee of the institute has been used as the model for the bill. Following is the complete text of the bill now being debated by the Alberta Legislature:—

An Act to regulate the Engineering Profession and to Incorporate the Association of Professional Engineers of Alberta.

Whereas a petition has been presented praying for the incorporation of The Association of Professional Engineers of Alberta, as hereinafter set forth, and it is expedient to grant the prayer of the said petition;

Therefore His Majesty, by and with the advice and consent of the Legislature of the Province of Alberta, enacts as follows:—

1. Short Title

This Act may be cited as *"The Engineering Profession Act."*

2. Interpretation

In this Act, unless the context otherwise requires,—

1. "The Association" shall mean the Association of Professional Engineers of Alberta;

2. "Board" shall mean the board of examiners of the association;

3. "Council" shall mean the executive council of the association;

4. "Member" shall mean a registered member of the association;

5. "President" shall mean the president of the association;

6. "Professional Engineer" shall mean any person registered or licensed as a professional engineer under the provisions of this Act;

7. "Professional engineering" or "the practice of a professional engineer" shall embrace reporting on, advising on, valuating, surveying for, designing, directing the construction of, or the engineering inspection of, any of the works or processes set forth in schedule A, or such works or processes omitted therefrom which are similar to those scheduled by reason of their requiring the intelligent application of the principles of mathematics, physics, mechanics, hydraulics, electricity, chemistry, or geology in their development and attainment. The execution or supervision of works as a contractor, foreman, superintendent, inspector, roadmaster, track-master, bridge-master, building-master or superintendent of maintanance, shall not be deemed to be professional engineering wherever such work is done under the responsible supervision of a professional engineer;

8. "Registrar" shall mean the registrar of the association;

9. "Secretary" shall mean the secretary or the secretary-treasurer of the association;

10. "Vice-President" shall mean the vice-president of the association.

3. Association of Professional Engineers of Alberta

C. E. S. Whiteside, L. E. Drummond, F. H. Peters, R. J. Gibb, J. F. McCall, F. W. Hobson, W. R. Pearce, R. A. Brown and R. L. S. Wilson, of the Province of Alberta, engineers, and such other persons as may hereafter become members of the association, are hereby constituted a body corporate under the name of "The Association of Professional Engineers of Alberta," and may acquire by gift, purchase, or otherwise, and may sell, mortgage, lease, or otherwise dispose of real or personal property for the purpose of carrying into effect and of promoting the objects and designs of the association, and may spend money in prosecuting violations of this Act.

4. Adoption of By-Laws

1. The association may pass by-laws not inconsistent with the provisions of this Act for—

(*a*) The election of the council;

(*b*) The government and discipline of the members;

(*c*) The management of its property;

(*d*) The appointment of such officers as may be necessary for carrying out the purposes of the association;

(*e*) The maintenance of the association and the fixing and collecting of annual and other fees;

(*f*) The examination and admission of candidates to the practice and profession of a professional engineer;

(*g*) The time and place for, and method of conducting the annual and other meetings of the association;

(*h*) All such other purposes as may be deemed necessary or convenient for the management of the association and the promotion of its welfare or the conduct of its business.

2. No by-law or amendment thereto framed by the council shall become effective until it has been ratified by two-thirds of the members of the association in good standing and voting thereon.

5. Interim Council

(*a*) There shall be an interim council consisting of the members hereinbefore mentioned.

(*b*) The interim council shall appoint an interim registrar, who shall for not more than three months have all the powers of an ordinary registrar.

(*c*) The interim council shall assist the interim registrar in his work by approving or disapproving of the credentials submitted to him by persons applying for registration.

(*d*) Within three months after the passing of this Act the interim council shall call a general meeting of the then members of the association, and shall, upon the appointment of an ordinary council by such meeting, cease to have any powers.

(*e*) The interim council shall have such powers as are necessary to carry on the interim business of the association.

(*f*) A quorum shall consist of five councillors, but no application for registration of any person in any branch of engineering shall be considered unless [illegible]epresentative of that branch is present at the council n[illegible]g.

6. Branches of Professional Engineering

Professional engineering shall, for the purpose of examination and representation upon the council only, be subdivided into the following branches: Civil engineering, electrical engineering, mechanical engineering and mining engineering. New branches shall be formed on petition of members and ratification by the association at a general meeting thereof.

7. Right to Practice as a Professional Engineer

1. Only a member of the association or a person who has received a license from the council so to do, shall be entitled to take and use the designation of "professional engineer," or any abbreviation thereof, or to practice as a professional engineer, or to hold himself out as being in any way specially qualified to practice in any of the branches of professional engineering hereinbefore mentioned.

2. Any person who does any act embraced in section 2, paragraph 7, shall be deemed to be practicing as a professional engineer, and no person shall employ any such person

to do any such act within the Province of Alberta, unless such last-mentioned person is a member of the association, or is duly licensed by the council to practice as a professional engineer.

8. Right to Registration

The following persons shall be entitled, subject to the conditions in this section set out, to be registered as members of the association:—

(*a*) Any person domiciled in Alberta at the date of the passing of this Act, if he has for five years previously practised as a professional engineer, and produces to the council on or before January 1st, 1921, satisfactory credentials.

(*b*) Any person domiciled in Alberta, if he is a registered member of an association of engineers having the same or similar powers in any other province of the Dominion of Canada, and produces to the registrar a certificate of membership in good standing in such other association, and an application for transfer of registry endorsed by the proper officer of the first-mentioned association.

(*c*) Any person domiciled in Alberta, if he has made application to the council for registration, and, in the opinion of the board possesses qualifications similar to those demanded by this Act by reason of experience, training or examination by some other examining body.

(*d*) Any person domiciled in Alberta, if he passes the examinations and complies with the other requirements of sections 10, 20 and 21 of this Act.

9. Qualifications for License

The following persons shall, subject to the conditions hereinafter set forth, be entitled to obtain from the registrar a license to practise as a professional engineer until the first day of January in the year succeeding the year in which the license is issued or the prior determination of the license by the council:—

1. Any registered member of an association of engineers having the same or similar powers in some other province in the Dominion of Canada, if he produces to the council a certificate of membership of good standing in such other association and pays such fee as may be prescribed by the by-laws of the association;

2. Any person not coming within the provisions of the next preceding paragraph, if he produces evidence satisfactory to the council of his qualifications to practice and pays such fee as may be prescribed by the by-laws of the association.

