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Editor

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CIRCULATION.

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CONTENTS.

CALGARY OIL FIELD

In view of the results obtained at the well of the Calgary Petroleum Products company, the recently issued geological map of the Sheep River Gas and Oil Field, Alberta, and the accompanying notes are of unusual interest. Last fall some account of the early discovery was given by Mr. R. W. Brock, Deputy Minister of Mines, and it was announced that Mr. D. B. Dowling had been assigned to study the district for the Geological Survey. Mr. Dowling prepared a geological sketch map of the area in which oil has been found, and this, with the accompanying memoir, is now ready for distribution. A considerable proportion of the text is reprinted in this issue of the Journal. In his report Mr. Dowling gives further details and useful notes on the occurrence of oil and gas in similar areas in the Western United States.

The map and memoir should prove very useful and the Geological Survey deserves great credit for placing them in the hands of the public at such a critical time.

Repeated warnings have been sounded against the reckless investment in shares of the numerous companies which have been recently incorporated. It is to be hoped that these warnings will be heeded. The capitalization of these several companies totals many millions and their properties are merely prospects. The recent strike has increased the value of the prospects, but the best properties are still in that class.

The results so far obtained must be very gratifying to those who are bearing the cost of the explorations. They may be expected to persist in their efforts. That there is oil has been demonstrated. Whether it occurs in large quantity remains to be determined. For the thorough exploration of the district there will be plenty of funds available. Experienced operators have been attracted by the possibilities of the Calgary oil field and vigorous exploration will be carried on.

NOVA SCOTIA COAL

Dullness in the iron trade in Canada and the United States continues, and the hoped-for revival seems as far off as ever. In consequence the iron and steel producers in Nova Scotia are having a very unpleasant time of it. The lack of orders for steel makes it more difficult to secure good sales for iron ore and coal.

Some of the coal mining companies are finding a fairly good market for their product. The Dominion Coal Co. is making large regular shipments, and President J. H. Plummer predicts a fairly good summer. On the other hand some mines are being worked only two or three days a week.

Nova Scotia has enormous quantities of coal and several of the mines have been well equipped. A much larger production can be made when the market warrants it and there will be a large production this year in any case. Coal mining should prove to be for many years one of Nova Scotia's greatest industries.

TECHNICAL EDUCATION IN NOVA SCOTIA

Considerable progress is being made in the provision of adequate technical education for the workmen of Nova Scotia. Largely through the efforts of Mr. F. H. Sexton, Principal of the Technical College of Nova Scotia, arrangements have been made for the holding of classes in many parts of the Province.

At the last annual meeting of the Mining Society of Nova Scotia a resolution was drafted asking that the recommendation made by the Royal Commission of Technical Education and Industrial Training, providing for increase in facilities for technical education, be carried out. The movement should prove a popular one. Enough has been accomplished to indicate that great improvement in the condition of the people can be made by giving the workman every chance to acquire technical knowledge.

CORRESPONDENCE

Editor Canadian Mining Journal:

Sir,—Appearing in your issue of June 1st is an article headed, "Report by the Provincial Assayer on the Surf Inlet Gold Mine, Princess Royal Island, B.C."

In this report measurements are wrong. Crosscuts are called drifts. Where the drift follows the foot wall it is said to follow the hanging wall, and where the vein could not be more perfect it is said to be broken up, thus showing that the writer had little conception of the facts before him.

It is stated in the summary of this report that the average assay value of the ore had not yet been determined. In justice to the management of the Surf Inlet property, let it be known that the Provincial Assayer was told that the average assay value of the ore was about $8.00. This has been determined by the manager, Mr. F. M. Wells, who is a thorough and competent sampler, and had his samples assayed by Mr. O'Sullivan, of Vancouver, and also by the writer, who was in charge, and accurately sampled and assayed the entire property. If the Provincial Assayer could take it for granted that the several crosscuts which he calls drifts were all in a fair grade of ore because we told him so, could he not have stated that the average assay value of the ore was about $8.00. He did not take a single sample underground, but relied entirely on the generosity of the management for his information.

In justice to the property and to Mr. F. M. Wells, who was the manager, it would be kind of you to give this letter space in your columns.

DAVID SLOCAN,
Rea Mine, Porcupine, Ont.

June 5, 1914.

OBITUARY
THE LATE ALFRED E. BARLOW

The awful disaster on the St. Lawrence river two weeks ago brought deep sorrow to many a Canadian home. Many who read the early accounts found that relatives or friends were among the missing. Mining men throughout Canada scanning the lists learned with regret that Dr. A. E. Barlow and his wife were lost.

Through his work in many parts of the Dominion, and latterly through his position of president of the Canadian Mining Institute, Dr. Barlow was very well known.

Alfred Ernest Barlow was born in Montreal, June 17, 1861. He graduated from McGill University, receiving the degrees of B.A. (1883). M.A. (1899) and D.Sc. (1900). He was in the employ of the Geological Survey of Canada for 23 years (1883-1906). In 1906 he resigned his position with the Survey to engage in private practice as consulting mining geologist. He lectured at McGill University during the past five years.

In his many years' work in the Government service Dr. Barlow became an authority on the Pre-Cambrian rocks of Northern Ontario. Among his most notable contributions are reports on the Sudbury nickel-copper district and the Haliburton corundum district.

Dr. Barlow was always an enthusiastic supporter of the Canadian Mining Institute. He gave much of his time to the furthering of the mining industry in Canada, and he was in 1913 elected president of the Institute.

CANADIAN MINING EXHIBIT AT THE PANAMA-PACIFIC INTERNATIONAL EXPOSITION.

San Francisco, June 10.

The Dominion of Canada will occupy a most prominent position among the foreign countries, officially represented at the Panama-Pacific International Exposition in 1915. The Canadian building, which is now under roof, will be completed and ready for the reception of exhibits in about three months. The structure, which is a triumph in architecture, has a length of 340 ft. a width of 240 ft. and a height of 50 ft. and will cost about $300,000. It will be the largest building ever erected by Canada at an international exposition, having about 65,000 ft. of floor space available for exhibits, and will present one of the most elaborate and comprehensive displays of the Dominion's resources and products ever shown on foreign soil. The total expenditure for the Canadian exhibition will be about $600,000. The exhibit will be entirely under the supervision of the Dominion Government.

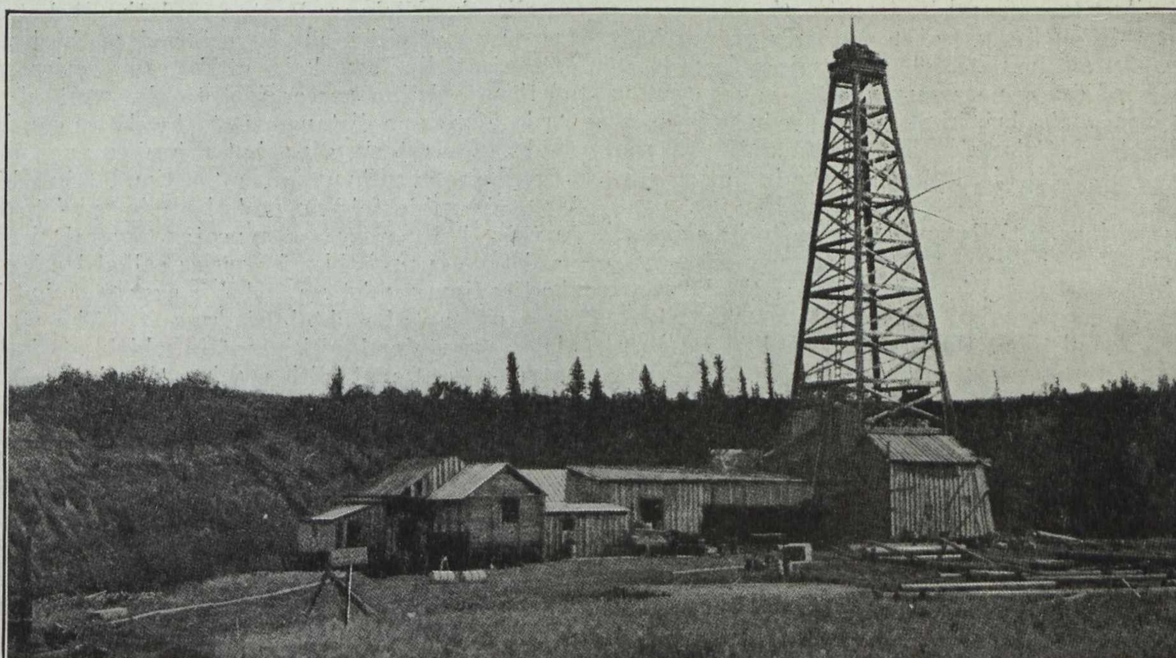
The Canadian Commission is making a special feature of the mining exhibit, which will be the most comprehensive presentation of the mineral resources of any country shown outside of the Palace of Mines, the magnificent structure now being completed by the Exposition Company.

A country with such a record in mining will send many visitors to the Panama-Pacific Exposition who cannot fail to be deeply interested in the wonderful exemplification of the mining industry which will be presented in the Palace of Mines and Metallurgy. In this magnificent structure, which occupies an area 451 by 579 ft. more than 200,000 square ft. of floor space will be available for exhibits, and every state in the American Union, and nearly every country whose people are extensively engaged in mining will be represented.

SHEEP RIVER GAS AND OIL FIELD, ALBERTA*

By D. B. Dowling.

The western edge of the great syncline which runs north and south through Alberta and crosses obliquely the fifth initial meridian, is for a short distance bent over into anticlinal form. West of this, which is the region commonly called the foot-hill country, the rocks are faulted and folded, and exposures of the lower series of rocks are to be found on many of the streams. Where the above-mentioned anticline crosses Sheep River the rocks exposed by the erosion of the crest of the anticline are Upper Cretaceous shales. These, on the south branch of Sheep river, are well exposed beneath sandstones which appear to belong to the coal bearing Edmonton series of Northern Alberta or the St. Mary River beds of Southern Alberta. In the centre of the anticline, sandstones and shales of the base of the Bearpaw or top of the Belly River formation appear, and in these, near the south branch of Sheep river, a leakage of strongly smelling gas has been known for years at the apex of the anticline.



Calgary Petroleum Products Company's Well, Sheep River, Alberta

Recent boring operations in this vicinity disclosed the presence of gas in the upper beds of the Belly River formation and, at a depth of a little over 1,550 ft., a small amount of light oil (about 90 per cent. gasoline) was found. This stimulated the belief that oil was to be found in commercial quantities in this region and many companies were formed with the object of drilling for oil. Assuming that oil is to be found in the rocks of the Belly River, or those at a lower horizon, it would be essential to success that drilling should be started (1), at a locality where oil and gas might be expected to accumulate and (2), where it could be reached at reasonable depths.

The Sheep Creek anticline offers, as far as structure goes, an opportunity of piercing these rocks at a moderate depth. To the west in the faulted zone of the foothills, these lower rocks are again brought to the surface and there may be areas there where oil may have accumulated, but the broken nature of the country would argue against any very large reservoirs.

A sketch of the geological structure on a line of section across the strike of these beds in the Sheep River area appears on the map accompanying these notes. The most striking feature illustrated by this section is the apparent great depth at which the Cretaceous rocks are buried at points to the east of the Sheep Creek anticline, and, therefore, all drilling in the Tertiary areas must depend for a possible supply of oil or gas on the rocks forming the Tertiary beds. Up to the present a small flow of gas has been obtained at several points, but this has been without much odor and the only oil found in Alberta in beds near this horizon is to the north, near Edmonton, in surface showings which have a possible origin in drift material brought from the Athabasca.

