PAGES

MISSING

The Canadian Engineer

A weekly paper for civil engineers and contractors

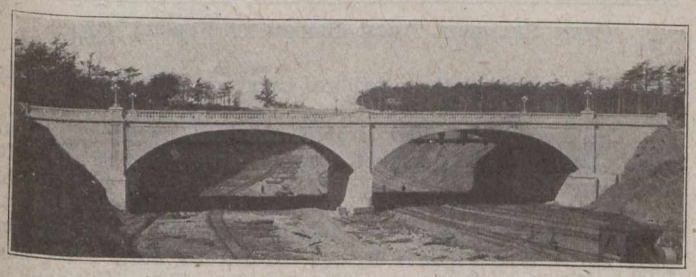
Canadian Reinforced Concrete Arch Bridges

Historical Review and Lists of Open Spandrel and Earth-Filled Arches With Clear Span of Over 100 Ft. or Total Bridge Length of Over 200 Ft. — Brief Review of Concrete Truss Bridges

By FRANK BARBER
Consulting Engineer, Toronto

IT was estimated by Edwin Thatcher that in 1904 there were only about one hundred concrete bridges in America. Now, after fifteen years, there are probably as many within a few miles of Toronto. Neither steel nor any other material ever revolutionized bridge building in such a short period.

In 1918 concrete bridges first exceeded steel bridges in the gross amount spent in any period. The "Engineering



YOUNG AVE. BRIDGE, HALIFAX, N.S.
(Earth-Filled Arch Bridge)

News Record" estimate of cost of bridge building in the first nine months in 1918 in the United States was as follows: Concrete bridges, $5,900,000; steel bridges, $4,800,000.

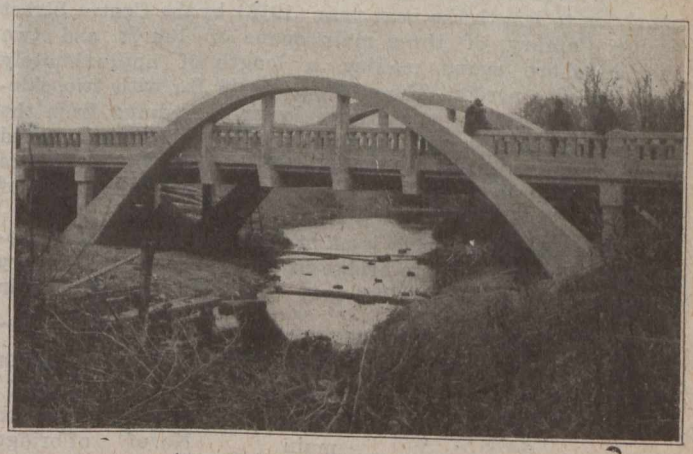
After a period of comparative inaction in bridge building, due to the war, and before what will probably be a period of considerable activity, it seems a fitting time to review concrete bridge building in Canada. After extensive correspondence with bridge engineers throughout Canada, the lists on pages 290 and 291 have been compiled.

The open spandrel arches are the most important, as this is the type adopted for nearly all the longer arches on

CONCRETE TRUSS BRIDGE AT WILLOW CREEK, MAN.

account of the great weight of the filling in earth-filled arches of long span. The seven given in the list in the order of the span length are also, except for the last, in reverse chronological order.

The first long-span Canadian arch was earth-filled and was built at Massey, Ont., span 92 ft., in 1906 by W. A. McLean, Deputy Minister of Public Highways, Ontario, but then chief engineer of the department. Besides being a pioneer in this field, it may be noted incidentally that Mr. McLean probably deserves chief credit for introducing concrete sidewalks in the towns of Ontario. This is not so well known as his later connection with Ontario's highways. The Massey bridge was exceeded in span two years later, in 1908, when Jas. Bell built the Lynhurst bridge, St. Thomas, of clear span 116 ft., costing about $11,000. In 1910 the palm for long-span arches passed to the first long Canadian open spandrel arch, the Wadsworth bridge at Weston, Ont., span 118 ft. 6 ins., built in 1910 by Barber & Young, at a cost of about $15,000, and the record spans have since been of this type. Mr. Bell's bridge,



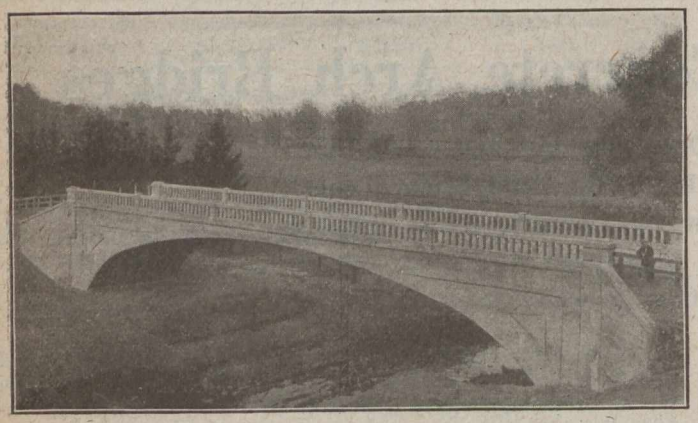
ARDEN ARCH NO. 3, MANITOBA
(Open Spandrel Arch with Floor Suspended Midway Between Springings and Crown)

however, remained the longest earth-filled arch in Canada until a few months ago, when the Tower Road bridge, Halifax, was completed, of span 144 ft., by W. A. Duff, bridge engineer to the Canadian National Railways. This is a flat arch, requiring no great depth of earth fill; otherwise hollow spandrels would have been more economical. Even so, this arch is probably close to the economical limit for filled arches and may not be soon exceeded by this type.

Reverting to record spans, the Wadsworth bridge was exceeded by two bridges built in 1913. One of these was at Port Arthur, a single span bridge of 130 ft. span in the clear by L. M. Jones. In the same year was completed the King George arch at Oakville for the County of Halton. The county engineer was Jas. Hutcheon, and the bridge was designed and erected by the writer as consulting engineer. Besides the main arch of span 135 ft., there are eight concrete beam spans, making a length of bridge proper

476 ft. The roadway is narrow for a bridge of this length, 16 ft., and it is without sidewalks. The cost was about $60,000.

Two years later (1915) the palm passed to the great University bridge, Saskatoon. This has three spans of 150 ft. and seven shorter spans, making a total length of con-

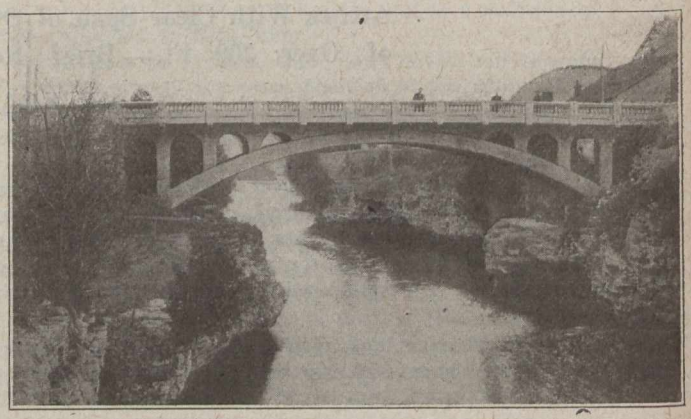


LYNHURST BRIDGE, ST. THOMAS, ONT.
(Earth-Filled Arch)

crete of 1,250 ft. The roadway is of generous dimensions, 45 ft. between curbs, with two sidewalks of 8½ ft. It was designed by the Provincial Board of Highway Commissioners for Saskatchewan; A. P. Linton, bridge engineer. Daniel B. Luten, as consulting engineer, checked the calculations and acted in an advisory capacity. The contract price was about $400,000, but the total cost, including land damages, was $520,000. C. J. Yorath was city commissioner for Saskatoon.

The Saskatoon bridge was duplicated as to spans and nearly as to length the next year (1916) by the Centre Street bridge, Calgary, of three main spans of 150 ft. and two shorter shore spans, making a length of approximately 1,000 ft. of concrete. The roadway is 42 ft., with two sidewalks. There is also a narrower lower deck, hung from the arch ribs by structural steel shapes. The bridge was designed by Geo. W. Craig, city engineer, and John F. Greene, bridge engineer, and was built by them by day labor at a cost of $366,000.

The Saskatoon bridge is at present the longest, and probably the finest, concrete bridge in Canada, with the Calgary bridge a close second. But they will soon be exceeded in length and span by the Hunter Street bridge, Peterboro', upon which it is expected that work will commence shortly. This will have a main span of 235 ft., with ten shorter spans, making a length from end to end of concrete of 1,365 ft. The roadway is 42 ft., with two sidewalks of 6 ft. R. H. Parsons is city engineer, and Harry Phelan chairman of the committee. (It is interesting to note that Mr. Phelan was also chairman of the Board of Works in 1910 when the Smith Street bridge—in the third list, page 291—was built, —one of the most important Canadian concrete bridges at that time). The Hunter Street bridge was designed by Frank Barber, consulting engineer, in collaboration with Claude Bragdon, architect. The estimated cost is $300,000.



OPEN SPANDREL ARCH BRIDGE AT FERGUS, ONT.

The last-mentioned three bridges carry or will carry double lines of electric cars.

The Lemieux Island Bridge, the last on the list on this page, is an aqueduct and roadway combined. It has spandrel curtain walls, and thus looks like a filled arch.

Besides the seven open spandrel arches all over 100 ft. in main span, two more are mentioned in the third list, on page 291. The Victoria Bridge, Brantford, built 1910, was one of the first of this type in Canada. The arch span is only 60 ft., but four beam spans bring the length to 246 ft., then the fourth longest. It has a wide roadway with sidewalks and carries electric cars. T. Harry Jones, the engineer, has designed several other very pleasing short span arches.

The other open spandrel arch in the third list, on page 291, is the handsome Crawford Street Bridge, in three spans, built by the city of Toronto. The arches are not,

OPEN SPANDREL ARCH BRIDGES WITH CLEAR SPAN OVER 100 FEET

Name.	Year.	Clear span of main arch.	No. of spans.	Total length of bridge proper.	Roadway between curbs.	Sidewalks.	Cost.	Engineer.
Hunter Street, Peterboro	(in course)	235′	1 main 10 approach	1,365′	42′	2 of 6′	$300,000 (estimated)	Frank Barber, Engineer, Claude Bragdon, Architect, R. H. Parsons, City Engineer.
Centre St. Bridge, Calgary	1916	150′	3 main 2 approach	approx. 1,000′	42′	2 of .′	366,000	Geo. W. Craig, City Engineer, Jno. F. Green, Bridge Engineer.
University Bridge, Saskatoon	1915	150′	3 main 7 shorter	1,250′	45′	2 of 8½′	520,000	A. P. Linton.
King George Arch, Oakville	1913	135′	1 main 8 approach	476′	16′	none	60,000	Jas. Hutcheon, County Engineer, Frank Barber, Consulting Engineer.
Port Arthur Bridge	1913	130′	1 span	about 180′	16′	2 of 5′	.....	L. M. Jones.
Wadsworth Arch, Weston	1910	118½′	1 span	178′	16′	none	15,000	Barber & Young.
Lemieux Island Bridge, Ottawa (aqueduct and highway)	1916	106′	4 equal spans	765′	20′	.....	59,500	John B. McRae.

EARTH FILLED ARCH BRIDGES WITH CLEAR SPAN OVER 100 FEET

Name.	Year.	Clear span of main arch.	No. of spans.	Total length of bridge proper.	Roadway between curbs.	Sidewalks.	Cost.	Engineer.
Tower Road Bridge, Halifax	1917	114′	1	about 200′	30′	2 of 6′	.....	W. A. Duff, Bridge Engineer to Canadian National Railways.
Lynhurst Bridge, St. Thomas	1908	116′	1	about 150′	16′	1 of 4′	$11,000	Jas. Bell.
Chicoutimi River Bridge, Chicoutimi County, Quebec	1916	113′	3	....	..	.....	.....	Gagne & Jennings.

CONCRETE ARCH BRIDGES WITH SPAN LESS THAN 100 FEET BUT OF TOTAL BRIDGE LENGTH OF OVER 200 FEET (EARTH FILLED EXCEPT AS NOTED)

Name.	Year.	Total length.	No. of spans.	Roadway between curbs.	Sidewalks.	Cost.	Engineer.
Ontario Street Bridge, St. Catharines	1912	750′	13 of 50′	26′	1 of 6′	$141,000	W. P. Near, City Engineer, Sprague & Reppert, Consulting Engineers.
Bank Street Bridge, Ottawa	1913	626′	7 of 76′	40′	2 of 8′	130,000	N. J. Kerr, City Engineer.
Hurdman's Bridge, Ottawa	....	about 500′	7 spans	..	.....	.....	J. B. McRae, Consulting Engineer.
Smith Street Bridge, Peterboro	1910	385′	3 of 94′	26′	1 of 5′	35,000	T. S. Hay, City Engineer, W. J. Francis, Consulting Engineer.
Crawford Street Bridge, Toronto (open spandrel)	1914	292′	1 of 81′ 4″ 2 smaller	21′	2 of 6′	45,000	C. W. Power, Chief of Dept. of Bridges, J. S. Burgoyne, Chief Asst. on Design, L. N. Edwards, Chief Asst. on Construction.
Edinvale Bridge, Simcoe County	1907	286′	4 of 60′ 1 of 86′	16′	.....	.....	Connor, Clarke & Monds.
Mission Bridge, Calgary	1915	284′ 6″	1 of 76′ 2 of 34′ 1 of 82′	40′	1 of 6′	.....	Geo. W. Craig.
Old Mill Bridge, over Humber River, York County	1916	282′	2 of 62′	25′	none	45,000	Frank Barber, Engineer, Alfred Chapman, Architect.
Chaude River, St. Bazile, Que.	1917	about 280′	3 of 79′	..	.....	.....	L. A. Vallee, Chief Engineer, Dept. of Highways, Quebec.
Montreal Aqueduct	1917	251′	3 of 57′	36′	.....	.....	Mouchel & Partners and Dominion Bridge Co.
Young Avenue Bridge, Halifax	1917	about 250′	2 of 96′	48′	2 of 16′	.....	W. A. Duff.
Victoria Bridge, Brantford (open spandrel)	1910	246′	1 of 60′ 4 shorter	38′	2 of 11′	50,000	T. Harry Jones.

strictly speaking, reinforced concrete, as they have structural steel enough in them to carry the imposed loads.