(*a*) Any person not domiciled in the Province of Alberta, but who is an employee of a public service corporation, private corporation or of a Government department outside the Province of Alberta, and whose practice is normally carried on in two or more of the provinces of Canada, and who, by reason of his employment, is required to practise as a professional engineer in Alberta, may obtain a license subject to the requirements of section 9, paragraphs 1 or 2, without payment of a fee.

3. Until the issue of a license under the provisions of this section, or refusal thereof, the official receipt for any fee paid shall constitute a temporary license to practise.

10. Corporations, Partnerships, Associations

No firm of partners, corporation or association of persons as such shall be registered as a member of the association, or be licensed to practise as a professional engineer.

11. Administration

1. The affairs of the association shall be managed by a council, which shall consist of a president, vice-president and councillors as hereinafter set forth.

2. The number of the council shall be determined by by-law, provided that each branch shall have continuous equal representation.

12. Officers

1. The president shall be elected annually by the association and shall hold office until his successor is elected. He shall act as presiding officer at the meetings of the council and of the association, voting only when votes are evenly divided.

2. The vice-president shall be elected annually by the association and shall have all the powers of the president during the absence of the latter from any cause whatever.

3. The last past president shall be a member of the council for the following year. Each branch of the association shall elect an equal number but not less than two councillors. The councillor for the first year after the first annual meeting from each branch receiving the largest number of votes at that election shall hold office for two years. Annually thereafter each branch shall elect councillors for a two-year term.

4. In the event of a member of the council vacating his seat for any cause whatsoever, the remaining members of the council shall appoint a member of the association from the same branch to fill the vacancy until the next regular election of councillors.

13. Annual Fee

1. Each member shall pay in advance to the secretary or any person deputed by the council to receive it, such annual fee as may be determined by the by-laws of the association, which fee shall be deemed to be a debt due by the member to the association and shall be recoverable with the costs of same in the name of the council in any court of competent jurisdiction.

2. If any member omits to pay the prescribed annual fee within six months of the date upon which it became due, the registrar shall cause the name of such member to be erased from the register, and such member shall thereupon cease to be entitled to practise as a professional engineer; but shall, at any time thereafter, upon paying such fee as may be prescribed by the council, be entitled to all his rights and privileges as a member from the time of such payment.

14. The Registrar

1. A registrar shall be elected by ballot by the council as soon as possible after the first annual election of the council, and biennially thereafter.

2. The registrar shall be the executive officer of the association under the direction of the council and shall have such powers as are necessary for the proper administration and enforcement of the provisions of this Act and the by-laws made thereunder.

15. The Register

1. A register of all professional engineers showing the dates of their certificates shall be kept and a list of professional engineers in good standing who are authorized to practise, shall be published in the first issue of "The Alberta Gazette" on or before February 15, of each year.

2. Every certificate of registration and license shall be signed by the president and the registrar, and shall bear the seal of the association and shall specify the branch or branches of professional engineering in which the professional engineer has been registered or licensed.

3. Every person registered under this Act shall have a seal, supplied by the council at his expense with which he shall stamp all official documents and plans. The seal shall state upon its face the branch or branches of professional engineering in which he has been examined or otherwise admitted.

16. Evidence

The certificate of the registrar under the seal of the association shall be *prima facie* evidence of membership of the association or license to practise, or non-registration or non-possession of license, as the case may be.

17. Examinations

The board shall inspect all diplomas, certificates, and credentials presented or given in evidence for the purpose of obtaining admission to examination, and may require the holder of such credentials to attest to them by oath or affidavit in any matter involved in his application. If such evidence is not satisfactory to the board, the board shall refuse to admit such candidate to examination for registration.

18. Minister to Appoint Examiners

From and after the first day of January, 1921, every applicant for registration not qualifying under section 8 paragraphs (*b*) and (*c*) of this Act, shall pass such examination as may be approved by the Minister of Education of Alberta and the said Minister shall upon the nomination of the council, appoint the board of examiners and shall prescribe the regulations governing such examinations.

19. Central Examining Board

The council, with the approval of the Minister of Education, shall have power to establish conjointly with the council of any association having the same or similar powers, in one or more of the Provinces of Canada, a central examining board, and to delegates to such central examining board all or any of the powers possessed by the board respecting the examinations of candidates for admission to practise, provided that any examination conducted by such central examining board shall be held in one place at least within the province.

20. Regulations Regarding Examinations

1. Regular examinations of candidates for registration shall be held at Edmonton or such other place or places as the council may direct.

2. The scope of the examinations and the methods of procedure shall be prescribed by the council subject to the approval of the Minister of Education of the province with special reference to the applicant's ability to carry on the particular branch or branches of professional engineering which he desires to practise in the province.

3. As soon as possible and not later than twenty-one days after the close of each examination the members of the board who shall have conducted such examination, shall make and file with the Minister of Education and the registrar a statement of the results of such examination, whereupon the council shall notify each candidate of the result of the examination and of its decision upon his application.

4. Every candidate for examination shall give at least one month's notice in writing to the registrar of his intention to present himself for examination and with such notice shall forward the fee prescribed by the by-laws of the association and before receiving his certificate of registration the prescribed entrance fee, the prescribed annual fee and a sum of not more than five dollars for the publication of his name in "The Alberta Gazette."

5. In case the candidate should fail in his examination he may present himself at any subsequent regular examination by paying the prescribed examination fee.

21. Qualifications

1. Notwithstanding any other provision of this Act, no person shall be registered or licensed unless at least twenty-five years of age, and unless he has been engaged for eight years in some branch of professional engineering, except in the case of a graduate from an engineering college or university approved by the council, in which case the period of engagement in engineering work shall be reduced to six years (which may include his term of instruction) two of which at least shall have been spent in practical engineering work.

2. Any person passing the examinations hereinbefore provided for, and otherwise qualifying, and failing to register within one year of the date of so passing the examination shall lose any right of registration that has accrued to him by reason of passing such examination.