Extended notes on the geology of the foot-hill area southwest of Calgary will be found in a report by Mr. D. D. Cairnes on Moose Mountain region, Geological Survey Publication No. 968. Information of a more general nature on the geology of the northwest provinces is contained in Memoir No. 29 by Wyatt Malcolm, entitled "Oil and Gas Prospects of the Northwest Provinces of Canada." The following notes are intended to supplement the information therein given in regard to the possibilities of oil being found in the Cretaceous rocks.

Summary and Conclusions.

The boring on Sheep River has demonstrated the presence of small quantities of oil in the Belly River rocks, and there is a trace of oil in the weathered face of these sandstones in outcrops on the stream nearer the mountains.

Gas has been obtained at a number of localities in the Belly River formation.

*Extracts from Memoir No. 52, Geological Survey, Department of Mines, Canada.

The Cardium sandstone, which seems to represent the top of the Niobrara, is exposed on Sheep River, to the west of the Sheep River anticline, and paraffin and oil have been obtained from hand specimens by treatment with chloroform. This horizon is probably the source of much of the gas in the shallow wells at Medicine Hat.

The Dakota sandstone is in places, especially to the east where it is superposed on the Devonian, impregnated with bitumen and heavy oils.

The above three formations contain many sandstone beds which where porous may serve as reservoirs for the accumulation of oil or gas; but their accumulation in quantity depends partly on the structural form and mainly on the character of the surrounding shales. Traces of oil, it appears, can be found in many of the dark shales of the Cretaceous, and in the oil fields of the western states, such as Wyoming and Colorado, the finding of oil at the several horizons in the Cretaceous depends greatly on the presence of sandy porous beds in which it can accumulate. The anticlinal form is, in the majority of cases, necessary for the concentration of the oil into pools, but in very dry beds such as in the Florence field, Colorado, the oil acts as the heavier liquids and collects in the bottom of the basins or synclines.

The Sheep River anticline would seem to be a favorable situation for the concentration of any oil or gas in the rocks beneath, and by deep drilling the horizons which present possibilities, namely, the Belly River, the Cardium sandstone, the Dakota, and the Lower Cretaceous sandstones beneath, may be reached. The anticline in the first fault block to the west, namely the one passing near Lineham, affords a chance to reach the Dakota at a comparatively shallow depth.

General Geology.

The Macleod branch of the Canadian Pacific railway skirts the eastern edge of a belt of hilly country which lies to the east of the foot-hills proper. The rocks in these hills are of early Tertiary age and consist of light colored sandstones and clays that are exposed in the vicinity of Calgary and westward, on the Bow River. In the district under discussion these beds are found in the hills west of Okotoks and are there seen lying almost horizontally. To the west, up Sheep River, there are occasional exposures, and near the forks of the river the dip of the strata is to the east, thus showing the approach to the western edge of the syncline. The rocks beneath the heavy bedded sandstones such as are occasionally seen cropping on the sides of the hills, are apparently varicolored shales and sandstones dipping eastward and are in evidence on the banks of the stream north of the post-office at Black Diamond. From beneath these comes a thick series of sandstones which a short distance farther west are tilted at higher angles, and as coal seams are found with them, they may be provisionally correlated with the Edmonton beds. As these latter sandstones are of a harder nature than the rocks above and below, their presence is indicated by a line of hills crossing the river valley and through which the two branches of Sheep River have cut channels. This line of hills marks the eastern side of a long fold running parallel to the mountains, and, at a short distance west, a similar ridge seems to be formed by the westerly dipping beds of the same series, thus indicating an anticline. The rocks exposed across this portion between the hills, are dark colored marine shales representing the Bearpaw or upper portion of the Pierre-Foxhill formations. The intercalated fresh and brackish water member, the Belly River series, comes very near the surface in the centre of the anticline. The presence of a sandstone with markings resembling plants, indicates a change in condition of deposition, but, according to the record of drilling operations on this anticline, shales continued for nearly 300 feet before the sandstone series was reached. Westward of the sandstone rib on the west side of this anticline, a decided break or fault is indicated and lower beds have been brought up. These, both in thickness and composition, resemble the Bearpaw shales; but since at the top, overlain by black or brown shales, there occurs a sandstone member which is not to be found in the exposures of these shales to the east, it is concluded that they represent the Claggett which is below the Belly River. Marine fossils have been collected from this series, but they are not of species definitely characteristic of any horizon. These shales overlie the Niobrara-Benton and the Dakota, but no exposures of either are here found as the lowest beds of the anticline are shales of the same series. The axis of this anticline passes just to the west of Lineham ford. For some distance west, the shales continue with moderate westerly dips, but a broken zone is reached near the eastern boundary of section 33, in which there is considerable folding and the thin sandstones found in this shale series are repeated several times. This sandstone is probably the series called by Mr. Cairnes the Cardium sandstone and it is expected that in places some oil may be obtained from it. The outcrops in places are stained with paraffin which can be detected only by treatment with a solvent such as chloroform, and in this way a trace of a heavy oil can also be obtained. A band of steeply inclined beds of Belly River sandstone is found just above the mouth of Macabee Creek, and in these there are two horizons similarly stained with paraffin. One at about the centre is supposed to represent the beds from which some oil was obtained in the well being drilled on section 6, township 20, range 2. The shales to the east of this series of sandstones may possibly be the Claggett, but as their thickness is considerable and the sandstones at the base resemble the top of the Belly River series rather than the Cardium sandstones, they are provisionally called Bearpaw.

Description of Geological Formations.

The rocks exposed in the district, including also some of those found in the foot-hills to the west, are discussed in the general order of the following table:—

Tertiary........	Paskapoo series of northern Alberta, or Porcupine Hill beds of Southern Alberta.
Cretaceous......	Edmonton series of northern Alberta or St. Mary River beds of Southern Alberta.
	Bearpaw shales, the equivalent of the Pierre shales described east of the Alberta syncline.
	Belly River series.
	Claggett shales, the equivalent of the Lower Dark shales of Southern Alberta, or the lower part of the Pierre.
	Cardium sandstones.
	Niobrara-Benton shales.
	Dakota sandstones.
	Kootenay formation.
Jurassic........	Fernie shales.
Paleozoic	

Paskapoo Series—The rocks of this series as exposed in Northern Alberta are thus described by J. B. Tyrrell: "The beds consist of more or less hard, light grey or yellowish, brownish-weathering sandstone, usually thick-bedded but often showing false bedding; also of light bluish grey and olive sandy shales, often interstratified with bands of hard, lamellar, ferruginous sandstone, and sometimes with bands of concretionary blue limestone."

The thickness in the outer edge of the foot-hills on flows of gas have occasionally been found as instanced in the gas well at High River, but there it is not certain that the beds are of purely fresh water origin.

In the valley of Sheep River these sandstones are exposed in horizontal beds in Wilson coulee near Sandstone station, and in the hills bordering the valley west to the forks. Near Black Diamond post-office a heavy bed of sandstone outcrops near the south branch in section 16, and west of this exposures of the variegated shales and sands of the base of the formation are seen

Geological map of part of Sheep River Gas and Oil Field, Alberta. Shows location of well of Calgary Petroleum Products Co.

Little Red Deer River was determined as being at least 5,700 feet.

In Southern Alberta the sandstones are comparatively soft with intercalated greyish and blackish shales, the lower beds (Willow Creek of Dawson) having a pronounced reddish or purplish tint. The series is so far found to be entirely of fresh water origin. A few coal seams in the lower part are found in the country between Calgary and Edmonton. No authentic records of oil having been found in rocks of this division are known, though there are unconfirmed rumors of oil being found in the country west of Red Deer. Small with an eastern dip. The thickness of the formation here has not yet been measured but seems to be very great. East of the hill country the beds that are at the surface should be those of the lower and more shaly part.

The late Tertiary rocks of Texas produce in some of the domes both gas and oil. Veins of gilsonite, a hardened bitumen, are found in Teritary rocks of Middle Park, Colorado, and in the Green River formation in Utah. The great oil fields of California are mainly in late Tertiary rocks. The Tertiary rocks of Wyoming, the lower part of the Wasatch formation in

Carbon county, contain sandstones that yield 8 per cent. of oil with an asphaltic base.

Edmonton Series.—In the vicinity of Sheep River the series of sands and clays which form the base of the Paskapoo, merge into grey clays and sandstones in which one seam of coal is known and these are succeeded by more sandy beds. The base of the formation is distinctly a sandstone which is exposed on each side of the anticline, and being more resistant to erosion is marked in the topography by a series of long, narrow hills. The thickness of the sandstone rib is probably over 1,000 feet. In the foot-hills a second coal horizon is found near the base, though on Sheep River none was noted. The upper coal seam at Black Diamond and south near Tongue Creek is repeated on the west side of the anticline in the McDougall mine near Lineham post-office. Coal reported near the surface at the McDougall-Segur well may possibly have been from the lower coal horizon in the Edmonton.

Bituminous sands covered by boulder clay have been found at several places north of Edmonton. The origin of these sands is doubtful and there is a possibility that in some parts of the series a small amount of oil has been formed which has been collected in sands beneath the somewhat dense boulder clay. The possibility, however, of masses of the tar sands having been transported from the Athabasca county by the Keewatin glacier is not to be lost sight of. Drilling at these localities has been very expensive and has not proved the supposition that the oil found its way upward from the Dakota beds below. These pools of oil have, moreover, little value except when near enough the surface, so that the containing bed can be removed by excavating. The localities so far reported are: near Egg Lake, township 56, range 25, west 4th; section 28, township 56, range 2, west 5th; at Legal in township 57, range 25, west 4th; and north of the Athabasca on Freeman River, 12 miles above its mouth. Other localities whose positions are not definitely known are reported near the east end of Lesser Slave Lake.

Bearpaw Shales.—These marine shales occupy a position above the Belly River and are the equivalents of the Pierre-Foxhill of the plains of Alberta. The latter formation, as now understood, embraces also shales below the Belly River formation and hence individual names are required for the two divisions respectively above and below the Belly River.

In the foot-hill country, near the mountains, the thickness is found to be 650 feet. In the Calgary borehole, shales amounting to 530 feet are taken as representing this formation. At Kipp, borings show a thickness of 615 feet of shale above the Belly River coal seam. On the Red Deer River, east of Calgary, the thickness is about 750 feet. East of Edmonton it is about 800 feet and on the north slope of the Cypress hills McConnell found its thickness to be 900 feet. On Sheep River, between the limbs of the anticline, there are, east of the apex, two apparently unbroken series of shales with ironstone nodules and thin hardened streaks of sandy ironstone, separated by a very narrow band of shales with a discordant dip. These series each contain a section of shales, the eastern nearly 1,200 ft. and the western 800 ft. in thickness. At first view this would give a thickness of 2,000 ft., but as this does not seem warranted by the evident thickness elsewhere the presumption that there is a repetition somewhere in this setcion is warranted. The crumpled beds between the above-mentioned blocks are taken to represent a line of weakness and a possible normal fault is there assumed. Other faults may be present but were not detected and as a preliminary it is assumed that there is a thickness of 1,200 feet of shales as shown in what appears to be one block.

In Alberta and, probably, also Montana, these upper shales do not seem to contain oil. In Texas the beds representing the top of the Cretaceous contain oil in the Corsicana field and are supposed to have supplied the oil found in the Tertiary rocks at Beaumont.

Belly River Formation.—This is a brackish and fresh-water formation consisting of sandstones, shales, and a few coal seams. It very closely resembles the Edmonton formation and only by its position below the dark Bearpaw shales is its identity definitely known. According to Mr. Cairnes (Moose Mountain Report, No. 968, p. 27) the maximum thickness in the vicinity of the mountains is 1,025 ft. On Sheep River above the mouth of Macabee Creek, where these beds are marked on the Moose Mountain map, there seems to be a greater thickness than the above. In these beds signs of paraffin were detected on the outcrops in two places and these may correspond to the horizons at which oil was found in the well on section 6, township 20, range 2, west of the 5th meridian. Gas has been obtained from this formation in several places in Alberta besides the above-mentioned well.