Dear, old, conservative Toronto does not believe much in reinforced concrete for arches. They are going to be safe and sane about it,—very. How do they know that this new-fangled material, said to last a hundred years and then some, will really do so? They propose to wait and see, and then they will know all about it,—in a hundred years.

Besides the nine bridges mentioned above, there are nine other open spandrel spans ranging from 80 ft. to about 40 ft. as follows:—

The Fergus bridge, Wellington County, by Bowman & Connor, 80 ft. span; the Kleinburg arch, 65 ft. span, for York County Highway Commission, E. A. James, engineer to commission, Frank Barber, consulting engineer; and six by the Manitoba Highway Commission, all under 60 ft. in span, Arden Arches Nos. 2, 3 and 4, and McKinnon's, Woodworth and Edward Creek arches. Three of these have the floor suspended about midway between crown and springings. The approaches of the First Street Bridge, Brandon, three spans of 40 ft., centre to centre, are also of this type. R. E. Speakman was city engineer.

It is believed that this completes the list of open spandrel arches of Canada, except for a three span foot, bridge in Guelph.

The third list, on this page, gives 12 concrete bridges, consisting of a number of small spans but of total length of bridge proper over 200 ft. The data given on the list is perhaps sufficiently descriptive of these bridges.

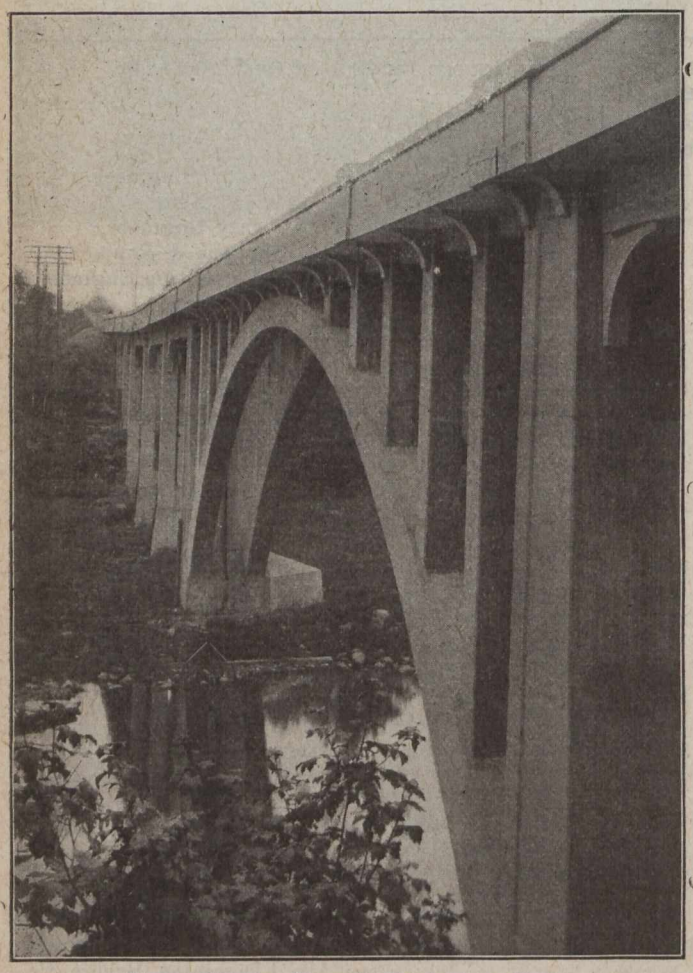
The two Ottawa bridges on this list, and one on the first list, Hurdman's and Lemieux Island, by J. B. McRae, and the Bank Street Bridge, are of fine appearance, especially the two latter, and are amongst the longest in Canada.

The lately completed lift bridge over the canal at Ottawa, though having a steel lift span, may also be mentioned as being the handsomest lift bridge known to the writer. A. F. Macallum is commissioner of works. The finish of all the late concrete bridges in Ottawa is washed granite.

These bridges place Ottawa at the forefront of Canadian cities as to concrete bridges.

Besides the longer arches given in the lists, the information to hand as to earth-filled arch bridges under 200 ft. in length and of spans between 60 and 100 ft., inclusive, is believed to be sufficiently full and accurate to attempt a résumé.

There are nine in Nova Scotia, all in Halifax, seven of spans 60 ft. and two of spans 66 ft., all single spans, all but one having two sidewalks, and with roadways varying from 15 to 33 ft. These are in addition to the two longer bridges, Young Avenue and Tower Road, given in the lists. They were



KING GEORGE BRIDGE, OAKVILLE, ONT.
(Open Spandrel Arch Viaduct)

all built for the Halifax Ocean Terminals Railway by W. A. Duff, assistant chief engineer. They are very handsome bridges. They all have ornamental railings and the exposed surfaces have received tool treatment.

It is believed that New Brunswick has at present no concrete bridges of spans over 60 ft.

In Quebec, besides the Chicoutimi bridge, span 113 ft., the third longest earth-filled arch, and the St. Bazile bridge, by L. A. Vallee, both given in the lists, Magwood & Walker built the Coaticook arch, span 100 ft., in 1910, which for five or six years was the longest concrete span east of Montreal. After these, the longest spans in Quebec province are two bridges by Gauvin & Lassard, each of span 80 ft., one at Notre Dame du Rosaire, 1916, and one at St. Phelamon, 1918, each costing about $12,000. Next to these two is a bridge on the international boundary over Missisquoi River, of two equal spans of 67 ft., by the Vermont State engineer, and one at Ste. Marie du Monnoir of two equal spans of 60 ft. by F. E. Came.

In Ontario, in addition to the longer bridges given in the lists, there are at least sixteen arches of spans from 60 to 100 ft., inclusive:—

Three by Jas. Bell in Elgin County, Queen's (two spans of 80 ft.), Brewery (two spans of 75 ft.), and Orwell, 75 ft., all built in 1908.

Three by Lucius E. Allen in Hastings County, built in 1913, Bridgewater and Bancroft, each 100 ft., and Spry's, 80 ft.

Three by Bowman & Connor, Eramosa Township, 60 ft., Maryboro Township, 80 ft., and Peel Township, 60 ft.

Three by Frank Barber, Russel, York Township, 60 ft., Newmarket, 60 ft., and Kirkham, Scarboro Township, 70 ft.

One for the Niagara, St. Catharines and Toronto (electric) railway, of main span 80 ft., with five small shore spans, one of the largest when it was built in 1908.

One by C. E. Ure, at Embro, 75 ft.

One by Chas. Talbot, St. John's, Neiddleses Co., 75 ft.

The historic Massey bridge of 92 ft. span was mentioned above. Although of smaller dimensions than those adopted for bridges here recorded, the Guelph Prison bridge by W. A. McLean is worthy of mention on account of its architectural beauty. It has a main span of 50 ft. and two shorter side spans and length of 160 ft.

In Manitoba there is an earth-filled arch of 60 ft. at Arden. Except for a concrete truss of 86½ ft., mentioned later, we have information of no other arches of over 60 ft. in Manitoba. There are sixteen arches over 30 ft., five of them earth-filled, six open spandrel, mentioned above, and five concrete trusses. These are all by the Manitoba Good Roads Board, and have roadways of 18 ft. between curbs. Two of the concrete trusses are especially worth mentioning: The Riverview bridge, span 86½ ft., which is amongst the longest concrete trusses in Canada, and the Rat Creek bridge, No 4, in three spans of 50 ft. and length 124 ft., the only Canadian concrete truss bridge of more than one span. Great care has been taken of the railings, finish and all other details in these Manitoba bridges, and they will compare favorably in appearance with bridges in any part of Canada. The writer is indebted for information as to these bridges to P. Burke Gaffney, bridge engineer to the Board.

Besides the Centre Street and Mission bridges in Calgary and the Saskatoon bridge, we have information of no concrete bridges west of Manitoba of spans greater than 60 ft., and there are said to be none, but information as to British Columbia is meagre.

An historical survey of concrete arches would be quite incomplete without a short review of concrete truss bridges. These are generally arches with the skewbacks tied together by lower chords, and generally with the floor suspended from the arched chords on a level with the lower chords. The first was built by Considère in France in 1904. The first in America was the approach to the Sparkman Street bridge, Nashville, Tenn. The first in Canada and second in America was the Middle Road bridge, between the counties of York and Peel, span 79 ft., designed by Barber & Young and built in 1909 by O. L. Hicks, contractor, one of the pioneers in concrete building in Ontario. In 1911 Prof. C. R. Young left the firm of Barber & Young to become lecturer in structural engineering in the University of Toronto. In that year the writer built two other trusses, Freeman's bridge, York County, span 91 ft., and until 1919 the longest Canadian truss, and Haliburton, span 55 ft., and by 1913 had built nine of this type: Three others in York County,—Highland Creek, Birrels on Yonge Street north of Toronto, and Eckhardt near Unionville; one near Collingwood; and Simpson's and Sproull's in Amaranth Township near Orangeville. Up to this time the concrete truss had not appealed to other engineers, but in 1913, Bowman & Connor built one at Eden Mills, of span 50 ft. In 1914, the writer built eight others mostly in York County and Bowman & Connor built four others in Wellington County. After 1914, concrete trusses became more generally distributed, and at present there are 56 of this type in Canada, 25 of them of 60 ft. span, or over, including four on the Toronto & Hamilton Highway, of spans from 100 to 120 ft., now being completed. These were designed by Mouchel & Partners for H. S. Van Scoyoc, chief engineer of the commission, and Geo. H. Gooderham, chairman of the commission. The five built by the Good Roads Board, Manitoba, have already been mentioned.

Concrete arches of all types and of spans over 60 ft., or total length of bridge over 200 ft., are distributed as follows: Nova Scotia 11, Quebec 7, Manitoba 2, Alberta 2, and Saskatchewan 1, making 23 outside Ontario, which has 57, making 80 in Canada. It is remarkable that approximately one-third of these are concrete trusses.

Concrete beam and slab bridges are not here being considered, but it may be said that although there are a great many of quite short span there are few of spans over 50 ft. and not more than a half dozen of considerable length, the two C.P.R. viaducts at North Toronto, of length 380 ft. and spans of 35 and 37 ft., being the longest.

It may be of interest to place the longest Canadian concrete viaducts and the greatest Canadian arches in their places in the list of the world's bridges. From lists compiled by the writer, there are 32 concrete arch bridges and viaducts longer than the Saskatoon bridge and 29 longer than the Peterboro bridge will be. There are 13 arches greater than the main span (235 ft.) of the Peterboro bridge, six of these in America.

If information later comes to hand of any arch bridges of spans of 60 ft. or greater which have not been mentioned, the omissions will be made good by a letter to *The Canadian Engineer*.

ONTARIO GOOD ROADS ASSOCIATION

IN the York County Building, Toronto, March 5th, 6th and 7th, was held the 17th annual meeting of the Ontario Good Roads Association, attended by 150 delegates from all parts of Ontario. C. R. Wheelock, of Orangeville, presided.

Addresses were delivered by Hon. F. G. Macdiarmid, C. R. Wheelock, Geo. S. Henry and A. W. Campbell. Papers were read by J. G. Wilson and F. A. Senecal.

A number of resolutions were passed and the following officers elected:—

Hon. presidents, J. A. Sanderson, S. L. Squire and C. R. Wheelock; president, K. W. MacKay, St. Thomas; 1st vice, J. J. Parsons, Jarvis; 2nd vice, W. H. Pugsley, Richmond Hill; 3rd vice, Capt. L. E. Allen, Belleville; secretary-treasurer, Hon. G. S. Henry, M.L.A.; assistant secretary-treasurer, Major T. L. Kennedy, Dixie.

Directors appointed were F. A. Senecal, T. J. Mahoney, W. H. Brown, C. Edgar, John Currie and H. Jamieson.

In the next week's issue of *The Canadian Engineer*, Mr. Wilson's paper on "Stone and Gravel Roads," and Mr. Senecal's paper on "Road Maintenance" will be published; also summaries of the resolutions passed, the addresses by Messrs. Campbell and Wheelock, and the executive committee's report.

The city council of London, Ont., have recommended the acceptance, subject to the consent of the city engineer, of the Imperial Oil Co.'s tender for the year's supply of asphalt. The firm's tender was $25 per net ton in packages, f.o.b. London, and $19.65 in tank cars.

The principal heavy structural tree species of Canada, named in order of merit and resources, are: Douglas fir, western hemlock, eastern hemlock, western yellow pine, western larch, red pine and eastern larch. The average weight per cubic foot of dry Canadian structural woods is from about 25 to 30 pounds. The heavier the wood the stronger and stiffer it is, according to a bulletin issued by the Forestry Branch, Department of the Interior.

The old-established contracting and supply firm of Schultz Brothers Co., Ltd., Brantford, has been reorganized in the anticipation of increased business during the reconstruction period. The officers now are: Geo. C. Schultz, president; Wm. D. Schultz, vice-president and managing director; Arthur E. Foulds, secretary-treasurer; Wm. C. Schultz, order department and factory production; J. Albert Taylor, estimating and structural engineer; Hugh W. Turner, general construction superintendent; J. I. Crowe, local construction superintendent; and T. W. Cleator, sectional building department.

The Engineer's Library

SEWAGE DISPOSAL

REVIEWED BY R. O. WYNNE-ROBERTS
Consulting Engineer, Toronto

By the late Leonard P. Kinnicutt; C. E. A. Winslow, and R. Winthrop Pratt, consulting engineers. Published by John Wiley & Sons, Inc., New York, and Chapman & Hall, Ltd., London. Renouf Publishing Co., Montreal, Canadian sales agents. 547 pages, 6 by 9 ins., 141 figures, cloth. Price, $4 net.

This volume contains 17 chapters dealing with the many complex problems of sewage disposal. The authors have laid emphasis upon broad general principles and have freely used detailed descriptions of the engineering details of typical plants, and extensive analytical tables, both chemical and bacteriological, as illustrative material.

The disposal of sewage by every practicable process is described in clear, terse and ample terms. The authors are well-known specialists in sanitary engineering and whilst the fund of material available for their purpose is voluminous, they have presented the information in a very acceptable manner. This is, the volume is not over-loaded with data; the reader is given the essential particulars such as are ordinarily required by a busy engineer.

The disposal of sewage by dilution is a very tempting one in many localities in Canada. The permissible dilution will naturally vary with the degree of oxygen exhaustion accepted as a safe standard. Some authorities limit this at 70 per cent. saturation, others at 30 per cent., whilst the authors consider 50 per cent. saturation as reasonable. Theoretically, while any dissolved oxygen remains in a stream there should not be putrefaction, but, practically, any value below 50 per cent. of saturation may be taken as a danger signal indicating that malodorous conditions are likely to occur.