22. Suspension for Misconduct

1. The council may, at its discretion, reprimand, suspend or expel from the association any member guilty of any disgraceful conduct in a professional respect, of gross negligence, or of a gross and continued breach of the by-laws of the association, or who has been convicted of a criminal offence by any court of competent jurisdiction:

Provided that no account shall be taken of a conviction for an offence, which though within the provisions of this section, does not either from the trivial nature of the offence or from the circumstances under which it was committed, disqualify a person from practising professional engineering.

2. The council shall not take any such action until a complaint under oath has been filed with the registrar and a copy thereof forwarded to the party accused. The council shall not suspend or expel a member without having previously summoned him to appear to be heard in his defence, nor without having heard evidence under oath offered in support of the complaint and on behalf of the member. The council shall have the same powers as the Supreme Court to compel witnesses to appear and to answer under oath in the manner and under the penalties prescribed by the law of Alberta. The president of the council or person acting as such in his absence, or the registrar is hereby authorized to administer oaths in such cases.

3. All evidence shall be taken in writing or by a duly qualified stenographer.

4. Any member so suspended or expelled may, within thirty days after the order or resolution of suspension or expulsion, appeal to a judge of the Supreme Court from such order or resolution, giving seven days' notice of appeal to the council, and may require the evidence taken to be filed with the proper officer of the court, whereupon such judge shall decide the matter of appeal upon the evidence so filed and confirm or set aside such suspension or expulsion, without any further right of appeal; and if the suspension or expulsion be confirmed, the costs of such appeal shall be borne by the suspended or expelled member.

5. Unless the order or resolution of suspension is set aside on such appeal, or the judge or the council otherwise orders, the member so suspended or expelled shall not practise further, except (in case of suspension) upon expiry of the period of suspension. Pending an appeal the member so suspended or expelled shall not practise as a professional engineer.

23. Penalties

Any person who, not being a professional engineer in the province, or who being suspended or having been expelled under the proceedings of the next preceding section—

(*a*) Practises as a professional engineer; or

(*b*) Usurps the practice of a professional engineer as set out in section 2, paragraph 7; or

(*c*) Assumes verbally or otherwise the title of professional engineer, or makes use of any abbreviations of such title, or of any name, title, addition, description or designation which may lead to the belief that he is a professional engineer, or a member of the association, or that he is a person specially qualified to practise in any of the branches of professional engineering hereinbefore mentioned;

(*d*) Advertises himself as such in any way or by any means; or

(*e*) Acts in such manner as to lead to the belief that he is authorized to fulfil the office of or to act as a professional engineer,

shall be liable on summary conviction to a fine of not less than fifty dollars nor more than one hundred dollars, and for any subsequent offence to a fine of not less than one hundred dollars nor more than two hundred dollars.

24. Fine of $100

Where no other provisions are made herein, every person guilty of violating any of the provisions of this Act or of the by-laws made thereunder, shall be liable to a fine of not more than one hundred dollars recoverable with costs under the provisions of the law respecting summary convictions.

25. Must Prosecute Within Year

No prosecution shall be commenced for any offence against this Act after one year from the date of the commission of the offence.

26. Injunction

Where any person after conviction for practising or attempting to practise as a professional engineer without being a member of the association or otherwise permitted so to do by this Act, practises or attempts to practise as a professional engineer within the province, the association may apply to a judge of the Supreme Court for an injunction restraining such person from practising or attempting to practise as a professional engineer in the province, and the court shall, on being satisfied that such person has practised or attempted to practise as a professional engineer in the province, grant the same injunction.

27. Fraudulent Representations

If any person shall wilfully procure or attempt to to procure himself to be registered or licensed under this Act, by making or producing, or causing to be made or produced, any false or fraudulent representations or declaratoins, either verbal or in writing, he, and every person knowingly aiding or assisting him therein, shall be liable on summary conviction thereof to a fine of one hundred dollars.

28. General Provisions

1. Nothing in this Act shall be read so as in any way to infringe upon the power of legislation given to the Parliament of Canada by *The British North America Act*, nor to take away or infringe upon any powers or privileges specifically granted to land surveyors, engineers, or any other class of persons, by virtue of *The Mines Act* or *The Boilers Act* or any other legislation of the Province of Alberta or of the Dominion of Canada or regulations made thereunder.

2. In particular nothing in this Act shall prevent any person now registered under *The Alberta Architects Act* from doing any act or thing which is within the scope of, or is ordinarily incidental to, the normal and distinctive employment of an architect.

29. Restriction of Activities

The activities of the association are hereby restricted to the functions necessary to the administration of this Act.

SCHEDULE A.

Works

Transportation work, roads, railways, waterways, and all detail works connected therewith, such as bridges, tunnels, yards, docks, lighthouses, rolling-stock and vessels, also aeroplanes and airships.

Public utility works, such as telegraph systems, telephone systems, electric light systems, water works, gas works, irrigation works, drainage works, sewerage works and incinerators.

Steel, concrete, reinforced concrete structures.

Mechanical works, such as steam boilers, engines, turbines, condensers, pumps, internal combustion engines, and other motive power machinery and accessories.

Electrical machinery and apparatus and works for the development, transmission, and application of all forms of electrical energy.

Mining and metallurgical works, such as mining properties, mine and concentrator machinery and apparatus, oil and gas wells, smelters, cyanide plants, acid plants, metallurgical machinery, equipment and apparatus, and works necessary for the economical winning or preparation of metals, minerals or rocks.

All buildings and structures necessary for the proper housing or operation of the above mentioned works.

Process

The mechanical, electrical, chemical, electro-chemical mining, or metallurgical treatment of the inorganic elements and combinations thereof for all industrial purposes.

Investigations relating to the examination, exploration and development of rocks and minerals, mineral deposits, rock structures and the application of geology to the industries of arts, or to engineering.

EARLY EXPLORATIONS AND SURVEYS IN THE CANADIAN NORTHWEST*

By Roger Fyfe Clarke
Dominion Land Surveyor, Ottawa, Ont.

HUDSON BAY has played such an important part in the successive stages of the development of Northwestern America, that the history of that part of the continent must begin with the exploration of this inland sea. Its discovery was incidental to the search for a northwest passage to the east. Thus in 1500 A.D., when the Portuguese navigator Cortereal discovered the entrance of Hudson's Strait, without further investigation he huried home to announce that he had discovered the sought-for passage. However, others who attempted to follow up his discovery, met with misfortunes until in 1610 Henry Hudson penetrated into the bay as far as the southwestern coasts.