Claggett Shales.—The shales lying below the Belly River rocks are marine and although very similar to the Benton, contain fossils that would place them higher in the series. They correspond in position to the Lower Dark Shales found by Dr. Dawson on Milk River near Lake Pakowki. These latter are classed by Stanton as being of Pierre age and representing the lower part of the Pierre shales as found in South Dakota. These beds are not found in any very great thickness in the foot-hills (150 to 300 ft.), and consist of dark shales with bands of ironstone similar to the shales above and below.

In Canada no reference has been made to the finding of oil or gas in these or in the lower Pierre shales, but in Wyoming some oil has been found in sandstones of the lower part of the Pierre, in the Powder River oil field, and also in the Salt Creek field in Natrona county. In Colorado, oil which is supposed to have come up from the Niobrara and Benton is found in the lower part of the Pierre in the Boulder and Florence fields. This horizon may correspond to the Claggett of Alberta.

Cardium Sandstones.—This division, which seems to represent shore and possibly land deposits formed at about the period represented farther east by the calcareous shales of the Niobrara formation, consists of coarse sandstones and black shales which have a thickness of about 50 to 100 ft. These are described by Mr. Cairnes and correlated with part of the Eagle sandstone of Montana. They are exposed on Sheep River as a narrow crumpled band at several localities west of Lineham post-office. The interest in this connection lies in the fact that several samples treated with chloroform imparted a decided brown-yellow color to this liquid. One sample so treated in the office at Ottawa, on evaporation left dark brown oily markings on the test tube and a large number of small needle-like particles, suggesting crystals of a white paraffin. This sandstone is a possible receptacle for oil that may come from the Benton shales beneath.

Niobrara-Benton Shales.—The upper part of this series may contain deposits of the same age as the Niobrara formation, but as these shales possess none of the Niobrara characteristics they are generally considered under the caption of Benton shales. This is also the case in Montana where the formation derives its name. At the town of Fort Benton there is no limestone corresponding to the Niobrara, and as there is no erosion interval or unconformity the Niobrara is probably represented by shales or sandstones; in this particular the Benton shales of Montana and Alberta no doubt embrace more than the formation known by the same name in Nebraska.

In the eastern exposures of the Cretaceous in Manitoba and also at various places along the northern face of the Cretaceous plateau, calcareous shales are found beneath the Pierre, which seem to be of Niobrara age, and at several localities these have a strong odor of petroleum and are often so impregnated that the shales will burn. Petroleum may be obtained from them by distillation.

These bituminous shales are exposed in the valley of the Pembina River south of Manitou in Manitoba, and on the face of the Pasquia hills in Eastern Saskatchewan, and, as before remarked, the Cardium sandstones which represent a contemporary deposit in the foot-hills seem to have contained petroleum in same of their exposures.

South of the International Boundary, the oil in the Salt Creek field of Wyoming is supposed to come from the Niobrara, but it is found in sandy beds at the base of the Pierre· In Colorado the oil of the Rangely oil district is procured from the central part of the Mancos shale and, as this formation includes Pierre and Niobrara-Benton, the horizon at which the oil is found may correspond to the Niobrara. In the Niobrara of the Florence field the rocks of the Apishapa and Timpas divisions contain in the pores and small joints much solid bitumen. None is found in the larger joints.

In Canada no mention is made of oil or bitumen as having been found in the Benton shales. In Manitoba they evidently contain much carbonaceous matter, but in the foot-hills the characteristic intense black color is not so prominent and the shales are more rusty in appearance and may be described as dark grey, rusty shales with many thin bands of ironstone and rusty sandstone.

Oil is found in the Benton in Wyoming and Colorado. In the Wyoming fields of Unita county, oil is obtained in the Aspen formation northeast of Spring Valley, and in the Bear River formation near Spring Valley. Near Bonanza, oil is found in the Wall Creek sandstone near the base of the Benton. The upper part of the Benton in the Douglas field, Converse county, contains a very thick oil, while that from the lower part is much lighter in color. In the Colorado oil fields, the Carlisle shale in the upper part of the Benton contains oil in the Florence field, while in the Boulder field it is thought that some oil obtained in higher measures has worked upward from the Benton.

Dakota.—The thickness of the Dakota in the foot-hills is from 900 to 1,700 ft. Rocks very similar to those of the Dakota formation and probably of the same age, are found in the foot-hills region and will, probably, be penetrated in some of the deeper borings. In the foot-hill exposures these rocks are sandstones of a general greenish tint. Dark shale beds are found in the lower part of the series and the division between the Dakota and the Kootenay series below is not well marked, and has been here assumed at a heavy conglomerate bed which serves as a horizon marker for the top of the coal-bearing rocks beneath. This series of sandstones is an important gas reservoir in the anticline which passes north through the plains region between Bow Island and Medicine Hat. The great pressure of the gas and its economic value has until lately satisfied the companies drilling, so that the origin of the gas has not been determined. It is well known however, that where these beds rest on the Devonian rocks of the Athabasca River, they are impregnated with a heavy oil which on weathered outcrops is thickened to a bitumen. The origin has been ascribed to the Devonian beneath, and in this connection it may be mentioned that these oils and tars are found over a large area in isolated exposures. The tar spring on Tar Island, Peace River, and others in the country at the head of the Wabiskaw River, although found in rocks above the Dakota, probably derive their oil from the Dakota. The suggestion that this sand formation acts as a reservoir for oil extracted from Devonian rocks is quite plausible, since in the basin drained by the Mackenzie where a wide area of these rocks occurs, many instances of tar springs in the Devonian are known. Thus on Slave River, below Fort Smith, and at several points on the west shore of Great Slave Lake, there are evidences of petroliferous shales and tar springs. Others are to be found on the banks of the Mackenzie near Fort Good Hope and below Fort Wrigley.

The sandstones of the formation discussed under the name Dakota no doubt underlie a great part of the area occupied by the Cretaceous plateau, and the question of its oil or gas bearing qualities depends in great measure on whether the underlying strata are capable of producing oil or not. It is not expected that the Devonian is in immediate contact with the Dakota over the whole area now covered by the Cretaceous, since the contact is one of unconformity and in the exposures of the lower rocks in the mountains a great thickness of Carboniferous limestones and shales, as well as later beds, are there found between the Dakota and the Devonian. It may be that some of these intervening beds are themselves petroliferous or gas-producing, in which case the Dakota may have enriched zones that would in a general manner be aligned with the mountains and would also follow the structure lines or flexures on the plains.

The nearest of the foreign oil fields developed in this horizon is that of Wyoming. In several of the areas there prospected, the Dakota formation is credited with containing bitumen and heavy oil. In the Powder River field, Natrona county, some oil is found in sandstone doubtfully called Dakota, but which may be of earlier age. Dutton and Rattlesnake fields also credit some oil to the Dakota. In the Oil Mountain field there is one spring on Oil mountain in Benton shales, but the oil probably comes up through a fault from the Dakota. In several fields in Unita county, small amounts of oil are obtained from the lower part of the Benton or Dakota.

In Crook county a heavy lubricating oil is obtained from the Dakota. Some oil has been got from near the outcrop of the top of the Dakota in the Newcastle field of Weston county. In Converse county, oil that is found in the lower part of the Benton or top of the Dakota is lighter than that found in the upper Benton of the Douglas field. A very light oil has been found in the lower part of the Dakota in the Shoshone field of Fremont county.

In Colorado, solid bitumen is found in the Dakota. In the states to the south, the origin of oil in the Trinity sands (probably of this horizon) is generally ascribed to the underlying Palaeozoic limestones and shales.

Kootenay.—This formation, which is generally very rich in coal deposits in the exposures in the Rocky mountains, thins out towards the east, so that its presence beneath the Dakota can only be expected in the western and perhaps southwestern portion of the Cretaceous area. The rocks are brownish sandstone and shales with abundant plant remains, and coal seams may be expected in the foot-hills area. This formation is found in Montana and thin deposits of about this horizon occur as far east as the Black hills. In the oil fields of Wyoming some oil is credited to sandstones at the base of the Cretaceous, which may be of this age, such as in Fremont county, and certain sandstones in the Douglas field of Converse county.

Occurrence of Oil and Gas.

Gas.—In Alberta, small quantities of gas are to be found in the sandstones of the Paskapoo and Edmonton formations. As these formations contain abundant evidence of plant life, both in the form of scattered material and in coal seams, the presence of gas may be expected; but as the beds are generally quite porous and are not capped by closer grained beds than the occasional clay deposits, the gas is probably to be obtained only in small amounts and at low pressure.

In the Belly River rocks which have a general resemblance to the Edmonton, the accumulation of gas is helped by the cover of close grained Bearpaw shales which overlie them, and although no great accumulations have yet been found in the prairie country, a very fair flow of gas was obtained in drilling on the Sheep River anticline. The gas was strong smelling and was evidently associated with a volatile oil.

Gas has also been obtained from rocks at about the horizon of the Niobrara at Medicine Hat and in Southern Manitoba.

The great flows of gas at Bow Island and at Pelican Rapids on the Athabasca, are believed to come from rocks at the horizon of the Dakota.

Oil.—The Devonian rocks of the Mackenzie basin have long been known to contain bituminous shales and they are also supposed to have been the original container of the oil found in the Tar Sand on the Athabasca. Small amounts of oil are known to exist in certain of the beds of the Niobrara as exposed in Southern Manitoba and Northern Saskatchewan. The percentage is, however, low and the oil could only be obtained by distillation. The value of these beds as sources of gas or oil, depends mainly on the presence of porous material above it, at the base of the Pierre, to act as a retainer. As remarked above, small flows of gas from this formation have been found near Treherne, Man.

In the foot-hills a sandy deposit at about the horizon of the Niobrara has been found in outcrop samples to contain paraffin and some oil, and it is expected that oil may be found at this horizon in the Sheep River borings.

The presence of oil in the Belly River formation at the well on Sheep River is the first intimation that the formation might be a source of oil, but an examination of the outcrops near Macabee creek revealed the presence of small traces of oil in these rocks so that the theory that this oil came up from below through faults or cracks at a recent date is not necessary.

SIXTH INTERNATIONAL CONGRESS

Of Mining, Metallurgy, Engineering and Economic Geology, London, 1915.

The next congress will be held in London, from Monday, July 12th, to Saturday, July 17th, 1915. The congress will be divided into four sections: mining, metallurgy, engineering and economic geology.

Participants in the Congress may be: (a) Honorary members and delegates of foreign states; (b) supporters of the Congress, that is, contributors of not less than £5 to the fund; (c) ordinary members who pay a Congress fee of £1, which entitles them to registration in any one of the four sections. These may register in any other sections by making a further payment of 5s. for each section.

The honorary members of the Congress and supporters will receive all publications of the Congress. Ordinary members will receive the transactions of that section in which they may elect to register by payment of the fee of £1. They can, however, receive the transactions of any other section on payment of the additional charge of 5s. per section referred to above. The Congress fee for ladies accompanying members is 16s. An application to join will be regarded as an undertaking to observe the by-laws of the Congress.

All participants will receive a card of membership and may take part in the discussions at meetings of the Congress and of the sections, in the excursions, and in the social functions. The authorized languages at the meetings are English, French and German. The official language of the Congress is English.

The Executive Committee have drawn up a list of selected subjects for discussion at the Congress, and have invited authorities to prepare papers thereon. In addition to these the Committee are prepared to accept a limited number of other papers, if found suitable for the objects of the Congress. All papers must reach the committee not later than January 31st, 1915. Papers may be submitted in any of the three authorized languages (English, French, German) and must be accompanied by a short abstract in the same language as the paper. The papers will be printed in one of the three languages, and the abstract will be printed in all three languages.