Coarse screening is, of course, essential in most sewage works, but the adoption of fine screens is somewhat problematic, since matter can be renewed in settling tanks at a less cost. The experience had in the United States in connection with the use of septic tanks is interesting. The liquefaction of septic sludge may be expected to be about 20 per cent. of the sludge obtained from plain sedimentation. The litigation over the patent rights of septic tanks has been long and costly and continues at the present time, despite the fact that septic tanks have been somewhat superseded.

The use of Imhoff or Emscher two-story tanks has not been uniformly successful owing to a variety of reasons mentioned in this book. Why these tanks work well in one place and badly in another is not clear, but deficient capacity and lack of skilled operation are usually factors in the problem. Intermittent filtration, contact beds, trickling filters, activated sludge process and the disposal of sludge are all carefully discussed.

With regard to the activated sludge process the authors state that the experience of the past few years has made it clear that this process fills an important place in the art of sewage treatment. On the other hand, they state that it is by no means a panacea and whether it should be preferred to treatment on trickling beds will probably depend upon various combinations of local conditions.

Sixteen pages of references to articles dealing with sewage treatment will be found very useful. This volume is recommended to all engineers who are interested in the subject as a valuable addition to their library of books dealing with various phases of sanitary engineering.

The Brant Township Council, Ontario, has accepted the tender of J. A. McKinnon, of Paisley, Ont., at $1,718 for buttressing the concrete abutment of Trainor's bridge.

Letters to the Editor

MIX FOR PAVEMENT FOUNDATIONS

Sir,—In my paper on "Road Foundations, Drainage and Culverts," on page 284 of your issue of March 6th, 1919, the proportions in the mix of concrete used as a foundation for city pavements should have read "1 part cement, 3 parts sand and 6 parts broken stone" as this is the usual mix used, and I would be obliged if you would note this correction.

GEO. HOGARTH,
Chief Engineer, Department of Public Highways, Ontario.

Toronto, Ont., March 11th, 1919.

STOP, LOOK AND LISTEN!

Sir,—The following branch of engineering was not mentioned in your list of February 27th:—

Who is the modern Atlas who is hiking down the track,
With a cable post foundation and stick relays on his back?
Block signaling and interlocking tracks, both far and near,
The concrete-mixing, bond-wire-fixing, Signal Engineer.

Yours truly
SIGNAL DRAUGHTSMAN.

Montreal, P.Q., March 7th, 1919.

RESPONSIBILITY AND RECOGNITION OF ASSISTANTS

Sir,—In a letter published in *The Canadian Engineer* for January 30th, 1919, the writer spoke of the relationship and ethics between a chief engineer and his assistants. Another connected subject is responsibility and how it should be distributed.

It has been said that both parties should aim at companionship. That is essential. However, it is impossible if one has to endorse all the actions of a subordinate; or if the latter does not receive the proper appreciation from his chief regarding such duties as may be delegated to him. Good organization comes from a happy combination of leaders and followers. Under good management, recognition of services is the basis of success. It is the goad which stimulates personal energy and directs it toward the summit of efficiency.

To be responsible is to have such qualities and means as will guarantee the fulfilment of conditions exacted under contract. Morally, this depends on the practice of the duties of life to which one is pledged; financially, it is having the monetary standing to vouch for the proper execution of undertakings. In the former case, that is what prevails generally and to which are bound probity and qualifications. That is the character embodied in subordinates and men ordered to apply their own ability in a certain field of action so as to get the best results. In the latter, it is the position of a man who commands, whose influence added to his financial power creates a certain degree of independence.

"Knowledge is Power" (Francis Bacon). This sentence may be applied in engineering. Qualifications are recognized as the guarantee of the proper execution of a work. Engineering science represents this power by itself. Engineers, for the greatest percentage, are dependent on it as salaried men. They are chiefs or assistants, both being morally responsible to their patrons. They must be ready to accept their own share of responsibility as professionals.

There exists some misunderstanding on this point. Many think that all must fall upon the chief's shoulders. He is a man directed to approach the council; the hyphen between the executive and the technical staff; he who distributes charges amongst subordinates (who are themselves responsible as engineers), so that the principals derive the greatest benefits possible.

"The master minds are those who through their knowledge of fundamental principles are able to organize and direct the efforts of others." (Jenkins). Engineers must be master minds. So they ought to use their judgment to interpret the value of their confreres and to dispose of same in the right way, by acquiring a habit of making observations and keeping record of same.

It is what they expect from their employers and they ought to apply same to their assistants. The engineer has to advise on questions relating to the industry, economy and natural resources. For this purpose he is helped by professional co-operators. He is chief or assistant. When a chief, he receives instructions to go over a question or to resolve a problem, he makes a distribution of duties and gives the impulse to a program he himself defines. When an assistant, he has to apply his knowledge, judgment and reliability as a qualified and responsible person to execute a portion of the program outlined by the chief.

If he succeeds in doing so, credit ought to be allowed him by bearing to the knowledge of the executive this man's ability to interpret the question. It is the assistant's right to be recognized and to receive the benefit of his own work.

Recognition is the best stimulus to incite initiative. This is not only a word to be used with the expectation of getting results from the community, but also to attain to the right spirit of justice which must govern every act of a chief.

When assistants are reporting on an engineering datum, the solution is from duly qualified engineers. A chief must not correct it, still less make use of it for his own advancement. Professional ethics require that he transmit it to whom it may concern, with a word of appreciation or disapproval of the question brought in point.

The man of lower grade thus receives due consideration, comes in touch with the executives, who are not ignorant of the activities of the technical staff and unconsciously indebted towards any of the assistants.

Then this man may expect a brighter future. He feels his merit is appreciated. He aspires to better himself by constant study. He dreams of attaining to a perfect achievement, not only in posting himself on the questions relating to his daily work, but in anticipating future problems, by becoming familiar with progressive discoveries and new appliances for promoting the interests of which he makes a specialty. He proves the truth of this opinion:—

"Chiefly the mould of a man's future is in his own hand." (Francis Bacon).

The chief is duly protected, as the responsibility is largely accepted by his assistants, who show themselves worthy of it. They are proud to see that every day gives them the opportunity of becoming an important factor in engineering. Discouragement finds no place in their heart.

ROMEO MORRISSETTE.

Three Rivers, P.Q., March 5th, 1919.

NEW FURNACE IN ALBERTA

ANNOUNCEMENT is made by the Canadian Western Steel Co., Ltd., Calgary, Alta., that they have just completed a new 25-ton basic open-hearth furnace at Redcliffe, Alta., the equipment being modern in every respect. The company's plants are at Redcliffe and Medicine Hat. They are manufacturing reinforcing steel, bolts, nuts, angle and channel iron, bands, bars, etc. George A. Mackenzie is the managing-director.

It is expected that a start will be made this year on the scheme for the reclamation of 30,000 acres at Sumas Lake, British Columbia, to be used under the land settlement scheme. A special loan will be necessary to finance the project. The cost of the scheme is estimated at $1,000,000, and may be charged against the lands reclaimed.

DRAINAGE WORKS ON RAILWAY LANDS*

By G. A. McCubbin
Chatham, Ont.

THE necessity for distinguishing between railway lands and the lands and roads of private or municipal owners in working out the provisions of the Ontario drainage laws, arises from the fact that nearly all railways are created and controlled by the Dominion government, while the municipalities, and the drainage laws which they are empowered to set in motion, are under control of the provincial government.

In the matter of direct taxation, the authority of the province extends to railway lands and companies equally with other lands and their owners, and, consequently, in so far as assessment alone is considered, there has never been any occasion to exclude railway lands from a fair schedule of assessment to meet the cost of a properly authorized municipal drainage work.

But when it becomes necessary to enter upon railway lands for the purpose of constructing any drainage work thereon, the authority for such work cannot be given by the province, but must come through Dominion legislation, either by itself or in conjunction with the laws of the province.

Amendments to Railway Act

Previous to the year 1903, private ditches, award ditches and municipal drains, or crossings for the same, could be constructed on railway lands only by agreement with the railway companies, the usual agreement providing for the work to be done by the railway and the cost to be borne by the municipality or the individual. In 1903 very important amendments were made to the Dominion Railway Act (sections 250 and 251) in respect to drainage. Section 251, with which we are more particularly concerned, is as follows:—

"Whenever by virtue of any Act of any province through which the railway runs, proceedings may be had or taken by any municipality or landowner for any drainage or drainage works, upon and across the property of any other landowner in such province, the like proceedings may, at the option of such municipality or landowner, be had or taken by such municipality or landowner for drainage, or drainage works, upon and across the railway and lands of the company, in the place of the proceedings before the Board in the last preceding section provided.

"2.—In case of any such proceedings, the drainage laws of the province shall, subject to any previous order or direction of the Board made or given with respect to drainage of the same lands, apply to the lands of the company upon or across which such drainage is required, to the same extent as to the lands of any landowner in such province: Provided that the company shall have the option of constructing the portion of any drain or drainage work, required to be constructed, upon, along, under or across its railway or lands.

Railway Board's Approval Required

"3.—In the event of the company not exercising such option and completing such work within a reasonable time, and without any unnecessary delay, such work may be constructed or completed in the same manner as any other portions of such work are provided under the laws of such province to be constructed.

"4.—Notwithstanding anything in this section contained, no drainage works shall be constructed or re-constructed upon, along, under or across the railway or lands of the company, until the character of such works, or the specifications or plans thereof, have been first submitted to and approved of by the Board.

"5.—The proportion of the cost of the drain, or drainage works, across or upon the railway, to be borne by the company, shall, in all cases, be based upon the increase of cost of such work caused by the construction and operation of the railway."

It is interesting to note in passing that this legislation was introduced into the House of Commons by a member who had been counsel for several municipalities in litigation against the railways, but who became, shortly after the passing of these provisions, a leading counsel of one of the great railway corporations.

Railway Company's Status

The effect of these amendments was to put railway companies in the same position as private owners, and with practically the same limited rights; there was no power of appeal against any municipal drainage scheme recommended by an engineer and adopted by a township council excepting under Section 9 of the Drainage Act, which deals with disposal of excavated material and similar matters of individual rights. The only protection that the railway company had against having an ill-considered and perhaps unnecessary and expensive scheme forced upon it was by objection taken before the Railway Board when the Board's approval of the work was sought by the municipality. Under the Ditches and Watercourses Act they might appeal to the county judge, who had full authority to modify or quash an engineer's award, but any such appeals of railway companies to county judges have been very rare.

The railway companies were thus placed in a rather difficult position, at least in so far as the municipal drains were concerned. The Railway Board did not choose to review all the merits and demerits of a drainage scheme initiated under provincial laws, taking the view that such matters should be dealt with by the various tribunals created by the province for this express purpose, and that the Board should deal only with such features of the work as affected the safe operation of the railway. Where a railway company sought for the modification of a proposed drainage scheme through appeal to the drainage referee, the referee was forced to hold that the company was only in the position of a private owner and had no right to attack the general character of the proposed drainage scheme.

Engineer's Functions are Judicial

In one case a railway company went first to the Board and afterwards to the referee, but for the reasons above stated was unable to obtain before either tribunal a trial of their appeal to prevent the work being carried across their lands. An amendment to the Drainage Act in 1912 (section 101a) gave the railway company in cases of this kind the status of a non-initiating municipality, in that it became necessary for the council of the initiating municipality to serve the railway company with reports, plans and specifications of any proposed work on the railway lands, and the company was given the right of appeal against the same to the drainage referee, but at the same time was made responsible for the costs of appeal regardless of the result in other respects.

The engineer who is properly authorized either under the Ditches and Watercourses Act or under the Municipal Drainage Act to enter upon railway lands and lay out drainage works thereon, should bear in mind that in this, as in all other matters, his functions are judicial, and he must be absolutely impartial as between the railway company on the one hand and the private owners or municipality on the other hand.

He should consider carefully to what extent, if at all, it is necessary to construct drains either along or across the railways. In the first place, the fact that a right-of-way may be 100 ft. wide, and that only a fraction of this is used for a single or double-track road, does not mean that the remaining strip of land on either side of the track is to be utilized for the construction of drains merely to save so much of the land of the adjoining owners as would otherwise be taken for the purpose.

The right-of-way is intended for railway purposes, and should not be made use of simply for the convenience or benefit of a drainage area, particularly where the railway

*Read February 20th at the annual meeting of the Association of Ontario Land Surveyors.

has not interfered with natural conditions to the extent of making drainage more difficult or expensive than it would otherwise have been.

On the other hand, there are circumstances in which natural conditions have been so altered that it is difficult to procure drainage in any other way than along the railway ditches and borrow pits, and under such circumstances we see no objection to the location of award ditches or municipal drains along the railway lands.

Section 250 of the Railway Act recognizes this principle, and requires the railway company, independently of the drainage laws of the province, to "make and maintain suitable ditches and drains along each side of, and across and under the railway, to connect with ditches, drains, drainage works and watercourses upon the lands through which the railway runs so as to afford sufficient outlet to drain and carry off the water, and so that the then natural, artificial or existing drainage of the said lands shall not be obstructed or impeded by the railway."

Bridges at Farm Crossings

In case of municipal drains being so located along the right-of-way, and bridges becoming necessary at farm crossings, these should be properly provided for under subsection 3 of section 9 of the Drainage Act, the allowance or payment being to the railway company.

Crossing a railway track with any drainage work is expensive in comparison with other portions of the work, and should not be required under the award or report of an engineer without careful consideration Since railway companies are required to pay practically the whole cost of these crossings, they are frequently asked for by owners who would see the railway company put to great expense for a crossing rather than spend a small sum to obtain drainage in some other way.

Regardless of whose money is used to obtain the required result, the engineer should see that no expenditure is required unless some commensurate benefit will be derived. In the words of the drainage referee (Grand Trunk Railway and Canadian Pacific Railway vs. Rochester): "The underlying idea is that the construction of the railway has interfered with natural conditions, and that the intention of the legislation is to permit the parties to revert to natural conditions as far as they can possibly do so, but, of course, subject to proper limitations. In other words, the railway should not be permitted to interfere with any work which is reasonably necessary to the proper cultivation of lands in the neighborhood, but if this is a sound proposition, the converse must be equally sound, and unless it is reasonably necessary for the proper cultivation of the lands in the neighborhood, the municipal authorities should not be permitted to interfere with the railway. . . . The question of the cost of these culverts is of great importance. On the part of the township, there is, of course, a natural tendency to think that money spent by the railway company is not to be considered, but I must, and do, treat the matter of expenditure by the railway company exactly the same way as I would treat expenditure of a farmer of limited means."