Two years later Thomas Bulton followed where Hudson had gone, and, wintering near the mouth of the Nelson River, named it after one of his men. Other navigators extended these explorations; among them was Captain James, who went as far as the south end of James Bay in 1631.

For two centuries after this, the search for the northwest passage to the Pacific was continued, chiefly by British navigators. While their persistence resulted in the discovery of all the Arctic lands lying to the north of the American continent, it also resulted in the death of many a heroic sailor.

Search for the Western Sea

When the more complete exploration of the shores of Hudson Bay made it evident that if the northwest passage existed, it must be in a very northerly latitude, this same powerful impulse to reach the western sea seems to have seized explorers by land. They pushed westward and ever westward toward that vision of their ambition, to stand and look out over that great sea in the west. Yet a century and a half rolled by after the discovery of Hudson Bay before it was vouchsafed to McKenzie to be the first to realize that vision.

About the middle of the seventeenth century, adventurous Canadians began to explore the country lying westward and northward from the French settlements in Canada. The two names most prominently associated with the earliest discoveries beyond the Great Lakes are those of des Grosseilliers and his brother-in-law, Radisson. These men, during the years 1658 and 1659 made an expedition westward from Lake Michigan to the Great Plains and returned to Lake Superior. They were the first Frenchmen known to have explored Lake Superior, although the lakes below that were known before their time.

This great lake attracted them so much, and the fur trade there proved so good, that they returned again from 1661 to 1663. Travelling north from Lake Superior, they reached the shores of James Bay. A year later they went by a small ship from Quebec around to Hudson Bay. But they could get so little assistance or even encouragement in these adventures from the authorities or merchants in Canada, that they finally drifted to England to seek assistance for further expeditions.

English Support des Grosseilliers

The English merchants appeared more ready to venture in the fur trade. In 1668 des Grosseilliers sailed from England to Hudson Bay, where he built a fort on Rupert's River. The next summer he returned to England with such a cargo of furs that there was no further difficulty about interesting influential people in that trade. As a result, the "Company of Adventurers of England, Trading into Hudson Bay" was formed, with Prince Rupert at its head. In 1670, this company sent out ships and established Moose Factory.

The French soon realized the mistake they had made in allowing the service of two such enterprising adventurers as

*Paper read at the recent annual meeting of the Association of Dominion Land Surveyors.

Grosseilliers and Radisson to be secured by the English. France made many efforts to lure them back to her service, and eventually succeeded in doing so. Thus it happened that in 1682 we find these same adventurers again in Hudson Bay, this time with ships from Canada. They established a post on the Hayes River. Naturally the French and English interests in Hudson Bay very soon conflicted, and for some years prior to 1714 France was in control there. In the latter year, however, England regained her territorial rights there by the Treaty of Utrecht, and has retained them ever since.

Before this time, regular posts had been established from Canada around Lake Superior and it is recorded that in 1688 a Frenchman named De Noyon wintered on the Lake of the Woods.

Verendrye's Explorations

The name of Pierre Gaultier de la Verendrye deserves great honor in the history of the Canadian West. He was a Canadian seignior, born at Three Rivers. After some years of honorable service in the French armies in Europe, he was in 1728 in command of the Nipigon post on Lake Superior. No doubt it was during his stay here, while the Indians were bringing indefinite reports of the vast countries lying to the westward, that ambition inspired Verendrye to explore those territories, and to pass over them to the shore of that mystic western sea. For many years he pursued this purpose with an energy and determination which overcame not only the tremendous natural difficulties presented by the regions through which he travelled, but also jealous interference and opposition on the part of influential people in Canada. He was accused of seeking merely his own profit in the fur trade. As he received no assistance from the authorities in France or Canada (except a monopoly in the prosecution of discoveries), he was forced to engage in trade to try to meet the great expenses entailed in fitting out his expeditions. The best evidence that he did not seek merely to enrich himself is that he expended what little property he originally had, in pushing forward his explorations, and eventually died a broken man, deeply in debt.

The circumstances under which de la Verendrye labored must appear almost incredible to us now. The only assistance he received from the government of France or Canada was permission to carry on his discoveries. Apparently, he would have been quite satisfied had that permission been wholehearted. All the expenses of his outfits, and even the wages of his men, he had to provide himself. Not only that, but he was balked at every turn by jealous people in Canada, who did their utmost, while he was away, to influence the governors against him. Time after time he was forced to return to Montreal because the supplies which he had arranged to have sent to Lake Superior were not sent. Thus, not only would his explorations be halted, but his associates in the West were in danger of starvation while he returned to the settlements to get the necessary supplies himself. How great must have been the zeal and determination of the man, to have struggled on under these conditions and to have achieved as much as he did!

Reaches Lake of the Woods

It is probable that before Verendrye's time, possibly during the 17th century, numbers of Canadian "coureurs de bois" penetrated into the country far to the west of the Great Lakes. But if they did, they left no records of their wanderings, for probably none of them ever returned. They became merged with the Indian tribes among whom they settled.

Verendrye attempted his first trip westward in 1731, accompanied by his sons and a son-in-law, de la Jemmeraie. But on reaching the Grande Portage, his men refused to go farther, so he was forced to winter there, although he sent Jemmeraie on to Rainy Lake, where Fort St. Pierre was built.

The following summer Verendrye succeeded in reaching the Lake of the Woods, where he established Fort St. Charles. This fort then became his depot, and in 1734 his sons established Fort Marepas near the mouth of the Winnipeg River, a few miles from Lake Winnipeg. His opponents in Canada interfered with his arrangements so successfully at this time that he was prevented from making any further progress for several years. So it was not until September, 1738, that Verendrye succeeded in reaching the Red River. He ascended this river and its branch, the Assiniboine, to the point where Portage la Prairie now stands. Here he built Fort la Reine and spent the winter. During this winter he travelled south-west across the prairies and reached the Mandan Indians on the Missouri river. The following summer his sons made explorations on Lake Manitoba and the lower part of the Saskatchewan River.