At the meetings of the sections of the Congress the papers will not be read, but authors will be invited to introduce the subjects of their papers for purposes of discussion. Except in special cases, the time allowed to authors for the introduction of their subject shall not exceed 15 minutes.

IRON ORE SHIPMENTS.

Shipments of iron ore from lake ports in May amounted to only 3,852,063 tons, as compared with 7,284,212 tons in May of last year.

Shipments to June 1 of this year were 4,121,749 tons; compared with 8,150,599 tons last year.

PORCUPINE.

Porcupine is making good progress. The Hollinger and Acme mines are in splendid shape. The Porcupine Crown and McIntyre mines are producing regularly. The Schumacher is being developed slowly, but with fairly good results. The Jupiter is developing good ore. The Vipond has been reopened. The Rea mine is being worked again and exploration is being carried on in the hope of finding ore at lower levels.

CEMENTING OIL AND GAS WELLS*

By I. N. Knapp.

I herewith present some notes on the use of Portland cement to cement in the casing, and for plugging, to exclude water from oil and gas wells, and the methods employed. I have used my best efforts to make each step of the operation of cementing wells prefectly clear. The information is the result of actual experience and observation.

If any formation does not give a satisfactory seat for a casing shoe, a wall packer, or a plug to exclude water from a well it becomes necessary to use a hydraulic cement. Portland cement mortars are best adapted for the purpose and neat cement only should be used in cementing in casing, for reasons given later.

Use of Mud in Cementing and Drilling.

It is necessary to use a mud mixture in any well to be cemented so as to exclude all oil, gas, or ground water, and such mud is circulated and made to carry the cement to place but not to mix with it.

Mud-ladened water is used in drilling by the hydraulic rotary method to seal off all porous strata immediately as encountered by the drill; also to counterbalance any tendency of ground water, oil, or gas running into the hole.

It is fundamental in drilling by the method mentioned that such mud circulation must go down through the drill pipe and bit and up the walls of the well and overflow to a mud pit at the surface.

Plastic materials such as are cut up by the bit and carried up the hole by the circulation are by the wobble of the drill pipe plastered and rolled into the walls of the well, thus giving any sand strata encountered a plastic covering.

Wells in unconsolidated materials consisting of sand, gravel, mud, and clay skilfully drilled by this method and kept full of mud at all times do not cave when the drill pipe is withdrawn and will remain clear for days so a pipe can be run to bottom without being "pumped down" and the mud circulation restored preparatory to cementing.

There are in very rare cases coarsely porous or cavernous limestones that cannot be mudded off in the usual way.

Capt. A. F. Lucas, in his early experimental drilling in Louisiana and Texas, demonstrated some 15 years ago the use of mud in drilling soft formations to keep the holes in shape and overcome gas and water pressures, and its use became general in the Texas and Louisiana oil fields some 12 years ago, and since in California.

Results with the Use of Mud.

As a practical matter, drilling with the hydraulic rotary method and using 25 per cent. of mud, I have repeatedly sunk through a gas horizon between 1,500 and 1,600 ft. deep, where there was a measured gas pressure of 650 lb. per square inch, set a screen in this horizon and cemented in a casing above the screen without a bubble of gas showing, and not until the pressure was reduced by bailing of the well did gas show.

Also, by the same method I have drilled through a known artesian water-bearing horizon between 1,900 and 2,000 ft. in depth without any sign of its existence, such as increase in the overflow, or of much loss of mud to the porous strata. In this water well a 6⅝-in. casing was set at about 1,880 ft. with a rubber wall packer and then drilled to 2,007 ft., when clear fresh water was pumped in through the drill pipe. When the mud was washed out the well began to flow and the drill pipe was withdrawn. This well threw out considerable sand, shells, and pieces of rock, possibly 30 or 40 cu. yd. in two days. In the course of a week the water ran practically clear and reached a steady flow of about 450 gal. per minute at the surface and gave a static head of about 80 ft. It had 80 ft. of surface casing and was then drilled 1,800 ft. without difficulty, passing three known water-bearing horizons and many loose sand beds, but the hole being always kept full of mud did not cave and the drill pipe could be left in over night with no sign of sticking.

Also, wells are frequently drilled into an oil-bearing horizon without showing a sign of oil, the only guide being the known depth to the oil sand in adjacent wells and the taste of oil in the particles of old sand in the overflow.

This brings out the extreme difficulty in prospecting for oil, gas, or water using the hydraulic rotary method of drilling.

Preparation for Cementing in Casing.

A well properly drilled by the method before mentioned and kept full of mud is in perfect condition for cementing. Wells drilled by other methods should be lubricated or filled with mud. Before running in the casing it is best to make sure such casing will go to the bottom and turn freely in the hole. This can be done by running in say three joints of the size of casing to be used on a string of drill pipe to the bottom of the hole. It may be necessary to put a rotary shoe on the end of the casing for removing lumps or straightening crooks in the hole. When the pipe is at bottom a proper mud circulation can be established and all water (salt, alkaline, or potable) as well as any oil or gas can be completely excluded and the well brought to condition for successful cementing.

The amount of cement to be provided may be roughly estimated by assuming that one sack (95 lb.) of neat cement mixture will fill 1.25 cu. ft. of space.

If, for instance, an 8-in. pipe is to be set in an 11-in. hole it will take between 20 and 25 sacks of neat cement to fill the calculated space for 100 ft. There should be provided a mixing box about 5 ft. wide by 8 ft. long by 18 in. deep with gate at one end to draw off the mixed cement, two cementing plugs, bottom and top (see Fig. 1) two mortar hoes, four shovels, two galvanized iron buckets, and a barrel to dip water from; also some sort of screen to pass the dry cement through to break up and take out lumps before mixing. Six men with a box of the size named and with the tools indicated will mix 10 batches of eight sacks each in 1 hr. It is desirable to get the mixed cement in place as quickly as possible and 1 to 1½ hr. is about the limit of time in which cement may be mixed for any one job of casing cementing and run in place. If more than 80 sacks of cement are required, a larger mixing box, or two boxes and more men, or a machine cement mixer will be required.

Mixing Cement Mortars.

It is impracticable to specify any particular percentage of water to be used in mixing cement neat or

*A paper presented at the New York meeting, A.I.M.E., February, 1914.

with sand. The best guide is to use the least possible amount of water practical for the work in hand.

As hydraulic cements require water to cause them to set and they will also harden immersed in water it is a common error to suppose they cannot be harmed by an excess of water. Experiments show that any excess in mixing is weakening in effect and retards setting and hardening. In fact, a large excess of water with prolonged mixing makes a mortar that will not properly harden at all.

If for instance eight sacks of cement are mixed with 18 buckets of water and the mixture works up too thin reduce next batch to say 16 buckets. In all cases make some measure of the water to get a uniform mixture of cement going into the hole.

Methods of Cementing in Well Casing and Plugging Wells.

There are several methods of doing this, such as: (1) Lowering the cement mixture in a dump bailer, particularly for plugging wells. (2) Pumping the mixture through a tubing properly arranged to force such mixture outside the casing. (3) Using two cementing plugs and pouring or pumping the mixture in the casing and forcing it down and up outside the casing by pump pressure.

The first method is unreliable and uncertain even in plugging a wet hole. Its use should not be attempted to cement in casing.

The second method is open to the objection of having a string of tubing to manipulate with the casing to be set and as ordinarily used with one cementing plug gives a wet string of tubing (pipe full of water) to pull out.

The third method of using two cementing plugs and displacing the mud with cement by gravity or pumping, as hereinafter described, is in my experience the best for general purposes, as it can be used with the certainty that the cement will be forced by pump pressure into the space between the casing and wall of the well in the shortest possible time and with the least chance of contamination of the cement mixture. There are other methods of cementing with which I am not familiar.

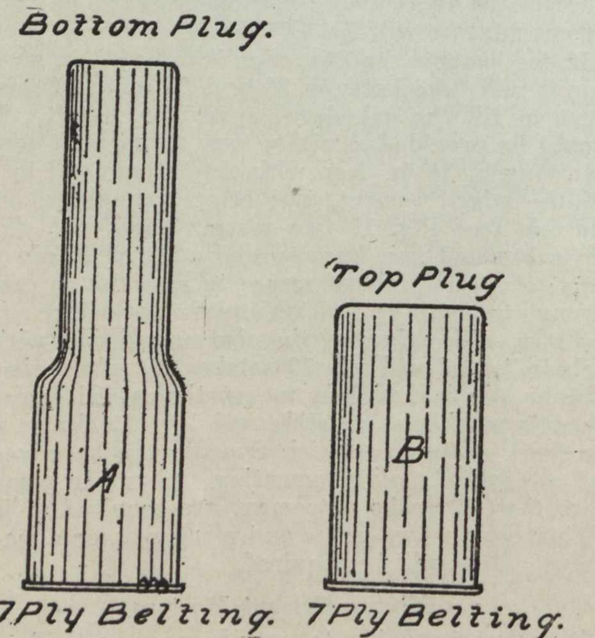


Fig. 1. Cementing Plugs.

The plugs, Fig. 1, are made of any soft wood that will drill out easily and of a diameter to pass freely through the pipe in which they are to be used.

The bottom plug (A) should be 30 to 36 in. long, to run in a 6 or 8 in. pipe, and other sizes in proportion. The full-size portion of the plug should be 6 or 8 in. long and the diameter then reduced to 4 or 5 in. for the rest of its length.

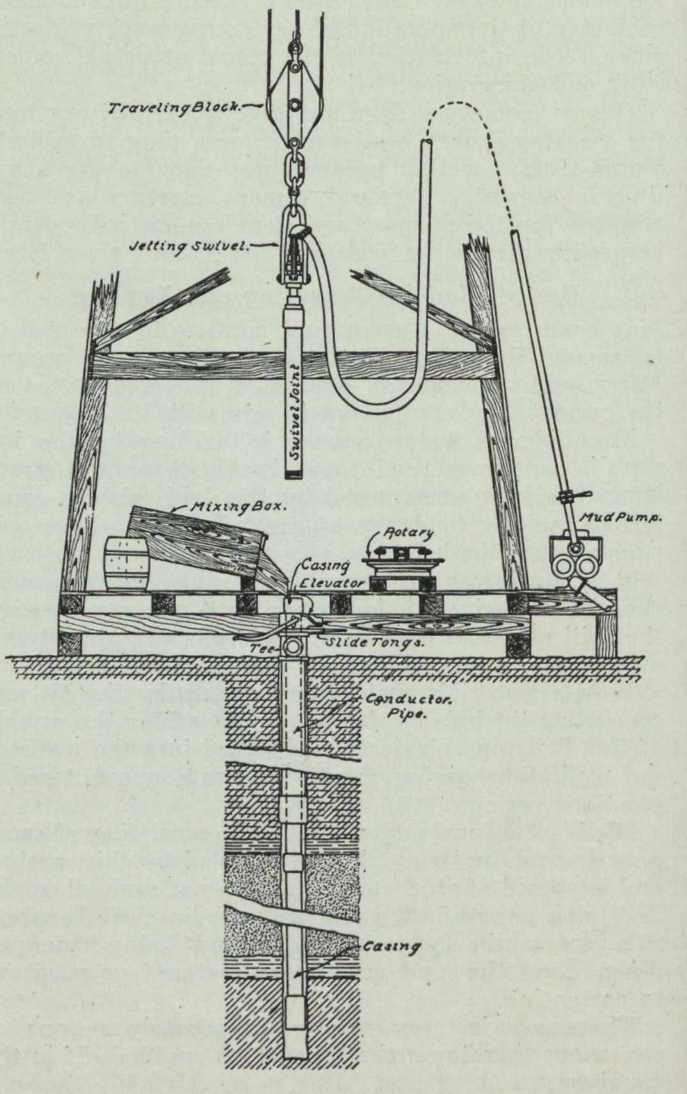


Fig. 2. Introducing Cement by Gravity.