Some Requests Entirely Unreasonable

Let us illustrate from real life how unreasonable some requests are in regard to these railway crossings. An existing municipal drain runs west along the south side of a railway, crosses to the north side through a 5 ft. iron culvert, continues west along the north side about 100 ft. to a farm boundary, and then turns north along the boundary line. When a survey was being made for the repair of the drain, the landowner asked to have the culvert moved to a point opposite the boundary, in order to do away with two rectangular turns, which he considered very objectionable.

When it was pointed out to him that a better result could be accomplished at a cost of $25, instead of $500, by locating about 200 ft. of ditch in the depression across the corner of his field, he suddenly discovered that those rectangular turns were old friends of his, and he did not want them interfered with.

In another instance a landowner, planning a system of tile drainage, wanted a main or outlet tile on one side of the railway, with several branches or laterals across the railway. These are perhaps extreme cases, but they show what the drainage engineer has to consider before these matters ever come to the attention of the railways

Grades to Fit Culverts

Drainage works across railway lands should, as far as possible, accommodate themselves to existing openings under the tracks, both as to grade and dimensions. It is absurd, for instance, to ask a railway to lower a pipe culvert 3 or 4 ins. to the arbitrary grade line established by the drainage engineer. The grade line should be made to fit the culvert unless a substantial deepening is required.

As to the size and character of the opening, the existing structure, if there be one, should be first considered, and if it reasonably meets the requirements of the drainage work, the railway should not be obliged to incur a heavy expenditure for a trifling enlargement. Water will go through any opening, however small, if given sufficient time or sufficient head. The effect of a slight contraction in a ditch, due to a bridge or culvert opening being somewhat smaller than the sectional area of the ditch, is to raise the surface of the water a little higher on the upper side of the opening than on the lower, and the water goes through with a greater velocity. The flow through the bridge or culvert may also be accelerated by the decrease in friction of the walls as compared with the banks of the ditch.

There are many masonry and concrete culverts which, while having sufficient width and sectional area, are found to have insufficient depth for the improved drainage which is now general throughout the country. In such cases, additional depth may be secured by using a pipe culvert in addition to the larger opening, or by the construction of a solid invert between the footings of the culvert, or, in case of a solid invert already constructed but not of the proper depth, the central portion of this may be removed and re-constructed. In all cases of this kind, the drainage engineer should consult with the engineering department of the railway.

Avoiding Skew Bridges

When new openings are being provided for, the convenience and the standard practice of the railway should be considered. It is more convenient and less expensive for a railway company to construct bridges or culverts at right angles to the tracks than it is to construct them obliquely, and this should be borne in mind by the drainage engineer, particularly in the case of small openings. The diversion of a small ditch by slight curves at either end of the culvert is not so serious a matter as the opening up of a considerable section of road-bed in order to put a pipe or box culvert obliquely under the tracks. For the larger ditches, such as are constructed by dredging, it may not be practicable to cross the tracks at right angles, and then skew bridges are a necessity.

The railway company has "the option of constructing the portion of any drain or drainage work, required to be constructed upon, along, under, or across its railways or lands," and from this apparently simple provision of the Railway Act some interesting questions arise.

For instance, under the Drainage Act, where assessment is made in money, can the company under this option choose to construct only a part of a drainage work upon its land, say the portion under the tracks, leaving the remainder to be done by the municipal council or its servants or contractors? Or is the option which the company has, to construct the whole of the work on the railway lands or none at all? Again, if the company constructs the whole of the work along and across the railway lands and the value of this work exceeds the assessment against the railway, as it sometimes does, is the difference to be paid over to the company as if to a contractor?

Railway companies are not inclined to have their tracks opened up by drainage contractors, but prefer to have the work under the tracks done by their own men, and usually exercise their option in this way. Some cases have occurred, however, where the drainage engineer's estimate of the cost of crossing the railway was considerably below the cost for which the work could actually be done, and in some of these cases the companies have chosen to pay the assessment and let the municipal authorities do the work under the tracks, with the result that the drainage area has had to bear a portion of the assessment which should properly be borne by the railway.

The report of the drainage engineer should not set any temptation of this kind in the path of the railway officials. On the whole, it appears most convenient and reasonable that the engineer in his report should estimate separately the cost of the ordinary drainage work on the right-of-way, such as tile drain, team work or dredging, and the cost of the work under the tracks, and that the railway should be allowed to construct either the crossing or the whole of the work on its lands, at its own option, but in no case should the railway be allowed to perform the ordinary ditching and unload the bridge or culvert upon the municipality.

Drainage Reduces Maintenance

The "increase of cost" of drainage work across or upon the railway due to the construction and operation of the railway, is to be borne by the company. We do not understand by this that the company should be assessed for this increase and nothing more, as has been contended by some railways, but rather that the company should bear this increase of cost under the express provision of the Railway Act, as well as being liable to assessment for benefit, outlet, and injuring liability under the provisions of the drainage laws.

The direct benefit to railways due to drainage is very important, and comparable to the benefit to highways. A specific case is where a track crossed the corner of a swamp, and required ballasting almost annually, but after the drainage of the swamp, the road bed became quite firm, and no further trouble was experienced. Assessments against railway lands for outlet and injuring liability, should be on the same basis as against lands and roads similarly liable.

There is some difference of opinion amongst engineers as to how the assessment under the Drainage Act is to be harmonized with the evident intention of the Railway Act in regard to this "increase of cost." The usual practice has been, as above suggested, for the drainage engineer to estimate the increase, and assess it specially against the railway, taking care that his estimate and assessment in this respect shall be sufficient for the purpose intended This works no injustice, unless the amount so assessed is allowed to remain in the schedule of assessment for maintenance, in which case the railway might be liable for an undue proportion of the cost of maintaining the whole drainage work.

An alternative plan, which would certainly accord with the spirit of the Railway Act, and possibly do no violence to the Drainage Act, would be to omit entirely from the formal estimate and schedule of assessment, the cost of railway crossings, merely providing that the actual cost of such work, whether performed by the railway or the municipality, should be borne by, or assessed against, the railway.

Ditches Along Right-of-Way

Under the Ditches and Watercourses Act, where the work itself is apportioned amongst the interested owners instead of an assessment being made in money, we take it for granted that the township engineer in making his award, would require the railway company to do any necessary work under the tracks and road bed, and that any further work necessary to make up the company's fair proportion of the whole work, should be assigned to the company on the right of way; that the company would not be required to do any portion of the drainage work outside of the limits of the right-of-way unless such were absolutely necessary in order to make a fair apportionment of the whole work.

If any considerable section of the ditch should be along the right-of-way, it would probably be necessary to require private owners to perform a portion of this in order to distribute the burden of construction in proportion to the benefit. Under these particular circumstances we would hardly expect the company to exercise the privilege of performing all the work on the right-of-way.

No drainage works may be constructed or re-constructed, upon, along, under or across railway lands, until the character of such works, or the specifications or plans thereof, have been first submitted to and approved of by the Board of Railway Commissioners. When and by whom should application be made for this approval?

Ditches and Watercourses Act

The machinery provided for carrying out the provisions of the Ditches and Watercourses Act is very different from that provided under the Drainage Act, and the proceedings are quite different. Under the Drainage Act the municipal council assumes the responsibility for constructing the work in accordance with plans and specifications provided by the engineer and incorporated into a by-law. As the council thus acts as trustees for the whole drainage area, it is expected that the council, through either its clerk or its solicitor, will take all necessary steps towards securing the approval of the Board.

Under the Ditches and Watercourses Act, the award of the engineer becomes effective as soon as it is filed with the clerk, or in the event of its being appealed against, as soon as it is confirmed by the county judge or the drainage referee. The municipal council is not directly interested, unless, as owner of a road or other property, it is required to construct a particular portion of the ditch.

There appears to be no responsibility upon any individual to apply for the approval of the Railway Board, but still the award cannot be enforced until this approval is obtained. In order to make this situation clear to all the owners affected by the award, it is advisable that the award itself distinctly set forth that its provisions are not effective until the approval is secured. As the railway company has the same privilege as other owners, of appealing to the county judge, and also if necessary to the referee, not only against the apportionment of the work but also against its character and location, it appears reasonable that if the company makes no such appeal, it should not make any serious objection when the application comes before the Board.

Though no person is responsible for making this application, it usually devolves upon the individual who initiated the proceedings, or, by instructions of the municipal council, it may be undertaken by the clerk or solicitor. The estimated cost of the application may be provided for in the award and be part of the costs charged against the railway company. The company may then obtain the approval of the Board at little or no expense, and in this event the cost should not be collected from the company; or if already collected, should be returned.

Misunderstandings Cleared Up

For similar reasons it would appear that the proper time for seeking approval of work to be done under the Drainage Act should be after the lapse of the time in which the company has the right of appeal to the drainage referee, or after the disposal of such appeal, if any. If the drainage work on the railway lands is not permitted by the referee, the report of the engineer or the provisional by-law of the municipality is set aside and no further proceedings are necessary, as in the comparatively recent case of the Canadian Pacific and Grand Trunk Railways against the township of Rochester, to which previous reference has been made.

As to the particulars which might be dealt with by the Railway Board there was at first considerable confusion and misunderstanding, which was cleared up to a great extent by an order of the Board dated January 17th, 1910, which reads in part as follows:—

"The practice in the past has been to submit to the Board, along with the material, the engineer's report, and a plan of the whole drainage area, with the names of all the land owners affected by the proposed work, etc. In some

instances, the actual bridge or culvert plans, so far as the work affects the railway, have not been submitted.

"It would seem that the proper view of this legislation is that the Railway Board has nothing whatever to do with the general drainage scheme, with the apportionment of distribution of cost of the work, or the fairness or legality of the proceedings, or the validity of the by-law. The legislature has provided forums for the adjustment of all these matters, and the Railway Board is called in merely for the purpose of seeing that the structure that is proposed for the drainage work is of a character that will not interfere with the safe operation of the railway.

"In future, upon application of this sort, all that need be filed, or submitted to the Board for approval, will be the estimate of the engineer of the volume of water that will probably pass through the culvert or opening through the railway lands, and the size he thinks the opening should be. This should be in the form of a statutory declaration, and the proposed mode of carrying the railway over the opening or culvert, with all proper plans of the work, should accompany the application.

Entirely an Engineering Question

"The whole matter then resolves itself simply into an engineering question, and the Board's chief engineer, being satisfied with the character of the bridge or culvert plans, the application to the Board becomes a merely formal one.

"No good can be accomplished by the discussion before the Board of the area to be drained, the legality of the proceedings, and a large number of other matters that the Board has in some instances in the past been called upon to hear.

"The application may be made either before or after the final passing of the by-law."

Plans and specifications of railway culverts and bridges prepared by drainage engineers were usually unsatisfactory to the railway companies, who preferred to follow their own standards of construction, and the order above quoted has been modified to the extent that drainage engineers are now required only to specify the volume of water to be provided for and the dimensions of the waterway required, leaving the detailed plans to be supplied by the railway.

Outlet as Necessary as Crossing

The limit of the cost of work which may be undertaken under the Ditches and Watercourses Act, is fixed by the act at $1,500, and if this amount must include the cost of crossing a railway with a new bridge or culvert, it would be almost prohibitive. There is a possibility, however, that this section of the act may be interpreted to apply only to the cost of work exclusive of the cost of crossing a railway, the railway crossing being more in the nature of an incidental or extra than an ordinary portion of a drainage work.

We had occasion, however, to consider a requisition under the Ditches and Watercourses Act in which the crossing was looked upon by the applicant as the entire work and was the only thing asked for, the apparent intention being to apply compulsion to the railway and reserve individual liberty for the land-owner. The requisition was refused and no action taken on it, on the ground that every ditch undertaken under the act must be continued to a sufficient outlet, that a railway crossing was only incidental to the construction of a complete drain, and that the railway was as much entitled to have an outlet provided under the award as the applicant was to have his crossing.

Companies May Initiate Proceedings

While our drainage laws impose the same burdens on railway companies as on other land owners, they also give these companies the same privileges, and in cases where it becomes necessary to secure outlets for the drainage of railway lands, the companies have as much right to initiate proceedings, either by requisition or petition, as have any other owners. They are entitled to the same treatment, without fear, favor or prejudice, by the engineer and by the municipal court of revision, and neither the railway's ability to pay, nor the improbability of their appealing against assessments, affords any reason for discrimination against them.

In all our dealings with railway companies, we have found the officials of the legal and engineering departments very reasonable and fair in their consideration of drainage matters. They are not the natural enemy of the municipalities and private land-owners that many people apparently believe them to be. The drainage engineer has to contend with some unreasonable requests from private owners for railway crossings, but probably with no absolutely unreasonable refusals or opposition from the railway companies.

Trouble with Indian Reserves

In concluding, let us turn from our consideration of the railways to the subject of Indian Reserves. We do not wish to imply that the one naturally suggests the other, either in the character of its personnel or in the state of its civilization. But as a drainage engineer, in examining a tree, looks to the roots to see if they are of suitable size and shape for bench marks before he looks to the trunk for good timber, to the branches for good fruit, or even to the leaves for grateful and refreshing shade, so his first (and probably his last and only) interest in real estate is not the hope to set his feet on higher ground but the possibility of new fields for drainage work.

It is in this respect the Indian Reserve reminds him forcibly of the railway; the boundary line of the Indian Reserve is to him the same impassable barrier that the right-of-way fence was prior to 1903, with this difference: That whereas it was a matter of days to reach some kind of agreement with the railways, it is now a matter of months or even years to reach any agreement for drainage works on a reserve.

Some of the land-owners and municipalities adjoining the reserves have been considerably handicapped in this way in their efforts to secure proper drainage, and we have no doubt they would welcome such legislation in regard to drainage works on the reserves as was enacted in 1903 in regard to the railways.

CONFERENCE OF RAILWAY ENGINEERS

ALL railroad engineers, whether members of the American Association of Engineers or not, are invited by that Association to attend a conference to be held March 17th, at Congress Hotel, Chicago. The object of the conference is to secure better remuneration for railroad engineers and to discuss the schedule of salaries recently recommended by the Association. There will be two sessions, the first to be called to order at 2 p.m., and the second at 7.30 p.m.