In 1741, Verendrye's sons again journeyed across to the Missouri river with the intention of pushing westward from there to the western sea. But their presents for the Mandan Indians were stolen, and as a result they could not secure guides to take them to the west. They were forced to give up that purpose for the time being, and return to Fort la Reine.

During the winter of 1741-2, a fort was established on Lake Manitoba and another called Fort Bourbon at the mouth of the Dauphin river on Lake Winnipeg.

Explored Rocky Mountains

In 1742 Verendrye's sons again essayed the journey to the Missouri and thence westward to the sea. They actually reached the Rocky Mountains, but the Indians who accompanied them would venture no farther. However, they spent 14 months exploring the country north and south along the mountains about the head waters of the Missouri river and its tributaries.

In 1744 Verendrye's eldest son built Fort Paskoyac, near the mouth of the Saskatchewan River. Five years later he ascended the river to the forks, where Prince Albert now stands.

About this time the Sieur de la Verendrye died suddenly in Montreal, while he was preparing another outfit for the West. The prosecution of the explorations he had set his heart upon, fell into other hands. Thus we find de Niverville in charge of Fort Paskoyac in 1750-1. During the summer of 1751, he sent ten voyageurs up the Saskatchewan to establish a post near the mountains. They ascended the south branch and built Fort de la Jonquière, either where Calgary now stands or some distance farther up. It is uncertain how long this fort was in use, though probably only for a season or two. In 1754 the Chevalier de la Corne built Fort de la Corne on the Saskatchewan, a few miles below the forks. This fort retained its position and name for a hundred years afterwards.

Owing to the approaching struggle with England for the possession of Canada, the French forts were all abandoned in 1756 and so ended the French explorations in the West.

Wars Delayed Exploration

After the conquest of Canada, numerous independent English and Scotch traders began to engage in the fur trade and penetrated into the western country. But it was some years before they covered the range attained by the French. In other words, the wars, which culminated in Britain gaining possession of Canada, delayed the progress of exploration in the West by at least 20 years.

In 1770 a man named Curry reached the old Fort Bourbon on Lake Winnipeg and the next year Finlay was at Fort de la Corne on the Saskatchewan. Joseph Frobisher conceived the idea of penetrating farther northward to intercept the Indians going down to the Hudson Bay Co.'s posts on the coasts of the bay. In the summer of 1772 he reached the Churchill river, probably by way of the Saskatchewan and north from Cumberland House. He met with such great success that many traders followed and by 1778 a post had been established on the Athabaska river, a short distance above the lake. With many independent traders engaged in the business, there was naturally a great deal of opposition and rivalry. This reduced the profits. To make matters worse, in 1780 a fearful epidemic of smallpox sweeping northward from the United States, carried off so many of the Indians that the fur trade was still further injured. Many of the traders realized that the difficulties to be overcome required a pooling of their resources to make a strong organization and do away with conflict among themselves. With this object in view, in the winter of 1783-4, the foundation of the North-West Co. was laid in Montreal. In the spring of 1784 the company was organized at the Grand Portage.

MacKenzie, Explorer, Not Trader

At this time, Alexander MacKenzie, a young Scotchman of fine physique and daring heart, was a clerk in one of the Montreal firms largely interested in the North-West Co. He went to the Indian country as a clerk, although soon afterwards he became a partner in the company. In 1789 he was in charge of Fort Chipewyan, on Lake Athabaska.

From the end of the French régime up to this time, the various explorations made were undoubtedly incidental to the fur trade. The early rivalry among the independent traders induced many of them to seek new fields. Later, when they combined to form the North-West Co., there was the desire to divert as much as possible of the trade from the Hudson Bay Co. So the fur trade offered a very powerful incentive to the penetration of new districts. However, the securing of a greater quantity of fur was always the one and only object in view.

In the case of MacKenzie, it was not so. He was actuated by a loftier vision. Beyond a doubt he realized, better in fact than his partners, that further explorations would benefit his company by opening up wider fields for trade. But he pushed his discoveries far beyond the point where they were of any immediate benefit to the fur trade. In both his major expeditions, he exhibited a determination which refused to be diverted, or to be deterred by the risks which lay before, until he finally reached the sea. That seemed to be the keynote of his purpose,—to reach the sea and know the bounds of the continent. He was an explorer first and a fur trader second. He was among those who saw the vision of the western sea, and the first to realize that vision in truth.

MacKenzie Reaches Pacific Ocean

In the spring of 1789, MacKenzie decided to go down the river from Lake Athabaska and try to reach the sea. In spite of the stories of fearful rapids from the Indians, and the assurance that they would be old and grey-haired men, if indeed they ever returned, he set forth with four voyageurs and a few Indians. They passed through Great Slave Lake and from there down without a single portage reached the Arctic Ocean. In three months from their time of starting, they were back at Fort Chipewyan.

Encouraged by this success, he essayed a still bolder feat. Setting out from Fort Chipewyan in the autumn of 1792, he wintered at a post up the Peace River near the mountains, and started westward from there as early as possible in the spring. He ascended the Peace River through the Rocky Mountains and turned up the south branch or Parsnip River, crossed to the Fraser River, followed it down to the Blackwater and from there struck overland across the Coast Range to the Bellakulla River. By this river he reached the Pacific Ocean July 22nd, 1793. There he missed, by only a few days, Capt. George Vancouver, who was exploring the Pacific coast. He returned on the route by which he had come and reached Fort Chipewyan before the winter set in. Soon after this MacKenzie went back to Montreal and did not return again to active work in the West.

(Concluded in the next issue)

The Private Bills Committee of the Alberta Legislature has amended the Act incorporating the "Association of Professional Engineers of Alberta" so that the examining body will be the senate of the University of Alberta. The clause defining professional engineering was also amended. The words "skilled and professional" were substituted for the word "intelligent" in the phrase "intelligent application of the principles of mathematics, physics," etc.

Letters to the Editor

MUNICIPALLY OWNED ASPHALT PLANTS

Sir,—In the issue of *The Canadian Engineer* for January 28th, 1920, on page 179 there is given a list of asphalt plants owned in the United States and Canada. I note that some of the cities in the eastern part of the United States, with which I am familiar, have been omitted. Trenton, N.J., Borough of Richmond (New York City), Borough of Bronx (New York City) and Camden, N.J., have been omitted; also the Borough of Queens (New York City) has two plants instead of one.