The top plug (B) should be about 8 or 10 in. long for the same sized pipes. Both plugs are faced on the bottom ends with one thickness of 7-ply rubber belting so that they will fit snugly in the casing. These pieces of belting act as scavengers; the one on Plug A cleans the inside of the pipe of mud as it descends so as not to adulterate the cement; the one on plug B tends to keep all the cement pushed ahead of it.

Explanation of Cementing Operations.

Fig. 2 indicates how the cement may be introduced into the well by gravity. It shows the lower panel of a derrick with mud pump and connections to jetting swivel, also the traveling block. The rotary is set to one side. A conductor pipe is indicated as set in the well with the top coupling replaced with a tee. The overflow from the well may thus be piped through the conductor pipe and tee to the outside of the derrick. In running the casing, as shown, into the well, the cementing plug A should be run through each joint as it is hoisted up in the derrick to be connected, in order to make sure that there are no blisters, dents, or other obstructions in them. The casing is lowered to bottom, marked, pulled back just enough so the mud will circulate freely by pumping, and again marked.

After the mud in the well and pits is evenly tempered by circulation, the casing is hung on the slide tongs and elevators placed on the tee on the conductor pipe just under the derrick floor. The swivel joint is unscrewed and set back. In order that the casing will take the cement by gravity the well is bailed down about 200 ft. by displacing the mud with the drill pipe or by bailing in the regular way.

If there is danger in bailing of a gas blow-out or a cave-in from water pressures then other methods must be employed as hereinafter described.

The well and casing should be kept covered at all times so that nothing can fall into the hole. After bailing, the swivel joint is hooked on again and hoisted out of the way to be ready for instant use.

The casing is indicated in the figure in place ready for cementing. The mixing box is placed so that when the end gate is opened the mixed cement will flow into the top of the casing. The water barrel is placed conveniently near and means for filling it quickly must be provided. The cement required should be stacked on the derrick floor and all the necessary tools assembled.

The dry cement should be dumped from the sack onto a screen, temporarily placed over the mixing box.

It should not be attempted by this method to put in more than 80 sacks (95 lb. each), as this is about the limit than can be mixed in one hour, with seven men and the appliances mentioned. Everything being ready, the first batch (8 sacks) is mixed, the cover taken off the casing, the plug A dropped in small end up, and the cement mixture run in. It is best to pass it through a wire screen (⅜-in. mesh) as it flows into the casing, so as to break up any dry lumps.

The succeeding batches are mixed and run in as rapidly as possible. The neat-cement mixture being

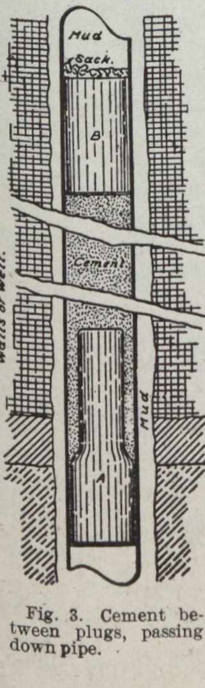


Fig. 3. Cement between plugs, passing down pipe.

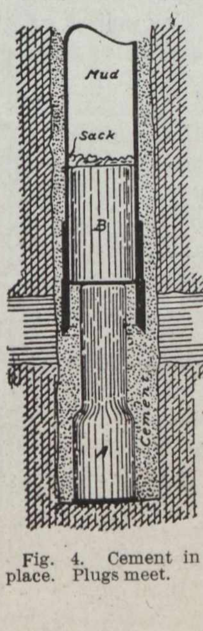


Fig. 4. Cement in place. Plugs meet.

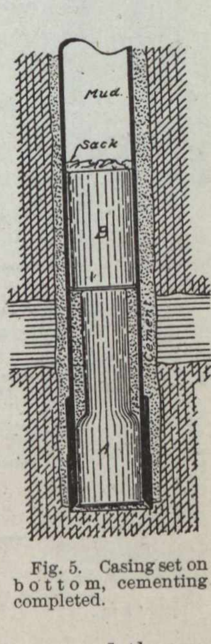


Fig. 5. Casing set on bottom, cementing completed.

much the heavier will force the mud down and then up outside the casing. If the casing is hung up more than 12 or 18 in. from bottom, care must be taken not to push the plug A below the casing before being brought to the position as shown in Fig. 4.

The required amount of cement having been put in, the plug B is dropped in with a cement sack on it as a packer against the pump pressure, the swivel joint connected, the elevator and slide tongs removed, the casing lowered to 12 or 18 in. off bottom and the mud pump started.

After the mud pump has run long enough to fill the swivel pipe and some pressure is shown by the pump gauge it should be stopped and the vent cock, indicated in Fig. 6, opened to let out the imprisoned air. If air is allowed to remain in the casing, or if the suction pipe of the pump or the piston rod packing leaks, such air becomes highly compressed into bubbles in the mud and may cause trouble. Meantime the mud pit is stirred up to make the descending column of mud as heavy as possible to counterbalance the cement column outside the casing. The number of revolutions required for the pump to fill the casing should be calculated and count kept to anticipate about when the cementing plugs should meet.

The cement column is forced by the pump down the casing between the two plugs as indicated by Fig. 3. When the first plug gets to the bottom of the well it goes partly out of the casing as indicated by A, Fig. 4, and allows the cement to pass outward and up between the casing and the walls of the well. The cement floats the mud and it is pushed upward by the pump pressure.

When the plug B meets the plug A, as indicated in Fig. 4, the cement is all out of the casing and the pump stops short by reason of the plug obstruction and the sack packer. The casing should now be given a few turns in the hole to distribute the cement. This can easily be done by two men with a chain tongs. The pump pressure remains on and the casing is set on bottom as indicated by Fig. 5.

The vent is then opened and there should be only a slight back flow, say a barrel of mud, if all air has been vented at the proper time, and the casing shoe is tight. It will be necessary to hold the pump pressure for 24 hr. if there is a strong back flow.

Objections to Cementing by Gravity.

This method requires a reduction of the mud head in the well by bailing and gives opportunity for a gas blow out or for oil or ground waters to enter and cave the well.

Also, the lower end of the casing is open, which may act as a scraper against the walls of the well and the casing may become filled with thick mud enough to prevent the passage of the plugs. It is the practice of some, after a string of casing with the lower end open is run in and the mud circulation established, to hang up the casing, unscrew the swivel joint, throw in a cement sack and pump it down to make sure the casing is clear before cementing.

If there is no danger in bailing the well down, or in plugging the lower end of the casing with the thick stuff, and 80 sacks or less of cement is to be used, the gravity method is, I think, the best that can be devised.

Necessity of Using Neat Cement.

By the means described the neat cement reaches the bottom of the casing with but little if any contamination.

The only means that we have of scavenging the outside of the casing and walls of the well is by floating the mud up and displacing it with the cement mixture.

The heavier the cement the better this action, hence it is desirable to use a cement neat and not reduce it with sand. The cement gets contaminated and mixed to an unknown degree with the mud clinging to the outside of the casing and the walls of the well, which also makes the use of a neat cement practically necessary.

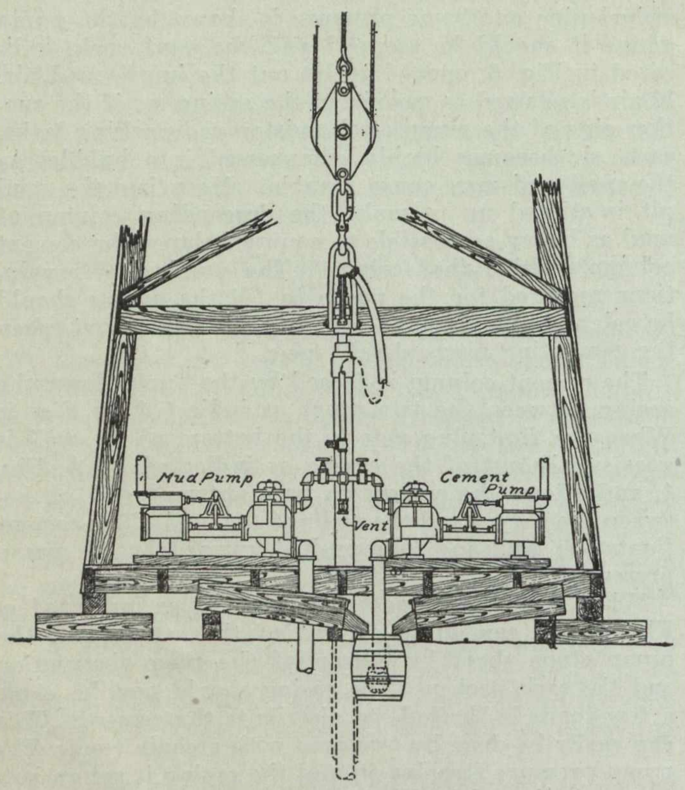


Fig. 6. Introducing Cement by Pumping.

Fig. 6 indicates a general surface arrangement for pumping the cement into the casing. The view is at right angles to that shown in Fig. 2, with two pumps set as commonly used in rotary drilling.

To increase the cement-mixing facilities, two mixing boxes can be used as shown, or a machine mixer employed. The mixed cement is drawn into a barrel, sunk below the surface. The suction pipe of the pump to the right is extended into the cement barrel and the pump to the left has its suction opening in the mud pit (not shown).

The manipulation is the same as in the gravity method of putting in the cement, except that when the plug A has been dropped in, the swivel joint is again connected, and the cement pumped in. When the cement is all in, the vent cock is opened; air will be drawn in because the descending column of cement will push ahead the lighter mud and make a vacuum.

The swivel pipe is then disconnected, the plug B and sack put in; the pipe is again connected, and the mud pumping started. I usually arrange for the mud pump to discharge into the cement barrel so that the cementing pump will run on mud and thus clean itself and the connections of cement. Since the surface of the cement may fall 100 ft. or more and the casing fill with air when opened, it is essential to vent this air, after the pump gauge shows some pressure, as before described.

Advantages of Pumping Method.

By this method no bailing of the well is required, so the danger from blow-outs and cave-ins is eliminated. Also a much larger quantity of cement may be handled in a given time than can be run in by gravity.

Improvement on the Cementing Methods Described.

The bottom cementing plug A has to pass partly out of the lower end of the casing in order to become operative by the common method and this prevents the use of a back-pressure valve. As the use of such valve together with two cementing plugs was desirable in deep (2,000 ft.) well cementing operations, I invented a method for the simultaneous use of both, as shown in operation in Fig. 7.

This apparatus consists of a double-swedged, by-pass nipple (if for an 8-in. string) made of a piece of 9-in. pipe, about 24 in. long, swedged to 8 in., threaded on both ends and couplings screwed on. Near one end of the 9-in. section two brass bars are put across at right angles, thus forming a rest for the bottom plug, and when the plug is in the position shown the cement is by-passed so the plugs can meet.

The brass bars can be made of ¾-in. brass pipe. They must be substantial, since the pump pressure may rise to 400 lb. and throw 10 tons pressure on them when the plugs meet. A back-pressure valve is screwed into the bottom coupling on the by-pass nipple as shown in Fig. 7. This should be a substantial brass valve for deep work. The bars and valve are made of brass so that they can be easily drilled out, with the wooden plugs, at the proper time.

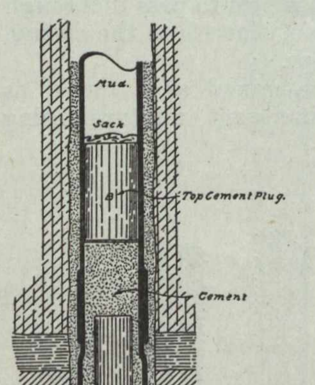


Fig. 7.