Willard Bechan, equipment engineer, New York Central Railroad, will preside at the afternoon session and W. A. Finley, president of the Association, will be in the chair for the evening session.

"Shall Engineers be Paid For Over-Time?" is the title of a paper to be read by H. P. Gillette, to be followed by discussion.

J. L. Jacobs, formerly expert on system and organization, city of Chicago, will discuss the principles and procedure in the classification and salaries of railroad engineers, to be followed by open discussion.

The sub-committee of the Association's Railroad Committee will present a preliminary report on schedules of pay. A committee on resolutions will then be appointed.

In the evening W. W. K. Sparrow, chief engineer of the Chicago, Milwaukee and St. Paul Railway, will read a paper on "How Shall Proper Recognition be Obtained?" to be discussed by various members upon request of the chairman.

A member of the United States Railroad Administration has been invited to address the conference on the application and the railroad engineer of order 27 and supplements 7 and 8. The conference will conclude with the report of the committee on resolutions.

National Saving of Fuel and Power.*

Canada Must Take Action Towards True Conservation—Co-ordination of Power-Producing Systems—Great Britain and United States To Save Coal—Excerpts from Report Presented at Tenth Annual Meeting of the Commission of Conservation

By ARTHUR V. WHITE
Consulting Engineer, Commission of Conservation

THE field which this Commission covers in its work of power conservation is such that in the time at our disposal it is impossible to review all features of the work. We shall, therefore, at this meeting consider chiefly the great importance which attaches to the more economic generation of power,—a problem to which, with the encouragement of their respective governments, the ablest experts of the principal manufacturing countries of the world are devoting particular attention. It has become clearly recognized that cheap power is one of the basic factors enabling manufacturing countries successfully to compete in the world's markets.

Before entering our discussion may I very briefly state that during the past year the following are some of the subjects which have specially engaged the Commission's attention: the applications by the St. Lawrence River Power Co. and by the New York & Ontario Power Co. involving use of additional water for power purposes from the St. Lawrence River; the completion of the Calumet-Sag portion of the Chicago Drainage Canal, facilitating the diversion of additional water from the Great Lakes system; and the increased development of power at Niagara by the new Niagara Falls Power Co., of Niagara Falls, N.Y., and by the Hydro-Electric Power Commission of Ontario in its Chippawa-Queenston development. The former project contemplates the utilizing of the full head from lake to lake in two stages, one at the Falls, the other at Lake Ontario; while the Hydro Commission project utilizes a single head of 305 feet at Queenston. The complete apportionment having now been made of the total diversion permitted under the Boundary Waters' Treaty, various propositions are being put forth for re-opening the treaty in order to secure additional water. The increasing erosion of the Horseshoe Falls is also demanding attention.

These and other matters cognate thereto, indicate the nature of some of the subjects to which special attention has been given during the past year.

Development of Water Powers

There is also under consideration much that is new in the way of legislation and regulation respecting the development of water-powers. In the United States there are special bills before Congress suggesting means for the better utilization of existing electrical and mechanical power and for the development of new sources of power; also for the acquisition by eminent domain of property and rights necessary for the improvement and increase of facilities for the development, transmission, distribution and supplying of electrical energy; also for the control and regulation of the use of boundary waters of the United States, for power and other purposes. In Canada, the Dominion Water-Power Board created—by order-in-council of 25th April, 1918, under the Chairmanship of Hon. Arthur Meighen, Minister of the Interior, Ottawa,—for the purpose of assisting the Government to take prompt and constructive action to provide for the future fuel and power needs of the country, and to assist also in co-ordinating government activities relating thereto, had under consideration at its first general meeting the problem of co-ordinating certain legislation and regulations relating to water-power development in the various provinces.

Although the manufacture of munitions of war has largely ceased, thereby liberating much power, nevertheless hope is expressed by many that during the next few years there will be throughout Canada an almost unprecedented activity in water-power development. The power already released by munition works, is likely to be absorbed in the immediate future by the extension of industrial plants and by consumers being able now to secure power which, owing to the exigencies of war production, had been denied them. It is believed that a portion of the 50,000 additional horse-power which is being made available by the third pipe-line installed by the Ontario Power Co., will be required to meet early demands of consumers,—in fact, that the past experiences with respect to power demands will be repeated in the future.

Let us now turn to the main part of our subject, which relates to means for effecting the greatest savings of coal and power.

The European War has resulted in impressing upon us, as nothing else has, the vital importance of coal. Practically all industry is dependent upon coal. The United States, producing practically half the present world coal consumption, has, through its fuel administration, been compelled to use every endeavor to curtail coal consumption by cutting off unnecessary or wasteful uses; and by requiring, wherever possible, consumption only under conditions making for increased efficiency.

Enormous Coal Production

It is difficult to form an adequate conception of the enormous quantity of coal produced annually by the United States. In endeavoring to convey an idea of this quantity, the fuel administration, in 1918, stated:—

"Every year the miners go into the ground and dig out coal, and the railroad ships it for hundreds of miles, dragging back the empty cars, until the amount mined is 2¼ times the earth and rock removed in digging the Panama Canal. It took sixteen years to dig the Panama Canal. The miners will dig 2½ Panama Canals this year."

During the battle of Verdun the French fired from their cannons, 60,000,000 shells, containing nearly 1,800,000 tons of steel, the production of which consumed nearly 9,000,000 tons of coal,—that is, 25 per cent. of Canada's annual consumption. Throughout the war the coal situation has been the factor governing the production of manufactured articles. Every large coal-producing country, except the United States, found it impossible to maintain the pre-war production of coal.

It is true that Canada, like the United States, has striven to reduce her fuel consumption, but being still dependent upon her neighbors to the south for 22,500,000 tons, —including over 5,000,000 net tons of anthracite,—out of a total yearly consumption of 34,800,000 net tons of coal, it is clearly incumbent upon Canada to apply every permanent means within her power to utilize coal in the best and most efficient manner. Where Canada is deriving so large a proportion of her coal from the United States, it certainly will contribute to her good status with that country if Canada takes hold and effects every possible fuel economy. This, besides being an evidence of good common-sense, will also result in the saving of a large amount of money now absolutely lost in coal wastefully used.

Fuel Restrictions and Economies

Doubtless, coal shortage will again recur. We must, therefore, not forget the "heatless days;" the times when gasoline could not be used; the denial of fuel for certain luxuries, as use on private yachts; the curtailment of fuel for the manufacture of such apparatus as musical instruments, talking machines, etc.; the allotment to florists for greenhouse purposes of only 50 per cent. of the fuel they

were accustomed to receive; the compelled use in certain districts of wood for fuel; the restrictions upon the use of natural gas; the prohibited use in many cases of anthracite coal and the substitution therefor of bituminous coal; the day-light saving legislation on both sides of the Atlantic; the cutting down of illuminated advertising and the enforced "lightless nights;" these and many other facts must be held in mind as indicating how widespread and absolutely necessary have been the efforts for economy with respect to fuel.

Although the efforts of the fuel administration, the termination of hostilities and a providentially mild winter, have reduced the great stress which has existed in connection with the fuel situation, nevertheless in the period of reconstruction and afterwards, the demand for fuel will doubtless be such that many of the restrictions placed upon its use and conservation during the war period will, in one form or another, find permanent expression; and hence it may be accepted that many of these special requirements made necessary by the exigencies of war are here to stay.

In Europe the great lesson of how to use coal economically has been learned. As a leading United States journal recently stated:—

"They have learned how to use coal economically in Europe, through having to pay all the way from $20 to $90 a ton for it. The man who is paying that does not need any fuel administration to urge him, on patriotic grounds, to stop wasting coal. He develops the keenest interest in that subject without prompting; and he saves the coal."

The writer goes on to declare that the government of the United States does not propose to dispense with its regulation of the coal industry, and adds:—

"The government will not take its hand off; it wants poor people to have a chance of fuel too. It gives the people the benefit of an inexorbitant price. They ought to show their appreciation by using the coal just as carefully as though they were paying the European price."

Now, our chief object in again specifically referring to this fuel problem is this: Canada has by no means wrestled as she should and must with the solution of her national fuel and power problem. We are glad that peat-producing equipment is being constructed, and we are glad to know that the building of a lignite briquetting plant is in progress.*

These efforts, which are certainly moves in the right direction, should be given the best possible support. Such efforts, however, should have been undertaken and consummated years ago. While waiting for relief from lignite production, etc., Canada, by properly applying the lessons of the past fuel shortage, may effect economies in the use of fuel which will result in saving much greater quantities of coal than will probably be produced by such peat and lignite plants as may be in operation within the next few years.

We desire, therefore, to emphasize in the strongest possible manner the need for making every reasonable improvement which will result in the saving of fuel. The best possible efforts under government and other expert engineering guidance should be made to make permanent such economies as have been demonstrated through the efforts of fuel-controlling and other organizations in European countries, in the United States, in Canada and elsewhere. Let us now consider some of the chief means by which these economies have been and may be effected:

Saving Power and Light in Factories

Efforts were made by the United States Fuel Administration to induce several coal-using factories to effect economies in light and power, by the utilization of more efficient lamps; the cleaning of dirty windows; the re-arrangement of machines and shafting and the proper alignment of shafting; changes in elevator service; the insulation of steam piping and the cutting out of unnecessary steam lines; the grouping of machines in a manner to flatten as much as possible the load curve; the testing out of power circuits for relationship of capacity with a view to their better inter-connection; the stopping of motors when the machinery to which they are attached, is idle; the correction of motors and other apparatus which were out of adjustment; the installing of proper protection about doors, windows, elevator shafts and stair areas, etc. Such efforts have resulted in effecting a coal saving in factories of from 11 to 34 per cent.

Elimination of Uneconomical Plants and Processes

In the United States there were found in factories, office buildings, hotels, apartments, institutions, hospitals, etc., about 30,000 local electric-generating plants. Many of such plants were readily supplied from some adjacent large central station. Where changes were made the results indicate a general fuel saving of from 20 to 60 per cent.

Fuel is being saved in industrial furnaces where used for direct heating,—such as is necessary in the clay products industries. The branch of the United States Fuel Administration in charge of this work estimates a probable annual coal saving of 3,000,000 tons.

If time permitted, we might touch upon other savings being effected in special manufacturing, such as in the refrigeration industry; by the increasing of efficiency of the modern steam turbine; savings resulting from standardization; from regeneration of electricity by improved methods of braking; the saving due to the employment of the "skip stop" system for railways; the staggering of hours of closing of factories; the savings effected by the greater utilization of gas production from coal; savings by the better combustion of coal and the avoidance of wastes resulting from the smoke nuisance; and the enormous savings possible by the electrification of steam railways. We shall, however, here have to pass these subjects.

Investigations in United Kingdom

In the United Kingdom the methods of mining and using coal have been the subject of an important and comprehensive investigation by the Coal Conservation Committee of the Ministry of Reconstruction. Its final report was issued in 1918.

The present coal consumption for *power purposes* in the United Kingdom is at least 80,000,000 tons. By proper co-ordinated and centralized systems of power production and distribution for the whole country, it is estimated that 55,000,000 tons of coal per annum might be saved, and in addition the following important advantages would result:—

"A reduction in the cost of transport in carrying coal.

"A possible saving in coal consumption for domestic purposes (the consumption for which purpose is now probably 35 million tons per annum).

"The reduction in the cost of coal handling involved in house-to-house delivery and general coal distribution.

"The great advantages and economies which would result from the more extended use of electricity in the household for heating, cooking and cleaning purposes in the way of labor-saving devices, reduction of smoke, increased cleanliness, etc.

"The possibility of utilizing the coal at present left in the pits or otherwise wasted.

"The possibility of extracting by-products, etc., before consuming the coal for power purposes.

"The increase in railway electrification, with its attendant advantages, which a comprehensive electric power supply system would render commercially possible and profitable."*

All these savings and advantages taken together show a total possible national advantage which can hardly be put

*Consult "Carbonizing and Briquetting of Lignites," by W. J. Dick, Commission of Conservation, Ottawa, 1917; also by same author, "Canada's Own Coal and the Fuel Problem" in "Industrial Canada," April, 1918; also, "The Briquetting of Lignites," by R. A. Ross, being report No. 1 of the Honorary Advisory Council for Scientific and Industrial Research, 8vo, 29 pp., Ottawa, 1918; also, "Fuels of Western Canada and Their Efficient Utilization," (revised edition) by James White, 8vo, 44 pp., Commission of Conservation, Ottawa, 1918.

*See "Final Report," Coal Conservation Committee of Ministry of Reconstruction, folio, 89 pp. (Cd. 9084), London, Eng., 1918.

at less than £100,000,000 per annum, apart from the manufacturing and industrial advantages of a cheap and efficient electric power supply. The reconstruction committee lays special emphasis upon the part which power will play in the cost of manufacture and in the matter of international industrial competition to which all countries are devoting such great attention. The economies resulting from the supplying of power to industry through the agency of the electric motor is everywhere recognized. In the factories erected for the production of munitions during the war, 95 per cent. of the machinery was driven by means of electricity. The committee, therefore, points out that the problem is not so much how to apply power to tool or process as the case may be, but how best to generate and distribute the electric power required.

Technical Difficulties in Great Britain

As some indication of the technical difficulties to be overcome in Great Britain, it may be cited that in Greater London alone there are 70 different authorities, 70 generating stations,—with 49 systems of generation, 10 different frequencies, 24 different distribution voltages and 70 methods of charging and prices. It is not surprising to learn that under such conditions the average size of unit is under 700 k.w., and the average size of station less than 6,000 k.w. In addition there are 9 traction stations used chiefly for supplying power to the rapid transport systems.

The committee recommends that, instead of over 600 districts as at present, Great Britain should be divided into some 16 districts, in each of which there should be one authority dealing with all the generation and the main distribution. For each district there would be a standard frequency and voltage for the trunk mains, into which power stations situated at the most advantageous sites would feed, and into which could be fed also power derived from surplus gas or waste heat. Especial attention would be given to the development of power at the pit mouth, where coal which it does not pay at present to bring to the surface might economically be utilized. The main steam power stations would be very large, probably 150,000 h.p. or over, with units of from 20,000 h.p. to 50,000 h.p. They would be constructed preferably outside the centres of population in situations where ample area could be obtained to permit the erection of by-product recovery plants and in some cases the establishment of electro-chemical industries.

There is at present being considered by the government of the United Kingdom, a bill to give effect to many of the recommendations of this committee.