R. R. BARRETT,
Engineer, The Texas Company.

New York City, March 5th, 1920.

UNIONIZATION OF ENGINEERS

Sir,—I would like to add a few words to the discussion on the above subject as published in your issue of March 11th.

This question can never be settled on the present basis of discussion, since the opposing sides represent two distinct classes of engineers, and this division must be clearly recognized in order to reach any definite solution.

Prof. Gillespie argues from the standpoint of the engineer in an executive or consulting capacity. This class must obtain recognition through legislation and the Engineering Institute, and can have no place or voice in union affairs.

Mr. Snaith, on the other hand, argues from the standpoint of the younger members of the profession, the draftsmen, instrument men and junior engineers, who are not included in the scope of legislative enactment, and of whom the great majority are not yet eligible for corporate membership in the institute. For such, under the present conditions, unionism seems to hold promises of betterment which, seemingly, can be obtained in no other way, and if the employing engineers do not remedy existing conditions of their own accord, unionism will be forced on this class as the only method of obtaining their rights.

The unions are rapidly increasing their membership in this country, and in Chicago they are now recognized by a number of the leading employers and have a definite agreement and monthly wage scale, which is as follows (overtime extra):—

Apprentices: Class B, $100; class A, $130.

Technical engineers, architects and draftsmen: Class C (experienced tracers, rodmen, etc.), $150; class B (detailers, instrument men, etc.), $200; class A (designers, checkers, etc.), $240; assistant supervisory engineer or architect, $300; supervisory engineer or architect, $333.

This schedule sets the minimum for each grade, and men who are exceptionally proficient can readily obtain more than the amounts set by the scale.

It will be seen from the above that the difficulty of grading members is not as great as anticipated by Mr. Snaith, as a man's training will automatically classify him; the employers will refuse to keep a man in Class B who is not capable of handling the work; and on the other hand, the man would refuse to do work requiring qualifications of Class A for very long while engaged at the salary specified for Class B.

Mr. Proctor speaks of several engineers expecting to graduate this year who are willing to work for little more than their board and car-fare. I wish to say that if Mr. Proctor accepts the kind offer of these misguided mortals, he is certainly not working for the advancement of the profession. The thinking members of the profession cannot but condemn the practice of engaging graduates as tracers or rodmen on the excuse that they know very little about practical work and then "allowing" them to do detailing or instrument work in order that they may "learn." It is such actions as this on the part of the employing engineers that are forcing the juniors into the unions. It has been my experience that graduates are usually able to handle such work from the start without the preliminary "education" which their employers would have them believe is necessary.

The engineering schools are as much to blame for the present condition of affairs as any other agency, on account of their neglect to give these students any clear idea as to the real value of their services and as to the methods to be employed in placing them on the market to the best advantage. This knowledge is just as necessary to the young engineers as their mathematics, and they would not make such ridiculous offers as the one quoted above if they had received the proper instruction in the "engineering ethics" which Prof. Gillespie so ably defends.

If the entire graduating class of 1920 were sent out with the fixed idea that their services were worth a certain minimum, and instructed not to accept less, the employers would soon have to come to the limit set, and the union would have no ground in which to sow its seeds of discontent.

JOHN H. RYCKMAN,
Designing Engineer,
Department of Public Works,
City of Chicago.

Chicago, Ill., March 23rd, 1920.

"UNIVERSAL" METERING RECOMMENDED

CITY Engineer Doane of Halifax, N.S., has asked his works committee to obtain tenders for the supply of 4,000 water meters. Mr. Doane recommends that every unmetered service in the city be metered. He says it is the only way in which an expenditure of one to two million dollars for a new water supply can be prevented. The city now obtains its water through two mains from Long Lake. The capacity of these mains is 11,000,000 gals. daily, which is all that can be obtained from that source in a dry year. The only way in which the supply can be increased is by going to an entirely new source. Therefore Mr. Doane recommends "universal" metering.

SASKATCHEWAN LAND SURVEYORS

AT the annual meeting of the Saskatchewan Land Surveyors' Association, which was held recently in Regina, papers were read by two members on engineering work at the front. Col. Garner read a paper on light railways, and Lieut. D. A. Smith on mapping. A resolution was passed instructing the council of the association to communicate with the Manitoba and Alberta associations of surveyors, with a view to close co-operation and united action in the development of the natural resources of the prairie provinces. The officers elected for the ensuing year are: President, D. Alpine Smith, Regina; vice-president, J. Lonsdale Doupe, Winnipeg; secretary-treasurer, H. S. Phillips, Regina. Councillors—J. E. Underwood, Saskatoon; and S Young, Regina. Auditors—Begg & Murray, Regina.

The Oakoal Co., Toronto, has requested the Board of Control of that city to place a price upon the city's garbage under a 10-year contract. In reply, the board fixed the price at $1 a ton, and stipulated that the company should pay a minimum of $50 daily even if their requirements at any time should be less than 50 tons daily. The board is also asking for $2,000 deposit as security, and stipulates that the agreement must be considered purely as a contract for the sale of a commodity and not as a franchise.

GETS MARKED CHEQUES; NOW MISSING

ACCORDING to daily newspaper reports, a warrant has been issued for the arrest of A. Sande, consulting engineer and architect, of Hamilton, Ont. Mr. Sande is said to be missing, and Provincial Detective Williams has taken possession of his office.

Mr. Sande, who is said to be a native of Switzerland, was formerly on the staff of engineers who prepared the Hamilton harbor plans, but some months ago he opened an office as consulting engineer and called for tenders for the construction of a million-dollar plant for the Cascapedia Pulp & Paper Co., of Baie de Chaleur, Que. Tenders were submitted on a cost-plus basis and were accompanied, it is said, by marked cheques for $2,500. According to the newspaper report, Mr. Sande deposited some of these marked cheques and this action led to an investigation by the Hamilton Branch of the Association of Canadian Building and Construction Industries, and a warrant followed.

Mr. Sande's friends firmly believe that he will return and give a satisfactory explanation of his absence and of the deposit of the cheques. When he left Hamilton, Mr. Sande told friends that he was going to Quebec to open a branch office.