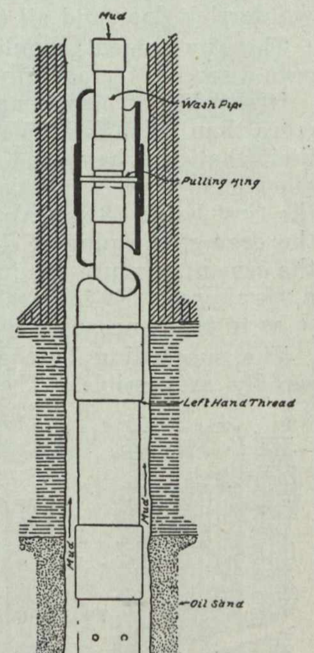


Fig. 8.

Under the back-pressure valve is fitted a 9 to 8-in. swedged nipple not threaded on the 9-in. end. This acts as a casing shoe and protects the valve.

The two couplings on the by-pass nipple should be screwed up as tight as possible and then pinned or riveted in each thread. When the wooden plugs, brass bars, valve, and cement are being drilled out there is a possible danger that these threads may work loose by the action of the drill and the parts unscrew. This would make trouble and should be avoided.

Advantage of Using the Double-Swedged Nipple.

This invention (not patented) prevents the possible accidental passage of the cementing plugs out of the casing and permits the use of a back-pressure valve. This valve prevents thick mud from being forced back into the casing. The casing can be partly floated, thus making a long string much easier to handle. The casing can be bailed down to take any quantity of cement by gravity without endangering the well, also the cement mixture after passing the valve cannot flow back into the casing. The cementing operation may be done by gravity or pumping as before described.

Setting Screen and Cementing Casing Above.

When casing cementing is required, it is usually necessary also to set a screen, to make a proper test for oil or gas or bring a well in from a known horizon. In such cases I prefer to set a screen the full size of the casing required, for the closer the screen fits to the walls of the well the better for the well.

The screen with two joints of the same size casing above may be run in on a string of drill pipe.

Fig. 8 shows a screen set in place with all necessary fitting. The brass blade shown at the very bottom is to produce friction in order that the left-hand thread at the top of the screen may be easily unscrewed at the proper time. The short one-thread nipple is to hold the brass blade and protect the back-pressure valve. This valve is for the purpose before described and permanently closes the lower end of the screen when set. The wash plug in the lower end of the screen serves as a guide and packer to the wash pipe. The function of the wash pipe is to carry all the mud down through the screen and the back-pressure valve so it may pass up outside the screen and casing.

The screen may be of any size or length and made with drill holes only or wire wound to any mesh desired. At the top of the screen is a left-hand nipple 2 or 3 ft. long with the left-hand thread up. By putting the proper tension on the drill pipe and turning, the left-hand thread unscrews and leaves the screen in the hole. The wash pipe is pulled out by the pulling ring.

When the coupling (6 or 8 in.) containing the pulling ring is landed on the elevators at the surface and the joint above unscrewed then the wash-pipe elevators (2 or 2½ in.) may be put on under the top coupling of the string and the wash pipe pulled.

Plugging Top of Screen for Cementing.

A soft wooden plug about 20 in. long is made as shown in Fig. 9. The bottom of the plug is made conical as a guide in entering and the body cylindrical to fit tight into the screen nipple, which has a left-hand thread.

The top is rounded over to guide the swedge nipple that is later placed to fit down over the left-hand thread. A 1¼-in. vent hole is bored through the axis of the plug in order to allow mud to flow back into the drill pipe in setting the plug.

A countersink 6 in. deep is made in the top of the plug so that it may be fitted on the end of the (4-in.) drill pipe. A piece of leather is nailed over the vent hole in the bottom of the countersink so as to make a flap valve.

The plug is then run in on a string of drill pipe to bottom.

I have found by experience that enough loose material will be pushed ahead of the plug to pack efficiently outside the left-hand nipple so that no cement will flow down outside the screen in cementing. Pump pressure is put on the drill pipe, which closes the flap valve in top of the plug. The string is raised and the drill pipe pulls out of the plug, an immediate fall of pressure being shown by the pump gauge, indicating that the plug is left in place.

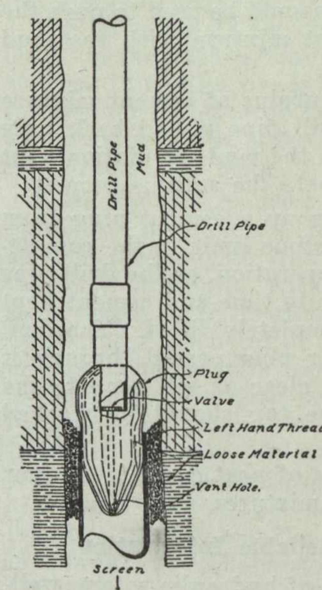


Fig. 9.

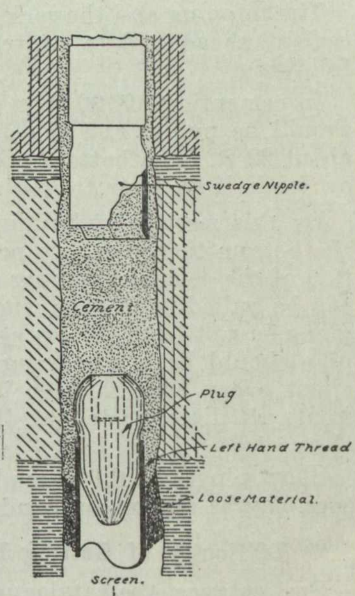


Fig. 10.

The string of pipe is pulled out and the well is then in shape for running in a string of casing and cementing.

Cementing in the Casing Above the Screen.

On this string should be a by-pass nipple, as previously described. Whether a back-pressure valve is to be used or not is determined by the depth and condition of the well. The string (if 8-in.) should have on its bottom end a 9 by 8-in. swedged nipple. The 9-in. end should be cut with an offset and the lip thus formed bellied out slightly as indicated in Fig. 10. The purpose of this lip is to guide the plug and screen in line by turning the casing and to give a "feeling" which will indicate whether the swedge nipple is resting on top of the plug or has slipped down over the left-hand thread as it should. The string is lowered to bottom and marked, then pulled up until the circulation of mud is good.

The cementing operation may be done by the methods already described. After the cement has had time to harden, five days should be plenty, the wooden plugs, brass bars, and back-pressure valve may be drilled out, the inside of the screen washed out with mud down to the wash-pipe plug and the drill pipe then withdrawn. A gate valve should be put on the casing and the well is then ready to bail to test for oil or gas.

Plugging Wells by Cementing.

The two-plug cementing system is well adapted to put in a cement plug in the bottom of a well to exclude water or fill a well any distance with cement mortar. For instance, if it is desired to plug off the bottom 20 ft. of a hole the proceeding would be practically the same as cementing in a casing but no by-pass nipple or back-pressure valve would be used and the drill pipe would be employed to pass the cement to the bottom of the hole. The bottom plug should be made 36 in. long, but not tapered, and bored full of holes, which are filled with lead so that the plug will stay on the bottom. The operation should be so performed that the bottom plug will shut off the pump when it reaches bottom and not by-pass the cement as before described. The drill pipe should then be pulled back until the bottom plug passes out. About half the cement to be placed should be pumped through, then the drilling pipe should be pulled back proportionately.

The top plug and the sack should be used to push the cement ahead and to prevent mixture with the mud following.

In cementing off 20 ft. a surplus of cement mixture should be put in and the drill pipe pulled back only about 22 ft. from bottom and the mud circulation kept on for half an hour to dissipate the surplus cement.

By this method of building up a cement plug from the bottom there need be no time limit to the completion of the cement-plugging operation, as the drill pipe can be pulled back from time to time and cement kept going in until the hole is completely filled. The drill pipe should have a scavenger plug passed through it about every hour to keep it clear of set cement; the joints as disconnected at the top should be washed clear.

Short plugs should be made of neat cement. Larger ones may be cement-and-sand mixtures.

Difficulty of Getting Reliable Information.

For instance, the catalogue of hydraulic rotary well-drilling machinery of a prominent oil-well supply company has an article on "Cementing Casing in Wells." I quote from it as follows: "Seventh: Force the plug into the well by running in the drill pipe on top of same until the plugs and cement reach the bottom of the hole; water should be run into the hole as the drill pipe is lowered."

This might be practical for shallow strings of casing up to 800 ft. But how about 2,000 ft.? If the drill pipe is stacked in trebles in the derrick it takes quick work to run in 1,000 ft. per hour, so, if it took an hour to mix the cement and get it in the top of the hole and two hours to run the plugs it would take close to three hours to get the cement to the bottom of 2,000 ft. of casing, when it would probably have set some—enough to be too hard to allow of its being forced up outside the casing into place. But why use a drill pipe for such purpose when the cement can be dumped down 2,000 ft. by the mud-pump pressure in 10 min. or less?

Quoting the same catalogue further: "Ninth: When in doubt of the plugs being together, a measuring line should be used for verification."

As a practical matter the length of the drill pipe is known by actual measurements so that the exact location of the plugs should be known when a drill pipe is run in as directed under the seventh item, so what verification is necessary with a measuring line?

Quoting further: "Eleventh: Cement will not set in oil. . . . ."

Dry cement will not set if mixed with oil because there is no water to hydrate it. Cement properly mixed with water and poured into oil will set and harden in the oil, as I know by actual trial.

Water Supply Paper No. 257, U. S. Geological Survey, on Well-Drilling Methods, in describing the hydraulic rotary method under "Drilling Operations," p. 71, says: "Drilling is accomplished by rotating the entire string of casing, on whose lower end is a toothed cutting shoe."

It would be practically impossible to drill a well 1,000 ft. in depth with a toothed cutting shoe on a string of casing in any possible formation. A casing that is to be set either as a water-excluding string or as an oil or gas string is never used to drill with. It is true very pretty pictures have for years past appeared in various well-supply dealers' catalogues showing how wells are drilled with rotary shoes, but as a practical matter wells are never drilled in this way. A rotary shoe is a very useful tool to run in with a joint of casing on a drill pipe to take lumps out of a hole and straighten it preparatory to casing. A rotary toothed cutter is sometimes used in core drilling, but the kind of rock or other material it will work in and produce a core from is very limited.

From "Special Operations," p. 74, I quote: "In penetrating firm material it is sometimes necessary to employ a rotary drill bit instead of a rotary shoe. Two styles of bit for this purpose are in general use—the diamond-shaped and the fishtail. The diamond-shaped is usually first employed, and the fishtail afterward used for reaming or enlarging the hole."

Now, this is all wrong. I will venture to say that 99 per cent. of all rotary drilling is done with a fishtail bit. The Sharp & Hughes bit is used for rotating on hard rock.

But why drill a hole too small and then ream it down? What is gained? As a matter of fact it usually takes longer to ream 100 ft. of hole than it would to drill the same 100 ft. of the full-sized hole at the first operation. Skillful rotary drilling completes the hole to the full size required and "muds up" all at one operation.

Technical Paper No. 32, Bureau of Mines, on Cementing Process of Excluding Water from Oil Wells as Practised in California, gives under "Recommendations and Suggestions," p. 7, the following: "3. The well should be cleared of all debris and mud and enough clear water should be pumped in to wash out any sulphur or alkaline water."

To pump clear water into any well at any time before its completion is a questionable proceeding, even if drilled with the cable tools in a hard formation. In wells drilled in unconsolidated formations with the rotary such action would mean complete destruction of the well. Only after all cementing is done and the well is completed and fully protected by casing or screens is washing with clear water practicable.

Quoting again from the same source: "5. Previous to cementing, some definite information should be gained relative to the action of the water in the hole on the setting qualities of the cement."