United States Taking Action

In regard to the centralization of plants at or near the coal mines, L. H. Rittenhouse, Chief of the Power Section, Production Bureau of the United States Fuel Administration, briefly states as follows:—

"There are a number of large modern central station electric power plants, installed in the various coal regions of this country. The purpose for which these were built was that of supplying electric energy to the coal mines for the purpose of operating their machinery in the production of coal. Among some of the more important of these plants may be mentioned: The Virginian Power Co., Charleston, West Virginia; The Logan County Light & Power Co., Logan, West Virginia; The Appalachian Power Co., Bluefield, West Virginia; The West Penn Power Co., Pittsburg, Pa.; and others.

"These companies have large turbo-generators, some up to 20,000 k.w. capacity, and, of course, are more economical than the many isolated plants at the various collieries which have been supplanted by these modern stations. As an investment proposition, they apparently pay the owners a good return and most of those mentioned, as well as others, were in operation before the war. The government encouraged the operation of, and additions to these central power plants during the war through the activity of the power section of the production bureau. Not only was the conservation in coal recognized as a necessary and worth while result, but the saving in labor and in iron and steel that was brought about by the operation of large units was recognized and full advantage taken in the planning of new and additional power facilities in the respective coal fields. In other words, it was impossible for an individual coal operator to install a small or medium size power plant if central station service was available. This policy was maintained through our co-operation with the Electrical and Power Equipment Section of the War Industries Board, which section had complete jurisdiction over all power house apparatus."

Power Plants in Coal Districts

Respecting the still broader question of conservation through the elimination of a great deal of the coal distribution by construction of power plants in the coal districts, the electric energy being transmitted to the various industrial centres of the country over high tension transmission lines, Mr. Rittenhouse continues:—

"To a certain extent, this result is accomplished by the power stations referred to above, as they transmit at voltages up to 66,000 and over distances reaching 100 miles in some cases. However, these plants are primarily intended to supply the energy required in the coal mines themselves and most of them are at too great a distance and of insufficient capacity to economically distribute power to large industrial centres along the eastern seaboard. It will only be a question of time, however, before large super-stations will be constructed in some of the coal fields, particularly those near the congested industrial sections in the east, and full advantage taken of the opportunity to burn the culm or refuse coal, together with the advantage of distribution at high voltage to industrial centres. The government has fully recognized the desirability of the adoption of the above plan, in that there will be a saving in coal consumption, man-power, transportation, etc. Indeed, this very problem had been approached just previous to the signing of the armistice."*

Heating by Electricity

Before passing to the concluding portion of our discussion, may I briefly state, with respect to the restricted possibilities of electric heating, that for years past I have been emphasizing the comparatively limited use which can be made of electric energy as a wholesale substitute for coal for heating,—including the heating of buildings. The sooner it is realized that hydro-electric energy can never as a heating agent be an adequate substitute for coal for the citizens of Canada, the sooner will action be concentrated upon sources from which real relief may be derived—there is no use entertaining hope towards a source from which no sufficient relief can come. It may be recalled that at our annual meeting in November, 1917, I stated that "The extent to which electric energy will be available for heating has been much overrated and, realizing the underlying physical limitations, one cannot be enthusiastic respecting the extent to which it may be utilized."

The underlying principles governing in this electrical heating proposition are simple.

In order to determine what is technically termed the mechanical equivalent of heat, J. P. Joule, an Englishman, about 1850—and subsequently a number of other experimenters—ascertained the number of foot-pounds of energy required to raise one pound of water one degree Fahrenheit. In their simplest form, the experiments consist of confining a known quantity of water in an insulated vessel and transmitting to the water by means of agitated vanes—like a churn—the energy developed by a known weight falling through a given distance. Taking into consideration the

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*Consult "Electricity will not Replace Coal," by Arthur V. White, in "Industrial Canada," Toronto, April, 1918; also, by the same author, "Coal Problem of Canada Demands National Action—A Solution of a Vital National and International Question" in The Monetary Times Annual, 4th Jan., 1918, pp. 25 et seq. See The Monetary Times, 1st March, p. 18; also, "Possibilities Ahead of the Gas Industry as Revealed by a Digest of Reports from Various Sources," by G. W. Allen in "Proceedings of 11th Annual Meeting of the Canadian Gas Association," 1918.

results of various experiments, this equivalent may be taken at 778 foot-pounds. It may be stated, for example, that 778 pounds falling through one foot will develop energy sufficient to raise one pound of water one degree Fahrenheit. This heat unit is termed a British thermal unit, or B. t. u.

Now, by definition, a horsepower is 33,000 foot-pounds per minute, or 33,000 x 60 foot-pounds per hour. If, therefore, we divide 33,000 x 60 by 778, we obtain 2,545 as the heat units derivable from one horse-power-hour of energy. Correspondingly, the heat units derivable from one kilowatt-hour are 3,412.

It makes no difference, of course, what prime agency has resulted in the development of the power. Consequently, it may be stated that a horse-power-hour of electrical energy can only yield approximately 2,545 heat units. One pound of anthracite coal contains about 14,000 heat units.

During the past year increased attention has been given to this subject, and the press, both technical and public, has referred to the matter in a manner which clearly shows that at last it is dawning upon the public mind that electrical energy as a wholesale substitute for coal is a forlorn-hope.*

If it is to be used wholesale, then electrical energy is more efficiently employed for power than for heating purposes. For many manufacturing processes requiring heat, and as an auxiliary heating agent for buildings, etc., electricity has a wide field of usefulness. Great economies in coal will be effected by a proper co-ordination of electricity and coal according to their respective spheres of greatest efficiency.

Growth of Co-ordination of Power Production

Greatly increased attention is being given to the subject of the inter-connection of various electric plants—whether steam-electric or hydro-electric, or combinations of both—with the object of securing greater efficiency in the supply of power and light to districts respectively served. The editor of the "Electrical World," referring to this subject, recently stated that "Economic co-operation is going to be one of the keynotes of the reconstruction period, and whether an engineer believes that inter-connection will pay or not in a given case, he will do well to analyze its prospects."†

In the United States, the fuel administration commenced investigations in different sections of the country to ascertain the operating status of various power-producing companies in order to determine how best to co-ordinate their activities to the end that coal might be conserved. Commenting in general terms upon these efforts, the chief of the states conservation bureau of the federal administration, L. R. Clapp, writes:—

"The inter-connection of power systems, both steam and hydro-electric, offers an opportunity for real fuel economy and has received the active attention of this bureau. In many parts of the country duplicate transmission systems exist, serving practically the same territory. One or more of such lines may derive all or nearly all of its power from water, while other companies use coal. No company operates with a continuous one hundred per cent. load factor, and almost always the peaks are different for different companies. Therefore inter-connections permit the use of the maximum water power and also allow an increase in the average load factor. In its hydro-electric work the bureau has had the assistance of the geological survey and much work of permanent value to the country has been effected along these lines. Another similar activity is the possibility of closing down an uneconomical central station where, in the same territory, a more efficient power plant is able to give the same service. It is estimated that there are, throughout the country, nearly 500 instances of such duplication, and several consolidations have been effected. The savings which have resulted from this work have been estimated to be some 540,000 tons of coal in the calendar year 1918. In general, we feel that this has not been a particularly profitable field for emergency conservation work, the projects involved requiring far too much time for their consummation for immediate benefit. Over a ten year period perhaps, important coal economies could be effected by this means."*

Efficiency of Entire Systems

Heretofore, efforts have been concentrated to secure the efficiency of the unit apparatus of power-generating stations, such as turbines, generators, transformers, etc., but now efforts are being directed to increase the efficiency, not only of units as such, but of the systems of which the units are an integral part. In this connection such questions as the load factors of generators and of systems, the diversity factor, etc., are being subjected to scientific analysis. The creation of super-power stations suitably located with respect to cheap and reliable supplies of coal, of water, of raw materials, for shipment and other purposes, will receive increasing attention. In connection with all these matters greatest care should be taken not to disturb ruthlessly existing organizations and installations, but rather to seek out ways and means by which they may be adapted in some ready and efficient manner to the new general scheme.

It will be profitable for those interested in this subject of co-ordination to study what has been accomplished by the fuel administration of the state of New York in the capitol district of the state; also by the Pennsylvania administration with regard to power generating stations in the mining districts; also by the inter-connection of plants in Eastern Massachusetts and elsewhere; and the extensive work of co-ordination by the Chicago, Milwaukee and St. Paul electric systems.

Co-ordination of Power Systems in Canada

The general trend of such work, however, will be quite clear from the following illustration respecting work in hand by the Hydro-Electric Power Commission of Ontario. This commission, in the extension of its various power installations has also been seeking greater efficiency by interconnecting and co-ordinating several of its systems until in effect they form one comprehensive unit.

By way of illustration, inter-connection has been arranged between the Wasdell's Falls system, taking power from the Severn River, with a head of about 14 feet and an installation of 1,200 h.p.; the Orillia system, with development at Swift rapids on the Severn River, under a head of about 50 feet and with 5,000 h.p. installed; the Eugenia system, developing at Eugenia Falls on the Beaver River, under a head of 550 feet and with a machinery installation of 8,800 h.p.; and the Severn system, with development at Big Chute on the Severn River, under a head of about 58 feet, with an installation of 5,600 h.p. It may just be mentioned that the steam plant at Owen Sound has been kept in commission, and at times is used to help on the Eugenia system, and the steam plant at the C.P.R. elevator at Port McNicoll is correspondingly used on the Severn system.

It is under consideration to have the Muskoka system, which develops at South Falls on the south branch of the Muskoka River under a head of 106 feet with installed capacity of 1,750 h.p.—a capacity of about 6,000 h.p. is possible—also co-ordinated to this group.

The commission has also proposed a new development at Port Elgin on the Saugeen River, under a head of 80 feet, with an estimated complete development of from 10,000 to 15,000 h.p. This, when constructed, will supply some twelve to fifteen municipalities which at the present time are utilizing coal for the production of their light and power.

It may be explained that at the Muskoka and proposed Saugeen developments, largely increased power may be obtained at times of flood flow. The Eugenia plant, on the other hand, is essentially a storage proposition, and can, therefore, at times of flood flow impound waters which sub-

*The Hydro-Electric Power Commission of Ontario recently issued two valuable papers by A. S. L. Barnes, namely, "Report on the Rate of Coal Consumption in Various Electric-Generating Stations and Industrial Establishments in Canada and the United States;" also, "Report on the Heating of Houses—Coal and Electricity Compared." (The same discussion is published by the Honorary Advisory Council for Scientific and Industrial Research as Bulletin No. 6).

†"Electrical World," New York, December 21st, 1918.

*From letter to A. V. White, 3rd of January, 1919.

sequently can be released in order to augment shortage of power resulting from low-water conditions at, say, the Muskoka or Saugeen plants.

In the districts just referred to we thus find the feasibility of co-ordinating at least six hydro-electric plants and two steam-electric plants. In addition, if future requirements so warrant, it is contemplated to install frequency changers so that the Niagara system of the commission,—the transmission lines of which run close to the systems above referred to,—may also be brought into parallel with them.*

From the foregoing illustration we perceive how widespread is the movement to attain the efficiency possible by intelligent co-ordination; and also, how diverse are the basic factors admitting of combination. No doubt in future, more than in the past, those installing new electric systems, or remodelling older systems will ensure that designs are adopted which will facilitate the taking advantage of the benefits resulting from possible paralleling with other systems.

Conclusion

Now, the burden of many of the comments and illustrations above given is this: On the principle that a "penny saved is a penny made," there should be careful investigation of some of the outstanding typical conditions under which coal at present is being consumed in Canada, whether in the home, in the institution, in the office building, in the small manufactory or in the larger industrial plant. If authorities have found, for example, through the enforced utilization of insulation upon steam piping, heaters, etc., or by the shutting down of uneconomical plants, or the substitution of efficient for inefficient apparatus, or the repair of apparatus, or in other ways, that very substantial savings of coal may be effected, then such economies, according to some reasonable scheme of administration, should be made compulsory in Canada. It is not the intention here to suggest any unreasonable procedure in connection with these matters. Certain economies involving radical changes may not be made fully effective except over, possibly, a five or a ten-year period. In other instances, however, substantial economies can immediately be effected to the benefit of the coal consumer, to the transporter and to the country as a whole. These, then, should receive prompt and best attention. Why, for example, should Canada be compelled—especially under conditions of coal shortage—to provide for the obtaining and transportation year after year of, say, ten tons of coal per annum to a certain consumer, if, through the wise expenditure of a few extra dollars, either in initial outlay for better apparatus or by effecting certain changes in existing equipment, the individual would only require to be supplied with seven or eight tons? The days for the widespread use of anthracite coal are numbered. Doubtless, in relatively few years its use will be authoritatively restricted. Bituminous coals and lignites will be subjected to by-product and other manufacturing processes with the object of producing a satisfactory and clean-burning fuel. Canada cannot and must not ignore the march of progress in these fuel problems, nor in effecting economies by the prevention of needless fuel and power wastes.

*For valuable résumé of activities of the Commission, consult "Electric Power Generation in Ontario on Systems of Hydro-Electric Power Commission," by Arthur H. Hull, in "Proceedings of American Institute of Electrical Engineers," January 1st, 1919; also published in *The Canadian Engineer*, issues of December 12th and 19th, 1918.

The Water Power Committee, appointed by the Conjoint Board of Scientific Societies of Great Britain, will soon issue an additional report, giving particulars which have been obtained since the publication a couple of months ago of the preliminary report. Sir Dugald Clerk, chairman of the committee, has informed *The Canadian Engineer* that it will be some time, however, before the final report of the committee is presented.

NATIONAL HIGHWAY COMMISSION

For Administration of a National Highway System, is Advocated by the Committee of the American Road Builders' Association

In Canada, organization of provincial departments, legislation and national functions differ from those in the United States in such manner that many matters that are problems for the states, present no difficulties to our provinces. On the other hand there are many similar and even identical problems to be solved. While the following report, which was presented last month to the American Road Builders' Annual Congress, at New York, by a strong committee, refers only to the United States, it contains much that applies with equal force to Canada.—EDITOR.

HIGHWAY transportation has changed so radically within the last ten years, due to the development of the passenger automobile and the motor truck, that the highway and highway-transportation problems of ten years ago have little relation to those of the present. Our highway plans of the future must be based upon the potentialities of the motor vehicle. It is necessary, therefore, to throw off the limitations of past traditions and to plan for the future with a vision commensurate with the prospective development of motor carriage.