DESIGNS NEW SEPTIC TANK

DESIGNS have been completed by F. J. Whittaker, municipal engineer of South Vancouver, B.C., for a new septic tank, and have been forwarded for approval to Dr. H. E. Young, secretary of the British Columbia Board of Health. There are now about 4,000 septic tanks in South Vancouver, and considerable trouble has been caused by the absorption of sewage by the surrounding soil. A conference of local engineers was called about six months ago by the city commissioner, and these engineers made suggestions which have been adopted and worked out in detail by Mr. Whittaker, resulting in the designing of a new tank. If Dr. Young approves the design, householders will be encouraged to have their old tanks altered to meet the new design.

Secretary W. J. Baxter, of the Essex Border Utilities Commission, has resigned in order to accept a position as advertising manager of the Ford Motor Co. of Canada, Ltd.

Applications for the position of engineer of the Ottawa Suburban Roads Commission have been received by that commission. An announcement will be made in the near future regarding the appointment. The commission are now receiving applications for the position of superintendent.

Louis Garbi, who was well-known a few years ago among paving men in Montreal, recently returned to Quebec after a prospecting tour in the Abitibi region, and announced that he had discovered a rich vein of molybdenite. Mr. Garbi and his associate, Robert Clarke, of Buffalo, have secured permits to exploit a territory of 3,000 acres in La Corne Township, and claim that the ore they found is richer than any other similar ore previously discovered.

The Private Bills Committee of the British Columbia Legislature has recommended that the bill incorporating the "Association of Professional Engineers of British Columbia" be passed by the legislature, but that the bill should not become effective until April 1st, 1921. The object of this proviso is to enable interested persons to present any reasons which may be discovered as to why the bill should be amended in any particular before it becomes operative. The bill has already been amended considerably by the private bills committee. Coal and oil production, surveying, economic geology, factory construction, tunnelling and road construction have been removed from the scope of the Act. Residence within the province is not essential for membership and employees of public service corporations and governments are exempt from being licensed or registered or having to submit proofs of qualification.

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PRINCIPAL CONTENTS

KEEP THE CEMENT SACKS AT WORK

ONE empty sack at the cement mill is worth any number of sacks lying idle in dealers' or users' hands, so far as shipment of cement is concerned. Like many other kinds of cotton goods, cement sacks are scarce. If every idle cement sack in the country were returned to the plant from which it was shipped, there would be a considerable relief of the present shortage of sacks.

Besides, cement sacks cost the contractor money,—money which is not working for him as long as he keeps the sacks in his possession and thus makes it impossible for the manufacturer to buy them again.

If a cement plant ships 1,000,000 barrels of cement a year in sacks, 4,000,000 sacks are necessary to take care of these shipments. Under actual conditions, a cement plant at the end of a year finds itself short a very large number of sacks because dealers and users have not returned all that they received. Every year it is necessary to supplement the stock of sacks by purchasing many new ones.

Many building and highway contractors have shown commendable enterprise during the past winter in purchasing and storing large quantities of cement in anticipation of immediate need when the construction season opens. Naturally, this has temporarily prevented the circulation of many cloth sacks, but there are so many empty sacks in users' and dealers' possession that if they were returned to the cement mills the number held out of circulation through storage of cement would be relatively insignificant.

Cement sacks represent an outlay of money until they have been returned for credit. Moreover, if they are not returned promptly, the cement manufacturer must find new containers before he can make deliveries, and this causes an unnecessary waste, because far more containers must be manufactured and used than would actually be necessary if every cement sack were kept at work.

ST. LAWRENCE MUST BE DEVELOPED

AT a recent banquet of the Kingston Board of Trade, H. G. Acres, chief hydraulic engineer of the Hydro-Electric Power Commission of Ontario, said that the development of navigation on the St. Lawrence River between Kingston and Montreal would mean but little for Canada unless power be developed at the same time. Every horsepower, he declared, that is possible to obtain from the St. Lawrence River, must be developed. He predicted that before long there will be a plant at Morrisburg developing 500,000 h.p., and a similar one at the Long Sault Rapids.

A. C. Lewis, secretary-treasurer of the Canadian Deep Waterways and Power Association, made a strong plea for canalization of the St. Lawrence River. He declared that the construction of the new Welland Ship Canal will be futile if the St. Lawrence canal system be not enlarged to permit the passage of ocean-going vessels.

D. B. Hanna, president of the Canadian National Railways, who dealt with some phases of the railway problem, denied the report that the government railway system is to be electrified. Only two small branch lines, he said, are to be electrified at present.

TO RAISE DUTY ON IMPORTED PLANS

MEMBERS of the council of the Royal Architectural Institute of Canada conferred with the Customs Board at Ottawa recently, and requested a revision of the basis of appraisal of imported architectural and engineering plans. The matter will be discussed further with Sir Henry Drayton, Minister of Finance, with a view of obtaining a more correct classification of plans in the tariff schedule.

OTTAWA OFFICE FOR ASSOCIATION C. B. & C. I.

IT has been decided by the executive of the Association of Canadian Building and Construction Industries that the head office of the association should be located at Ottawa. J. Clarke Riley, general secretary of the association, will open an office at an early date at 139½ Sparks St., Ottawa, in the quarters which are now being occupied by the Ottawa branch of the association.

PERSONALS

T. A. SPRATT has been appointed temporary superintendent in charge of all of the roads taken over by the Ottawa Suburban Roads Commission.

A. M. WEST, city engineer of North Vancouver, B.C., has resigned in order to enter business on his own account. Mr. West's resignation will take effect April 15th.

BERTRAM DOWLER has been appointed road superintendent of Gloucester County, Ont. Mr. Dowler recently had the contract for the construction of the new Billings bridge.

DAVID HANNA, chief of surveys and draughting in the roadways department, city of Toronto, has resigned in order to accept a position as superintendent of water works at Windsor, Ont.

J. A. HOUSE has been appointed manager of the Guelph Radial Railway. This railway will be taken over by the Hydro-Electric Power Commission July 1st. Mr. House was appointed upon the recommendation of the commission.

M. J. BUTLER, formerly president of the Engineering Institute of Canada, who recently retired as managing-director of Armstrong-Whitworth Co., Ltd., has been appointed a member of the housing commission at Oakville, Ont.