I regard it as not to the point to talk about the action of salt, alkaline, sulphur, or gypseous water or oil in the hole, on cement when the neat Portland cement is first hydrated with suitable water, mixed on the surface, and passed with practically no chance of serious contamination to its final place.

Quoting again from the same: "An excess of gypsum in the water might delay the setting of ordinary cement three or four months."

I would be glad to be "shown" on a statement of this kind. Experiments of E. Candlot, an eminent cement expert (Sibley Journal of Engineering, January, 1905), show that when gypsum was ground with cement clinker in the ratio of 1½ parts in 100, which proportion was found to produce the best effect in retarding the set, the maximum time for initial set was

5 hr., and final set 19 hr., and not three or four months.

Technical Paper No. 43, Bureau of Mines, on p. 6, describing a blow-out preventer, says: "The preventer, when used, is always placed on the last string of casing set or landed, thus controlling the flow between that string and the drill pipe or casing that is being lowered." Then, same page, under "Sealing of Artesian Water or Gas Strata" says, "This end can be easily accomplished in drilling with a rotary rig by forcing muddy water to the bottom of the well through one of the lateral openings of the preventer."

Suppose, for instance, the preventer casing was set at 700 ft. and the drill was working at 1,000 ft., leaving 300 ft. of hole open. It would be a practical impossibility to mud the bottom of the hole by pumping muddy water into the top of the well between the casing and drill pipe.

It is an elementary requirement in rotary drilling and mudding to have a mud circulation down the drill pipe, or a casing, and up between this pipe or casing and the walls of the well, if any mudding is to be accomplished.

The wobble of the rotary-drill stem must do the plastering; it cannot be efficiently done in any other way. Under the same head comes a most surprising statement: "The mud can easily be removed by releasing the pressure or bailing down the water in the hole."

But it is not necessary to quote more. The educated engineer that desires some information on well drilling and operating cannot possibly study out how mudding and cementing is really done from such a report. In marked contrast one can find in the Institute Transactions exact, clear, and authoritative information on drilling holes in prospecting for coal, also on mining and preparation of coal for market, furnished by men who have actually performed the work. Unfortunately, petroleum mining has not had like information on drilling wells, and on refining and marketing the oil.

There were over 25,000 wells drilled for oil and gas in the United States east of the Rocky mountains the past year, or a well completed every 21 min. Their average cost was probably between $2,500 and $3,000 each. Between $50,000,000 and $75,000,000 was expended in drilling to keep up the supply of oil and gas.

It is really surprising that no more has been written upon the art of drilling wells and producing oil and gas by men experienced in these matters.

DETERMINATION OF PROPERTIES OF PETROLEUMS

In technical paper No. 74 published by the U. S. Bureau of Mines, Messrs I. C. Allen, W. A. Jacobs, A. S. Crossfield and R. A. Matthews give the following account of methods used in determining the physical and chemical properties of the crude petroleum of the oil fields of California.

Sampling.

The samples were collected at the wells by members of the Bureau of Mines. They were put in 1-gal. tin cans that were soldered tight and shipped at once to the laboratories where the analyses were made. The samples were taken, where possible, by allowing the oil to run from the outflow of the well directly into the sample can; where this method was impracticable a dipper was used. After the can was filled it was soldered tight as soon as possible, to avoid loss of the more volatile constituents of the sample by volatilization. Oil that had been exposed to atmospheric influences for even a short period was not collected. It was believed that collecting fresh oil, quickly sealing the can, and not opening the can until a part of the oil was taken for analysis insured the composition of the sample analyzed being identical with that of the oil that flowed from the well.

Physical and Chemical Examination.

The specific gravity was determined by means of the westphal balance.

The Baume scale for indicating the density of petroleum (in the writers' opinion a most deplorable system and one to be discouraged) is in such common use that for the convenience of those unfamiliar with the specific gravity of oils both the Baume degree and the specific gravity are given.

Flash Point.—As most of the crude oils examined contained at least a trace of water, they showed a marked tendency to froth when heated and gave considerable difficulty with the closed Pensky-Martens flash tester, many frothing over at temperatures much below the flash point of the oil. For this reason, and to obtain comparative tests, it was considered advisable to determine the flash points of all the crude samples in an open Pensky-Martens cup carefully screened from air currents. On account of the frothing of the samples the temperature had to be increased slowly; a rise of 2° to 3° C. per minute was found to give good results. The gas test flame, of the size and form recommended for the Abel tester, was exposed for one second 1 cm. above the surface of the oil, at each rise of 1° C. beginning at 10° below the flash point as determined by a preliminary test.

For accurate testing the Bureau of Mines flash testers which have been developed since these tests were begun are recommended.

Burning Point.—After the flash point had been determined, the heating was continued without interruption, exactly as before, until the "flash" became permanent, that is, until the oil ignited and continued to burn quietly.

The viscosity was determined in an Engler viscosimeter at 20° C.

The calorific value was determined in a Berthelot combustion bomb. (Dinsmore-Atwater model.)

The British thermal units per lb. were calculated by multiplying the calories per gram by 1.8.

Sulphur was determined by carefully washing out with distilled water the contents of the bomb after the combustion, the sulphuric acid being precipitated with barium chloride in the usual manner, and the percentage of sulphur calculated.

Water was most accurately and most conveniently determined during the course of an ordinary fractionation; it distilled over in those fractions having a boiling point between 100° and 150° C. under atmospheric pressure and could be removed readily from the receivers with a micropipette and weighed. Usually a few drops of water adhered to the condenser and failed to run into the receivers; in this event a small pellet of absorbent cotton moistened with water, squeezed as dry as possible and weighed, was fastened to a wire and run up into the condenser to remove these last traces of water. The weight of the drops was determined by the increase in weight of the cotton pellet.

The fractionation, or separation of each oil into its crude commercial components, was made in an electrically heated still, and was conducted as follows:

Two hundred grams of the sample of oil was weighed into a ¼-liter flask. The flask was then connected to a Liebig condenser placed vertically, and the distillates were collected in weighed receiving tubes placed in a Bruehl receiver.

The oil was distilled under atmospheric pressure at increasing temperatures up to 325° C., the receivers being changed at each increment of 25°. The temperature was then allowed to drop to 125° C., to keep the oil from boiling over when the vacuum was used, and the distillation was again continued under a vacuum of 10 to 20 mm. mercury pressure till the temperature within the flask reached 325° C.

Separation and Determination of Paraffin.—Existing methods for the determination of paraffin in crude oils, residues, and fluxes depend almost wholly on the relative solubilities in various solvents of the solid paraffins, the liquid paraffins and unsaturated bodies that occur in petroleum and its products. One of the oldest methods is that of Grotowsky, modified by Engler and Bohm, which depends on the separation of paraffin by its insolubility in a mixture of ethyl alcohol and ether. This method has been improved by Holde and is the one in most common use to-day. Zaloziecki separates paraffin by crystallizing it from a mixture of ethyl and amyl alcohols. The method of Pawlewski and Filemonowicz depends on the insolubility of paraffin in glacial acetic acid; that of Holand on the insolubility of paraffin in absolute alcohol.

None of these methods is applicable to all mixtures containing paraffin. Efforts to improve these methods by previous treatment of the mixture with sulphuric acid or by distillation have not been entirely successful. In Holde's improved method the sample is first distilled down to a coke, and the paraffin is separated from an aliquot part of the distillate by crystallizing it from a mixture of ether and alcohol at a low temperature. If impure, the paraffin is treated with sulphuric acid or is recrystallized from absolute alcohol. This method, though the best one in use at present, gives inaccurate results. It is long and tedious; some paraffin is probably destroyed in the distillation, some is lost in the solutions, some heavy oils may be retained in the precipitate and the maintenance of temperatures as low as — 20° C. is attended with difficulties.

Efforts have been made in the Bureau of Mines laboratories to improve these methods, but up to the present time no method of universal application has been found. The following method, still incomplete in detail, is suggested as being of use in some cases:

The sample to be treated is dissolved in petroleum ether, filtered, and the filtrate treated first with concentrated sulphuric acid and then with fuming sulphuric acid. The petroleum ether is then distilled off and the residue dissolved in acetic ether. Ninety-five per cent. alcohol is added and the mixture cooled to 0° C. in ice. The separated paraffin is filtered off, washed with 75 per cent. alcohol, dried, and weighed. Under the above conditions 2.5 mg. of paraffin (melting point 56° to 58° C.) will dissolve in 100 c. c. of the solvent mixture.

Refining.—The oils—napthas, lamp oils, and lubricants—were further refined as follows: Two hundred and fifty grams of the oil was put in a 1-liter separatory funnel and shaken vigorously; that is, 120 to 150 shakes per minute for 15 minutes in a shaking machine, as follows:

Four times with 10 c. c. of concentrated sulphuric acid (or until the oil was not appreciably colored by this acid treatment), once with a 10 per cent. solution of sodium carbonate to remove the free acids, and three or four times with water to remove the last traces of soda, etc. The oil was then dried with Glauber salts and distilled.

This refining acid treatment yielded a water-white, practically odorless product of excellent quality.

Because of their high viscosity, it is advisable to dilute the heavier fractions (those distilled under a vacuum at temperatures above 250° C.) with 1 part of chemically pure benzene before subjecting them to the acid treatment.

Unrefined napthas.—Those fractions that boil at temperatures up to 150° C., under atmospheric pressure, comprise the "unrefined napthas."

Unrefined lamp oils.—Those fractions boiling between 150° and 300° C., under atmospheric pressure, comprise the "unrefined lamp oils."

Unrefined lubricants.—Those fractions boiling between 300° C., under atmospheric pressure, and 325° C., under a vacuum of 10 to 20 mm. mercury pressure, comprise the "unrefined lubricants."

Asphaltum residue.—That part remaining in the flask, undistilled, is termed "asphaltum residue."

In practically all of the oils examined this residue was a jet-black, lustrous mass, that was brittle at room temperatures and had a consistency much like ordinary taffy. It could be chewed, but was very sticky when slightly warmed; on solution in benzene it left no appreciable quantity of carbon flecks. This showed that these asphaltum petroleums, after removal of the oils distillable at temperatures up to 325° C., under a pressure of 10 to 20 mm. of mercury, leave a residue of solid elastic asphaltum usable for commercial purposes.

Refining losses.—The above acid causes a total loss of approximately 11 per cent. in the oil treated. This loss is too high, and should be reduced.

PLANT OF ARMSTRONG, WHITWORTH, OF CANADA.

A very important addition to the steel plants of Canada is that of the crucible steel plant of Armstrong, Whitworth of Canada. The works are located near Montreal, at Longueuil. There is already erected approximately 60,000 square feet of buildings.

There is being installed in these buildings crucible steel furnaces, with all necessary apparatus for making higher grade steels, including high speed steel. The plant provides for the complete handling from raw material to the finished product. A portion of the shop is set apart for the manufacture of twist drills, milling cutters, reamers, taps, shear blades and special small tools, which will be manufactured from high speed steel. In the spring the company expects to install either electric furnaces or converters for making mining drill steel of a very high grade. By dint of many experiments, the investigators have succeeded in fabricating a high grade hollow steel bar for special use in mining drills, which undoubtedly will be a boon to the mining fraternity.

Small intricate steel castings and complicated drop forgings will also be made suitable for the small repair parts of mining machinery.

The plant will be run altogether on Canadian lines, with every endeavor to suit the requirements of the Canadian consumer.

THE ORIGIN OF PETROLEUM*

By Dr. Hans Von Hofer, Vienna, Austria, Translated by R. W. Raymond, New York, N. Y.

Apart from the hypothesis of a cosmic origin (which failed of acceptance because it was not adequately supported by facts), the only important controversy concerning the origin of petroleum has been, for a long time, between the advocates of inorganic and of organic origin respectively. Each of these theories has had a long history of development, and is still being perfected, under the influence of two causes: (1) the increasingly extensive and thorough study of the oil-fields (of which new examples are periodically discovered and opened); and (2) the progress of synthetic experiments devoted to this question. Moreover, the advance in our physical and chemical knowledge of the properties of this peculiar natural product has necessarily modified all criticism of conflicting views.