While indications of this new era in highway transportation, with its attendant problems, have been apparent to thinking men for five or more years, the public did not grasp the revolutionary character of the change until the war threw upon the highways the burden of relieving the industrial distress brought about by the inability of our railways to care for the enormous war traffic. As a result of this experience, the public now recognizes that motorized highway transportation is an essential factor in our economic life. Consequently plans that would have received no attention as late as the year 1916, are readily approved at the present time.

The development of our highway systems was entrusted originally to the townships, but their inability to handle the problem satisfactorily became apparent more than a generation back, and control of the principal roads passed to the counties. It remained with them until the advent of the motor vehicle. It soon became apparent that if the motor vehicle was to be used to maximum advantage, road systems extending under uniform control across county boundaries were necessary. For that reason, we have had in the last ten years a marked development of state highway systems. So important did the problem become, that in 1916 the plan was inaugurated whereby the Federal Government itself appropriated money to aid and encourage the states in the organization of strong state highway departments and the adoption of adequate state highway systems.

Enormous Motor Traffic

To-day highway traffic cuts across not only county boundaries but state boundaries as well; the passenger car and the motor truck have entered very extensively into interstate commerce. Conservative estimates place the passenger traffic of automobiles at 45 billion passenger-miles per annum, and the freight carriage at 6 billion ton-miles per annum. These figures are very conservative, considering that there are 6,000,000 motor vehicles in service, of which 500,000 are commercial cars, ranging from the light delivery wagon to the heavy truck.

To provide adequately for this traffic and to allow the nation to benefit to the maximum from the potentiality of the motor vehicle, it is necessary to provide properly built and maintained highway routes that cut across state lines, tying the principal cities of the nation together and connecting the interior with the seaboard. Such a system, adequate to the needs of present and future through motor traffic, can be secured only by the most perfect co-ordination between all of the states of the Union, or by the Federal Government undertaking the construction and maintenance of those routes.

Highway engineers in state employ throughout the country are agreed that the type of co-operation which would be needed between the states in order to create an effective national highway system, is impossible to secure save by a degree of Federal control which would allow the state highway departments little or no independence, when acting as agents of the Federal Government, in the location, construction and administration of the Federal highways. Such subordination does not seem to appeal to the state highway officials. The alternative is Federal construction, and Federal maintenance.

National Highway System's Benefits

The benefits that will accrue from the establishment of a National Highway System, built and maintained by the Federal Government, can be classified under four main heads:—

1. Political, or spiritual;
2. Economic;
3. Military;
4. Benefit of the example which the national system will set for all highway construction and maintenance.

Political or Spiritual Advantages

By political benefit is meant the welding together of the people which comes from the obliteration of sectional lines and the realization that from the Atlantic to the Pacific, from Canada to the Gulf, we are not a collection of heterogeneous people, but a single nation. This breaking down of sectional lines can be brought about only by improved methods of communication and transportation, such as the telegraph, the telephone, the railroad and the highway.

What this breaking down of sectional lines means to the people of the United States became apparent during the great war. In April, 1917, there was doubt whether all our people would unite in the great cause. It was feared that we might find that we were merely a collection of heterogeneous races. The contrary proved to be the case. We were found to be a nation with a single ideal, and almost to a man we pledged our lives and our last dollar for the attainment of the great object.

In this work the passenger automobile has played no little part. With the extension of through routes, passable at all seasons of the year, interstate automobile traffic will be encouraged and any one who can afford to buy a $400 automobile can be as well acquainted with districts a thousand miles from his home as he formerly was with the precincts of his own city.

Evidence that the country appreciates this political or spiritual benefit is shown by the money we spend for the maintenance of national parks and the provision we make for recreation in our national forests. The last report of the National Park Service indicated that more than $800,000 was spent in the year ended in June, 1918, while a recent report of the United States Forest Service maintained that the national forests had afforded a recreational service to the people estimated in value at $7,500,000.

No one can estimate the benefit to the nation of the wiping out of sectional prejudices. It is difficult, therefore, if not impossible, to appraise the spiritual benefit, but if this nation had not been united in the period between April 6, 1917, and November 11, 1918, we would at this time be bowing to the peace terms of the Hun (!?!) and every dollar of value in the country would have depreciated enormously under the yoke of our war expenditures and the indemnity that would have been extorted by Germany. For the spiritual strength which the nation will gain from improved intercourse, the nation can afford to appropriate far more money than will be needed for the construction of an adequate National Highway System.

The economic benefit of a national system of highways is best indicated by the extent to which motor truck routes radiating from large cities cut across state lines. Those around New York furnish an excellent illustration. They cut into or across the states of Massachusetts, Rhode Island, Connecticut, New Jersey, Pennsylvania, Delaware, Maryland and the District of Columbia. In other words, motor trucking routes are an important agency of interstate commerce.

Military Benefit

The third benefit of a National Highway System is that which would be derived in case of a military emergency. The war department has refused to designate any roads as military highways, but we have the testimony of leading army officers that every highway connecting large centres is a military highway, in effect, during war times. All of the trunk lines leading into the big munition centres last year were military highways, even though not so declared. We most sincerely hope that out of the Peace Conference there may come a league of nations, but even with that fortunate result, it will still be necessary for us to be prepared. No one will contend that if a league of nations is formed we shall abolish the war department. And if we do not abolish the war department, we cannot afford to neglect one of the essential means for the transport of materials and men—the highway system.

We had an excellent demonstration of the possibilities of the highway in war times when during the war 16,000 army motor trucks ran over our roads from the Great Lakes to the Atlantic seaboard. Such routes, to be effective, must be under a single control, in order that the construction and maintenance may be adequate to the demands of military traffic.

Benefit of Example

In addition to the benefits already emphasized, the building and maintenance of a National Highway System will furnish an object lesson to the citizens of every state in the union. The National government would be unhampered in the selection of roadway surfacing and in the methods of maintenance. In all of these respects the standards would be the highest warranted by present-day traffic conditions, and such routes, crossing every state in the Union, and coming under the personal observation of thousands of citizens, would set a standard for state and county road work that would be of inestimable value in the development of adequate local highway systems.

Extent of System

At the beginning we would recommend the planning of a highway system of 50,000 miles, or about 2% of the public-roads mileage of the country. This would be adequate to serve directly 46% of all of the counties of the United States, while another 41% of the counties would be adjacent to those through which the highways would run. In other words, such a system would serve directly or with a reasonable degree of directness 87% of the population of the country. At a cost of $25,000 per mile, such a system would cost $1,250,000,000, and if the appropriations for construction were made at the rate of $100,000,000 per year, the fundamental system would be completed in 12½ years. Surely this is a small expenditure for a nation that raised $15,000,000,000 in Liberty loans in 18 months, while three of its states have authorized state highway bond issues totaling $210,000,000. The estimate of $25,000 is purposely made high, though it is realized that in many sections of the country suitable materials are available for the construction of adequate surfaces at less cost.

Administration of System

As to the administration of the system, it is our judgment that the best benefit can come from a National Highway Commission, which would have no other duty or responsibility than that of studying, planning, building and maintaining the National Highway System. An indication that the mature judgment of the country is adverse to placing the Federal road work in a bureau subordinate to an administrative department is afforded by the fact that in practically every state, highway work is handled by a separate highway commission and is not placed under a bureau in the state department of agriculture, or in any other state department.

There is, however, much agitation for the inauguration of a Federal department of public works. Should this be established, the highway work of the nation would logically

fit therein, and being an engineering department, devoted solely to the consideration, planning, construction and maintenance of public works, it would be in a position to serve better the highway needs of the nation than is a bureau subordinate to a department devoted to a work foreign to that of highways.

Of the two agencies,—a highway commission or a Federal department of public works,—the commission has the better opportunity for adoption by Congress and, for practical reasons, we urge advocacy of that form of control rather than of a new cabinet department.

Conclusion

For the reasons herein set forth, for the political, economic, military and educational benefits that would accrue, your committee believes that the Federal Government should embark on the construction of a National Highway System.

Such a system should initially be laid out to include 50,000 miles, approximately 2% of the road mileage of the country.

For its control we would recommend the establishment of a National Highway Commission.

BEATING THE PIRATE

By Sidney Neu

THERE is never a gathering of contractors and dealers without a defamatory discussion of "the pirate." Certainly, prices should be maintained and all jobs should be figured with ample allowance for overhead and profit, but it can't be done—"the pirate" gets the business.

The pirate, according to the Standard Dictionary of Contracting Terms, is a third rate mechanic, calling himself a contractor, having an office located in his "Truly Warner," who buys some of his materials second-hand and steals the rest, considers specifications as a thing to be avoided if possible and evaded where necessary, skins the job to the bone, and hasn't even sense enough to make a profit out of the extras, and whose shoestring is just sufficient to keep him two jumps ahead of the sheriff—for a while.

Should this delectable individual really cause worry to a legitimate business man? Is he so strong that the legitimate contractor must descend to his level to stay in business?

Although it is not generally known, there are or have been "pirates" in every line of business. When John Wanamaker started in business there were hundreds of peddlers peddling in Philadelphia. Did John follow their tactics, selling his wares for as much as he could get? He did not; yet John Wanamaker grew and the peddler quit. We still see occasionally itinerant vendors of collar buttons, shoelaces and suspenders, yet the legitimate haberdasher can afford to pay his rent. The legitimate clothier is prosperous in spite of the bargain sales of the department stores.

There are obvious reasons why these legitimate stores survive their pirates. They have something to offer which the public values that the pirate cannot give, and they impress this on the public continuously by advertising. Their advertising creates so much business that there is plenty for them after the pirate has snooped off his little chip.

The legitimate contractor or dealer, if he is really "legitimate," has something to offer that "the pirate" cannot give.

The Canadian Ingersoll-Rand Co., Ltd., recently absorbed the Jenckes Machine Co., Ltd., of Sherbrooke, P.Q., thus putting the Rand company in possession of two plants. The products of the Jenckes plant will continue to be those familiar to customers of the Jenckes Machine Co., including structural and plate work, tanks, penstocks, mining machinery, pulp and paper mill equipment, water wheels, etc. The headquarters of the Canadian Ingersoll-Rand Co., are at 260 St. James St., Montreal.

LEGISLATION TO PREVENT POLLUTION

Of Boundary Waters, and of Waters Crossing the Boundary, Will be Framed by the International Joint Commission

UNDER the terms of Article IX of the Treaty of January 11th, 1909, the governments of the United States and Canada referred to the International Joint Commission, for investigation and report, the following questions:—

1.—To what extent and by what causes and in what localities have the boundary waters between the United States and Canada been polluted so as to be injurious to the public health and unfit for domestic or other uses?

2.—In what way or manner, whether by construction and operation of suitable drainage canals or plants at convenient points or otherwise, is it possible and advisable to remedy or prevent the pollution of these waters, and by what means or arrangement can the proper construction or operation of remedial or preventive works, or a system or method of rendering these waters sanitary and suitable for domestic and other uses, be best secured and maintained in order to insure the adequate protection and development of all interests involved on both sides of the boundary and to fulfil the obligations undertaken in Article IV of the Waterways Treaty of January 11th, 1909, between the United States and Great Britain, in which it is agreed that the waters therein defined as boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other?

Extensive Investigation

This investigation, in which the Commission had the co-operation and support of the federal, state, and provincial boards of health on both sides of the boundary, involved extensive bacteriological examinations to enable the Commission to answer the first question in the reference.

The second question, as to remedies, involved an examination by sanitary engineers of the existing municipal sewage disposal and water-supply plants on both sides of the boundary, and the working out of plans designed to afford an effective remedy for the pollution found to exist.

The Commission published elaborate reports, prepared by its experts, on both the bacteriological and the engineering sides of the investigation, and also its own annual report to the two governments, containing a summary of the results of the investigation and the Commission's conclusions and recommendations, copies of all of which are available on application to the Commission.

As a result of these recommendations, the United States proposed that Canada should join in requesting the Commission to prepare and submit for the consideration of the governments such rules and regulations as might be necessary to regulate and prohibit pollution of boundary waters and waters crossing the boundary.

The following order-in-council embodies the concurrence of the Dominion Government in the proposed reference:—

The Order-in-Council

"The Committee of the Privy Council have had before them a report, dated 15th February, 1919, from the Acting Secretary of State for External affairs, submitting to Your Excellency the final report of the International Joint Commission in the matter of the reference by the United States and the Dominion of Canada relative to the pollution of boundary waters.

"The Minister, in so doing, takes occasion to refer to a despatch from His Majesty's Charge d'Affaires at Washington to Your Excellency, enclosing copy of a note from the United States Secretary of State dealing with the condition of affairs revealed by this report, and especially with the recommendation of the Commissioners that, in order to remedy and prevent the pollution of boundary waters, and to render them sanitary and suitable for domestic purposes and other uses, and to secure adequate protection and development of all interests involved on both sides of the boundary, and to fulfil the obligations undertaken in Article IV of the treaty, it is advisable to confer upon the Inter-

national Joint Commission 'some additional jurisdiction to make rules and regulations, directions and orders, as in its judgment may be deemed necessary to regulate and prohibit the pollution of the boundary waters and waters crossing the boundary.'

"The Minister agrees with Mr. Lansing in the advisability—in order to an adequate consideration of the above recommendation—of requesting the Commission to prepare for submission to their respective governments drafts of the instruments best calculated, in the opinion of the Commissioners, to give effect to their recommendations, whether by convention or legislation, or by both methods.

"The Minister, therefore, recommends that His Majesty's Charge d'Affaires be informed that the Canadian Government are ready to associate themselves with the United States Government for the above-mentioned purpose.

"The Committee concurring, recommend that Your Excellency may be pleased to forward a copy hereof to His Majesty's Charge d'Affaires at Washington, for the information of the United States Government."

The conclusions and recommendations in the Commission's final report on pollution of boundary waters were as follows:—

Conclusions and Recommendations

1. The Great Lakes beyond their shore waters and their polluted areas at the mouths of the rivers which flow into them are, except so far as they are affected by vessel pollution, in a state of almost absolute purity. With the exception of these pure areas, the entire stretch of boundary waters, including Rainy River, St. Marys River, St. Clair River, Detroit River, Niagara River, St. Lawrence River from Lake Ontario to Cornwall, and the St. John River from Grand Falls to Edmundston, New Brunswick, is polluted to an extent which renders the water in its unpurified state unfit for drinking purposes. This pollution has its origin chiefly in the sewage and storm flows from the riparian cities and towns and the sewage from vessels. It is very intense along the shores of the Detroit and Niagara Rivers and in the contaminated areas in the lakes. Throughout the whole length of the boundary waters where sewage is discharged from the sewerage works of cities and towns the pollution is most concentrated in the shore waters on the side of the boundary on which it originates. These shore waters, besides being in places unsightly, malodorous, and absolutely unfit for domestic purposes, are a source of serious danger to summer residents, bathers, and others who frequent the localities. So foul are they in many places that municipal ordinances have been passed prohibiting bathing in them.