J. J. TRAILL, assistant professor of hydraulics at the University of Toronto, has resigned in order to accept a position on the hydraulic engineering staff of the Hydro-Electric Power Commission of Ontario. Prof. Traill has been associated with the University of Toronto for 14 years.

L. K. JONES, assistant deputy minister and secretary of the Department of Railways and Canals, will retire at the end of this month on account of ill-health. Mr. Jones has been connected with the department for more than 30 years.

LESTER W. GILL, who was recently appointed Director of Technical Education for the Dominion Department of Labor, was born in 1871 in Prince Edward Island. After an elementary education in the public schools, he left home and spent three years in commercial work in the United States. In 1892 he entered the mechanical engineering course at McGill University, and graduated with honors in 1896. After a year of post-graduate work in electrical engineering, including research in magnetism, he was awarded a two-year scholarship and spent one year in research at McGill University, and the other year at Harvard in physics and mathematics. After this distinguished student career, Mr. Gill joined the staff of the Westinghouse Electric and Manufacturing Co. In 1900 he was appointed professor of general engineering at the School of Mines, Kingston. When this school developed into the Faculty of Applied Science of Queen's University, Prof. Gill limited his work to mechanical engineering, and later to electrical engineering. He designed and superintended the installation of the central heating plant at Queen's University. In January, 1915, he volunteered for overseas service, and recruited from the students and graduates of Queen's University a battery of field artillery. In February, 1916, he went overseas as major in command of that battery, which he had organized in less than three months, and which later became known as the 46th Battery. After five months' training in England, Maj. Gill and his battery were sent to France. At Vimy Ridge he was gassed, and after eight weeks in the hospital he was assigned to special technical work with the Ministry of Munitions, where he spent nine months. In September, 1918, he asked to be returned to combatant service. His application was granted, and he was under orders to return to the front when the armistice was signed. Application was then made by the Khaki University for his transfer to its staff. In December, 1918, he was made responsible for the administration of all the work of the Khaki University in England. When that university was disbanded in August, 1919, Maj. Gill returned to Canada and his former position at Queen's University. He has represented Canada upon two occasions at meetings of the International Electro-Technical Commission, and is a member of the Canadian Engineering Standards Association.

JOHN H. RYCKMAN, formerly of the bridge engineering staff of the Toronto Works Department, is now designing engineer for the Department of Public Works, Chicago, Ill. Mr. Ryckman graduated from the School of Practical Science, University of Toronto, with the class of 1906.

ERNEST DRINKWATER has been appointed city engineer of St. Lambert, Que. Mr. Drinkwater has resided in that city for the past eight years, but has had an office as consulting engineer in Montreal. He was born in Manchester, Eng. One of his first positions in Canada was as superintendent in charge of a large paving and sewerage contract in St. Lambert.

DOUGLAS MCCONNELL, a Quebec land surveyor and civil engineer, was presented with a gold-headed cane by his fellow-surveyors of the Montreal district at a meeting held recently at the Cadastre office, Montreal, upon the occasion of Mr. McConnell's golden jubilee as a land surveyor. Hon. J. P. R. Casgrain, president of the Corporation of Quebec Land Surveyors, presided and read an address referring to the valuable services rendered by Mr. McConnell in the development of Canadian resources.

OBITUARIES

F. S. MACDONALD, manager of the Pacific Great Eastern Railway, died last Thursday at his home in North Vancouver, B.C.

W. C. CONNOR, contractor, of Toronto, died at his residence in that city last Sunday, aged 77. Mr. Connor was born in Stouffville, Ont. He took an active interest in his business until five months ago, when he became seriously ill.

MALCOLM MCMILLAN, president of McMillan Bros., Ltd., railway contractors, Winnipeg, died last Sunday at the Winnipeg General Hospital after a long illness. Mr. McMillan was born in 1861 in Bruce county, Ont., and had been a resident of Winnipeg for the last 40 years.

ALEXANDER GARVOCK, contractor, of Ottawa, died suddenly last Sunday at his home in Ottawa at the age of 78. Death was due to heart failure. Mr. Garvock was a familiar figure in contracting circles in Ottawa for a half century. He did not give up active work until a year ago, when his son, Alex. J., assumed charge of the firm's work. The late Mr. Garvock was born in Scotland and learned his trade as a stone mason. He started contracting upon his own account in 1884, and built a large number of schools, churches and office buildings in Ottawa.

HARRY THORNTON RUHL, formerly an engineer on the Canadian Pacific Railway and the Canadian Government Railways, died of pneumonia last month at Albany, N.Y. Mr. Ruhl was an American by birth, but he spent a large part of his life in Canada, chiefly with the Canadian Government Railways as divisional engineer at Moncton. He was associated with F. P. Gutelius for many years, first on the Canadian Pacific, then with the Government Railways, and later as engineer of maintenance-of-way of the Delaware and Hudson, with headquarters at Albany, which position he held up to the time of death.

HARRY OSBORNE, who until a year ago was works manager of the C.P.R. Angus Shops, died last Thursday at his residence in Montreal after a brief illness. Mr. Osborne was born 61 years ago in England. He came to Canada about 40 years ago. After a few years with the G.T.R., he joined the mechanical staff of the C.P.R., and was gradually promoted until he became manager of the Angus Shops at the time of their construction. Mr. Osborne was largely consulted in the design and equipment of the Angus Shops. When he retired from service about a year ago, the 7,000 employees at those shops turned out en masse and presented him with an illuminated address and a purse of gold.

DANIEL BERNARD MCCARTHY, eastern sales manager of the Neptune Meter Co., New York, died March 6th at his residence in New York City, after an illness of less than a week. Death was the result of bronchial pneumonia. Mr. McCarthy was born in Wevertown, N.Y., January 1st, 1871, and was educated in the public schools and Troy Business College. After several years with a contracting firm, he became superintendent of the Waterford (N.Y.) Water Co., continuing in that capacity for nearly 21 years, until the town purchased the company. During his management of the Waterford water works, he became associated with the Neptune Meter Co., and represented that firm as a travelling representative for 17 years, covering Canada and many of the eastern states. In May, 1914, he was appointed eastern sales manager. Mr. McCarthy was well known among water works engineers and superintendents throughout Canada. He is survived by his widow and one son, George H., who is a senior at Cornell University.