2. In the Detroit and Niagara Rivers conditions exist which imperil the health and welfare of the citizens of both countries in direct contravention of the treaty. This is true, though in a less marked degree, of the Rainy and St. John Rivers.

3. In the St. Marys, St. Clair, and St. Lawrence Rivers pollution exists which is in substantial contravention of the spirit of the treaty, and unless these conditions are improved, and the rivers placed under the control of competent authority, the resulting injury will be much more pronounced as population increases.

4. Vessel pollution in certain parts of boundary waters exists to an extent which causes substantial injury to health and property. It is derived from two sources, sewage waste from vessels and "water ballast" which is taken in by lake vessels at their ports of departure and emptied into these waters at or near their ports of destination. Vessel pollution is distinctly traceable in boundary waters in lanes and channels which vessels traverse in navigating them, their waters being thereby rendered unfit for drinking purposes.

5. In some cases sawmill and other mill wastes, garbage, offal, carcases, and other refuse matters are discharged into boundary waters. This practice results generally in a contravention of the treaty.

6. It is feasible and practicable, without imposing an unreasonable burden upon the offending communities, to prevent or remedy pollution, both in the case of boundary waters and waters crossing the boundary.

(*a*) In the case of city sewage, this can best be accomplished by the installation of suitable collecting and treatment works, the latter having special reference to the removal of bacteria and matters in suspension.

(*b*) In the case of vessel sewage, a feasible and inexpensive remedy lies in the employment of recognized methods of disinfection before it is discharged. In the case of water ballast suitable rules and regulations should be prescribed with a view of protecting the water intakes.

(*c*) The discharge of garbage and sawmill waste into boundary waters should be prohibited, and industrial and other wastes, which are causing appreciable injury, should be discharged subject to such restrictions as may be prescribed.

7. In order to remedy and prevent the pollution of boundary waters and to render them sanitary and suitable for domestic purposes and other uses, and to secure adequate protection and development of all interests involved on both sides of the boundary, and to fulfil the obligations undertaken in Article IV of the treaty, it is advisable to confer upon the International Joint Commission ample jurisdiction to regulate and prohibit this pollution of boundary waters and waters crossing the boundary.

FAVORS CLOSED PROFESSION

IN last week's issue of *The Canadian Engineer*, in the report of a meeting of the Toronto Branch of the Engineering Institute of Canada, it was stated that R. O. Wynne-Roberts, during the course of a speech, had announced that he was against a closed profession. This was an error in the report. Mr. Wynne-Roberts calls to our attention that he stated that he was decidedly *in favor* of legislation for closing the engineering profession. *The Canadian Engineer* regrets this error and apologizes to Mr. Wynne-Roberts for the misunderstanding of his attitude.

The tender of the Hunter Bridge & Boiler Co., of Kincardine, Ont., has been accepted for the steelwork in connection with the Paisley bridge, which Fred B. James, county engineer, is remodelling for the Bruce County Council, Ontario. The price tendered for the new steelwork is $4,600, and for the repair work, 8½c. per lb. The concrete work was let to J. A. McKinnon, of Paisley at $3,124.

Maj.-Gen J. W. Stewart, of the railway contracting firm of Foley Brothers, Welch and Stewart, Vancouver, who has been on the western front since 1916, as head of railway construction along the British lines, is in Montreal. Interviewed on the great services rendered to the British transport service by which the Canadians became as famous behind the lines as on the battle front, he said that during the first two years of the war the British constructed a little over 100 miles of railway. From 1916 to the end of the war they built more than 3,000 miles of standard gauge and 6,000 miles of narrow gauge. This was a strong factor in the winning of the war, as the British army was thus enabled to move no less than 250,000 tons of munitions every month, said General Stewart.

Willis Chipman, consulting engineer, Toronto, has been appointed to the legislation committee of the Engineering Institute of Canada, to represent the Toronto Branch. In order to inform him as to the general attitude of the branch, a special meeting will be held this evening at the Engineers' Club, to discuss all phases of proposed legislation. Four prominent members have been asked to address the meeting and lead the discussion. A notice to members has been sent out by the chairman and the secretary-treasurer of the branch which says: "The members of the Toronto Branch are advised to read the articles on 'Legislation' appearing in the issue of the 'Engineering News-Record' of February 27th and *The Canadian Engineer* of the same date. These articles will be used as a basis for discussion."

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PRINCIPAL CONTENTS

DOMINION GOVERNMENT DESIRES MORE RAPID HOUSING PROGRESS

IN view of the fact that the Dominion loan for housing purposes was instituted having as one of its objects the stimulation of building operations during the transition period from war to peace, and the providing of employment and housing accommodation for returned soldiers, the Dominion government is anxious that the provinces take advantage of the loan as early as possible during the present year.

This is pointed out in a general statement issued by Hon. N. W. Rowell, chairman of the Cabinet Committee on Housing, which accompanies a memorandum sent to each of the provincial governments outlining the conditions upon which the $25,000,000 appropriation may be participated in and making certain suggestions as to the development of the scheme in so far as the provinces themselves are concerned.

The conditions and general principles incorporated in the memorandum have already been submitted to the provincial governments and all suggestions which have been made in their behalf have been fully considered and generally adopted. The statement by Mr. Rowell is as follows:—

"In some provinces, special officials are being appointed as directors of housing and town planning, and in others it is proposed to place the administration of these matters under the care of a special commission. Some action of this kind would seem to be very desirable in each province with a view to facilitating the work of preparing and carrying out schemes, and to secure that early action will be taken in utilizing the proposed loan.

"The Housing Committee of the Cabinet have arranged with Thomas Adams, housing and town planning adviser of the Commission of Conservation, to co-operate with the officers of the provincial governments in preparing and promoting schemes. General schemes prepared by the provincial governments and the communications of provincial authorities with regard to any details, may be sent to Thomas Adams at Ottawa. Municipalities and individuals should direct their communications to their own provincial governments or officers.

"It is hoped that the Federal branch of administration may be found useful to the different provinces as a clearing house for comparative information regarding details of schemes, methods of standardization of dwellings, costs of construction, town planning procedure, methods of expropriating lands for schemes, model plans of dwellings, statistics regarding amounts and periods of repayment of loans, etc.

"The conditions and general principles incorporated in the accompanying memorandum have been submitted to the provincial governments and all suggestions which have been made on their behalf have been fully considered, and generally adopted."

The memorandum attached to the above statement is a lengthy one, explaining in detail the condition on which the loan is granted, the terms of repayment and the standards recommended.

CIVIL SERVICE SALARIES

ENGINEERS who are civil servants in the employ of the Dominion Government may expect an early and substantial increase in salary, as the Civil Service Commission of Canada, of which W. J. Roche is chairman, sometime ago employed a staff of experts to classify the civil servants and to recommend readjustment of salaries. Knowing that this work was being done, a committee representing the council of the Engineering Institute of Canada, submitted to the experts a recommended schedule of engineering salaries which the institute considers to be fair and reasonable.

This schedule calls for increases of from 50% to 250% in the salaries of the engineers employed by the various departments of the Government.

There is, of course, no definite knowledge that this recommended schedule of salaries will be adopted, but it is understood that it is being given serious consideration by the classification experts, and it is expected that it will be adopted very largely and perhaps even in its entirety. The chairman of the commission informs *The Canadian Engineer* that the classification will likely be completed within the next three weeks, and that it will then be submitted to Governor-in-Council before being made public.

CANADA'S RESOURCES OVERESTIMATED?

THE tenth annual meeting of the Commission of Conservation was held in Ottawa recently, and occupied three days. Senator W. C. Edwards presided in the absence of Sir Clifford Sifton, chairman of the commission, who resigned some weeks ago, but whose resignation has not yet been accepted.

Referring to the work of the commission, the acting chairman said that, for his part, he thought much had been accomplished in ten years. The legislation with regard to railways and the consequent saving of our forests, due to the efforts of the commission, was in itself sufficient justification for its existence. He made a strong protest against the distribution of the idea, so prevalent, that Canada's resources are inexhaustible. This idea is, he believed, productive of waste. He declared that the lumber east of the Rocky Mountains is almost exhausted, and that every province in the Dominion over-estimates its lumber resources. Canada is rich in pulp wood, but unless the supply is conserved, she will not long continue so. Fisheries and minerals must also be saved.

The reconstruction work being carried on was criticized by the speaker. "A lot of commissions which have been established for dealing with after the war problems," he said, "will do little good. A careful study of the national resources of

the country and a systematic development of them would do more to solve these problems than anything else.

"The United States," he said, "has been called the most wasteful of nations, but a survey of conditions in Canada shows that she is pre-eminent in this respect, a pre-eminence of which she has no reason to be proud. Canada is now trying to adjust herself to post-war conditions, but it must be borne in mind that wasteful methods of developing or utilizing her natural resources will prove a fatal handicap."

PERSONALS

MAJOR G. L. RIDOUT, who last week opened an office in Toronto as a construction engineer, graduated in 1907 with honors in engineering at the Royal Military College, Kingston. After a season as structural draftsman in the bridge engineering office of the Canada Foundry Co., he undertook field engineering with the same company on steel bridge erection. From 1908 to 1910, inclusive, he made surveys and prepared reports on bridge sites and erection plans in connection with replacing old spans while maintaining traffic on the Canadian Pacific western lines, the National Transcontinental, the Timiskaming and Northern Ontario, and the Canadian Northern Ontario and Quebec lines. In 1910 Mr. Ridout undertook a sub-contract for erection of special steel towers for canal crossings and Toronto entrance for the Hydro-Electric Power Commission's transmission line, and the following year became resident engineer and superintendent of construction on the first 37-mile section out of Montreal of the Shawinigan Power Co.'s 110,000-volt transmission line. From 1912 to 1914, he was engaged in reinforced concrete construction with a well-known contracting firm, designing and erecting construction plant. In August, 1914, Mr. Ridout secured a commission in the Canadian Engineers and proceeded overseas with the first contingent. The following January he was commissioned in the Royal Engineers and was sent to France with the rank of lieutenant. In February, 1916, he organized a skilled railway construction company from men selected from the trenches, and he was commanding officer of this unit, at first with the rank of captain and later with that of major, until a month after the armistice. Most of the work of the unit was on the location and construction of standard-gauge railways, although seven months were spent in the construction of light railways through Elverdinghe, Boesinghe, Pilkem and Langemark. Major Ridout was mentioned in despatches and later was awarded the military cross. Under his command, his company reconstructed the main line of the Nord Railway to Lille, and the speed with which this particular work was carried out received special mention in Sir Douglas Haig's Victory Despatch.

LIEUT. ERNEST O. EWING has returned from overseas and has resumed his position with the firm of James, Loudon & Hertzberg, Ltd., consulting engineers, Toronto.

HAROLD R. WATSON has been engaged by James, Loudon & Hertzberg, Ltd., consulting engineers, Toronto, to take charge of a newly-established architectural department. It is the intention of the firm to engage in general architectural practice, but they will specialize in the architectural work of engineering structures.

E. A. CLEVELAND, consulting engineer, Vancouver, B.C., has discontinued private practice to accept an appointment as consulting engineer to the provincial government, particularly in regard to the development of the Southern Okanagan Lands recently purchased by the government for soldier and general land settlement.

A. J. MACDOUGALL, mechanical engineer of the Toronto Power Co., has resigned to accept the vice-presidency of the newly-incorporated National Electro-Products Co., Ltd. His successor is C. SPENCER, who was formerly in South America for interests associated with the company, and latterly in the American Army. Mr. MacDougall will build a plant in Toronto for the manufacture of oxygen by the electrical process.

A. G. WILKINS AND C. LAURENDEAU have joined the engineering staff of the General Supply Co. of Canada, Ltd., Ottawa. Mr. Wilkins is an engineering graduate of McGill University, and Mr. Laurendeau, of Laval University. Mr. Wilkins will look after the Wallace & Tiernan installations in Ontario, while Mr. Laurendeau will look after those in Quebec. The General Supply Co. of Canada, Ltd., are the Canadian agents for the Wallace & Tiernan Co., Inc., of New York City, and the growth in the number of installations of W. & T. chlorinators for water and sewage disinfection, have necessitated this increase in the staff in addition to J. Van Benchoten, who remains as chief engineer of the company's chlorinator department, with headquarters at Ottawa.

OBITUARY

ROBERT E. MILLIGAN, general manager of the New York Continental Jewell Filtration Co., died February 25th at his home in Newark, N.J. Mr. Milligan had not been in very good health for the past two years, and about February 1st, he became ill with pleurisy, from which he was unable to survive. Mr. Milligan was born November 8th, 1867, in St. John, N.B., and was educated in the public schools of that city. He attended the New York College of Pharmacy, from which he graduated in 1889 and became chemical engineer for the Continental Filtration Co., of New York. He was in charge of the company's work in St. Louis, and represented it in experiments at Pittsburg, subsequently constructing a number of filtration plants. In 1900 he became associated with the New York Continental Jewell Filtration Co. as chief engineer. In 1902 he was appointed assistant general manager, and the same year was awarded the Octave Chanute Medal (for mechanical engineering) by the Western Society of Engineers. In 1907, he was appointed general manager of the company. He was also a director of the National Water Main Cleaning Co. and the Continental Heater Corporation. He was past-president of the Water Works Manufacturers' Association, and a member of the American Society of Civil Engineers, American Water Works Association, Western Society of Engineers and Royal Society of Chemical Industry. He was well known in municipal and consulting engineering circles, and his funeral was very largely attended by men prominent in the water works field.

Following were the tenders per net ton, f.o.b. Hamilton, war tax and duty paid, for asphalt, opened last week by the Board of Control of Hamilton, Ont.:—Imperial Oil Co., $24.25 in packages, $19.25 in tank cars; Atlantic Refining Co., $25.59; Asphalt & Supply Co., $28.95 in packages, $25.90 in tank cars; U.S. Refining Co., $33.75; Texas Co., $34.28 in packages, $29.79 in tank cars; Barber Asphalt Co., $59.66.