1. The Hypothesis of Inorganic Origin.

That the notion of an inorganic origin of petroleum, first set forth by Berthelot in 1866, and afterward ingeniously developed and formulated by Mendelejeff, should thus have proceeded chiefly from chemists, is quite natural; for the question was one of possible chemical processes in the earth's interior, and of imagined chemical reactions to be verified by experiment. Hypotheses of this kind were suggested by many chemists, of whom two, P. Sabatier and J. H. Senderens, may be specially named by reason of their highly interesting chemical experiments.

Among geologists, Mendelejeff's hypothesis was received at first with much interest and favor; for it rested on the assumption of a central terrestrial mass of iron carbide, and the geologists had good reasons for adopting that assumption. Yet comparatively few of them attempted to furnish geological proofs of the hypothesis: the majority either silently believed in it, or for one or another reason rejected it altogether.

An apparently weighty support of Mendelejeff's view was furnished by the American, G. F. Becker, who found in the oil-regions of the United States important and abnormal disturbances of the isogons of terrestrial magnetism, and inferred that in these regions the central iron mass must come nearer to the surface than elsewhere. To my mind, the better explanation is, that in these oil-fields great quantities of magnetic iron have been placed. All iron pipes, especially when set vertically and hammered, notoriously become magnetic; and this is the case with the tubings of the oil-wells—sometimes to such a degree that iron screws, lowered by ropes into the bore-holes, are so strongly attracted by the iron linings that they stick fast, and will not descend further. Moreover, the disturbances of the isogons are not uniform—a circumstance easily explained by the varying amount of iron tubes. Finally, violent irregularity of these curves is shown in places where deposits, either of oil or of magnetite, are not known.

Mr. Becker's conclusions were disputed by W. A. Tarr for other reasons.

The most zealous advocate in America of the inorganic origin of petroleum, so far as I know, is Eugene Coste, of Calgary, who has collected with praiseworthy industry all the facts which support this hypothesis. To give to his many arguments the serious, thorough, and critical examination which they deserve, is the principal purpose of the present paper, as will be seen further on.

During recent decades, no European geologist of authority has advocated the inorganic origin of the petroleum occurring in large deposits.

II. The Hypothesis of Organic Origin.

As regards organic origin, the view may first be mentioned, that petroleum is the product of distillation from coal—from which, in fact, artificial distillation had obtained photogene and other products having considerable physical resemblance to kerosene. This view was first expressed in Europe by F. von Beroldingen (1778). Von Kobell, Anstedt, Leon Malo, Romanowsky, Noeggerath, Huguenet, v. Hochstetter and others accepted the hypothesis; but the proofs adduced by v. Beroldingen were soon recognized as inadequate. Since petroleum often occurs not underlain by coal-beds—occurrences of coal and oil being, in fact, usually (as on the northern border of the Carpathians) mutually exclusive;—and since, moreover, the distillation-products of coal are entirely different from petroleum chemically (as Baron Reichenbach proved, as early as 1833), this hypothesis had to be abandoned. So far as I know, it received no support in America, because in Pennsylvania, the mother-land of the oil-industry, there were no coal-beds under the deposits of oil.

Animal Origin.

Hypotheses of an organic origin were thus narrowed to the direct transformation of animals or plants to petroleum. Already in 1794, Haquet suspected that the oil of Galicia came from marine mussels, "dissolved" in salt water. L. v. Buch, Quenstedt, Volger, Naumann, Dufrenoy, Posepny, Verbeck, Fennema, and many other eminent geologists, accepted this hypothesis, mostly in view of the circumstance that the bituminous rocks carry the fossil remains of animals. Bertils found in the Kuban district of southern Russia, in a bunch of mussel-shells, a substance partly "petroleous," partly animal remains still undecomposed. R. A. Townsend reported a similar observation from the Tertiary oyster-banks of Assam, in Asia. Ch. Knab somewhat extended the hypothesis; and in North America it found in Whitney, for the petroleum of California, and the brilliant Sterry Hunt, for the oil-deposits in the ancient limestones of Canada, Pennsylvania, and Ohio, its most influential advocates, with whom others allied themselves.

When, in 1876, I visited the oil-fields then under exploitation in the eastern United States and Canada, the question of the genesis of these deposits received my earnest attention. I adopted the hypothesis of their animal origin, and in my report of this journey, entitled, Die Petroleum-industrie Nordamerikas, I briefly argued in its favor. Since that report was the first account given in the German language of the geological, technical, and commercial features of this interesting and economically important field, the hypothesis of animal origin (as well as the theory of anticlinals, advocated by me) was tested by observations in the European oil-fields, and, confirmed by geologists such as Tietze, Paul, Uhlig, O. Fraas, v. Gumbel, H. Credner, C. Zinken, and many others, it continued to win more and more advocates.

*Extracts from a paper presented at the New York meeting, A.I.M.E., February, 1914.

In 1888 appeared my book, Das Erdol und seine Verwandten, in which I examined critically all the genetic hypotheses known to me, and not only demonstrated that of animal origin, but pointed out certain important factors in the process of transformation, particularly the comparatively low temperature and high pressure, as indicated by geological evidence. An important landmark in genetic hypothesis was thus established, furnishing for the guidance of synthetic experiments two important conditions of the transformation of animal bodies into petroleum.

A few weeks later, C. Engler, of Karlsruhe, tested my thesis experimentally, by heating in retorts, under a pressure of 10 atmospheres, and to a temperature of from 300° to 400° C., first fish-oil, and afterward fishes and mussels. He obtained in this way a product very like petroleum, from which he isolated several members of the methane series. My hypothesis, thus further corroborated, became a theory, known as the Engler-Hofer theory, since both of us had equally contributed to its establishment. It won the support of chemists as well as geologists—whose numerous names it is not necessary to catalogue here.

It is noteworthy that the geologist and the chemist must co-operate in the solution of genetic problems in geology—the former by investigating the natural conditions attending a given formation, while the latter synthetically performs the process itself. Only when thus confirmed is the theory adequately established.

Vegetable Origin.

A great additional service rendered by C. Engler was his tireless labor through many years in the investigation of the various transformations undergone, up to the present time, by the original materials and primary forms of petroleum—a labor which still further perfected the Engler-Hofer theory. These investigations showed that vegetable fats also, by dry distillation under high pressure and at comparatively low temperature, could be transformed into petroleum, as American chemists (Warren and Stoner, Sadtler, etc.) had already proved. Our theory could therefore be extended to include those plants which, like animals, contain fats and albumens, but no cellulose—namely, the microscopically small diatoms. T. Fegraus and A. F. Stahl, who first pointed out this source of petroleum, were followed by G. Kramer and A. Spilker, and, still later, by Potonie. This hypothesis is applicable only where, as in California, the minute and delicate siliceous shells of these fossil algae occur in connection with oil-deposits.

Many American geologists and chemists like Lesley, Newberry, Ashburner, Shaler, Orton, Peckham, Mabery, etc., had already either advocated a common animal and vegetable origin, or (like the two highly esteemed investigators last named) assigned an animal origin to the nitrogenous California product, and a vegetable one to the non-nitrogenous oil of Pennsylvania. The contrary appears, however, to be the truth, since the diatoms are found in California, and not in Pennsylvanian, oil-fields. Probably the advocates of the double origin were not thinking of these microscopic vegetable forms at all; they speak in a general way of "plants." But the more highly organized plants contain cellulose, which would leave after distillation a carbonaceous residuum, such as is not found in petroleum and its deposits. For this reason, the above hypothesis, once so generally favored, could not be finally accepted.

According to our present knowledge, the original material of petroleum is principally fat, and subordinately wax, resin and albumen. These substances, especially fat and albumen, occur chiefly in both the lower and the higher animal organisms. Petroleum, therefore, is mainly of animal origin, though it may have been formed, here or there, from fatty plants, particularly diatoms.

STANDARD OIL

According to the Boston News Bureau, of the 34 Standard Oil companies 11 are transportation companies, four are producers, 19 are refiners and marketers. Of the latter, five are marketing concerns exclusively, three do a refining business only, and 11 are both refiners and marketers. The leading companies engage in both refining and marketing. In this class are Standard Oil Co. of New Jersey, the former parent concern, with its capital of close to $100,000,000, and Standard of New York, which last year raised its capital to $75,000,000. Standard Oil of California, another of the heavier capitalized companies, is a refiner and marketer. The latter now has a capitalization of $50,000,000, but stockholders have been asked to approve an increase to $100,000,000. The refining and marketing companies have been a great melon patch in the past two years. In only one company outside of this group have shareholders been given a bonus in stock distribution. This was South Penn Oil Co., a producer. At dissolution the 19 companies in the refining-marketing group had a combined capital of $168,188,382; now it is $321,788,382, an increase of $153,600,000. The first startling melon-cutting came when Standard Oil Co. of Indiana announced its 2900 per cent. stock dividend. Of the 19 companies of this group, 13 have made capital increases resulting in bonuses to stockholders. Following is a list of companies in this group, with their capital at the dissolution, present capital, and disposition of new stock:

	Capital at dissolution.	Present capital.	Method of distribution.
Anglo-American	$5,000,000	$10,000,000	100% Div.
Atlantic Refining	5,000,000	5,000,000	....
Borne-Scrymser	200,000	200,000	....
Chesebrough Mfg.	500,000	500,000	....
Colonial Oil	250,000	250,000	....
Continental Oil	300,000	3,000,000	900% Div.
Galena-Signal com.	8,000,000	12,000,000	50% Div.
Galena-Signal pfd.	2,000,000	2,000,000	....
Solar Refining	500,000	2,000,000	300% Div.
Standard Oil N. J.	98,338,382	98,338,382	....
Standard Oil Cal.	25,000,000	50,000,000	Subscription
Standard Oil Ind.	1,000,000	30,000,000	2,900% Div.
Standard Oil Kans.	1,000,000	2,000,000	100% Div.
Standard Oil Ky.	1,000,000	3,000,000	200% Div.
Standard Oil Neb.	600,000	1,000,000	*Div.
Standard Oil N. Y.	15,000,000	75,000,000	400% Div.
Standard Oil Ohio	3,500,000	3,500,000	....
Swan & Finch	100,000	500,000	Subscription
Continental Oil	300,000	3,000,000	300% Div.
Vacuum Oil	2,500,000	15,000,000	Subscription
Waters-Pierce	400,000		
(now Pierce Oil)		10,500,000	2,625% Div.
Total	168,188,382	321,788,382	

*Capital first increased from $600,000 to $800,000 with 33 1-3% dividend, then to $1,000,000 with 25% dividend.

Cash dividends paid by refining-marketing companies for two years ended Dec. 31, 1913, aggregated over $111,000,000. In 1912 about $30,000,000 was distributed, and in 1913 more than $81,000,000. In the last year, however, almost $40,000,000 came from special dividend by the New Jersey company representing liquidation of loans by former subsidiaries.

The largest dividend payer is Standard of New Jersey, with regular annual payments of close to $30,00,000. Next comes Standard of Indiana, which last year paid $9,600,000. New York is now the third largest dividend payer at $6,000,000 annually. Standard of California is now distributing $5,000,000 yearly.

Actual earnings as reported by eight companies, together with indicated profits of three companies, and adding dividend payments of six companies, gives a total of over $59,000,000. This does not include earnings of the New Jersey company, estimated in some quarters at $40,000,000 annually. Giving New Jersey credit for $30,000,000 brings the total to $89,000,000, exclusive of the New Jersey company's earnings from liquidation of loans.

Refineries represent an enormous investment. Just how much, it is impossible to say, for the companies which publish balance sheets make no distinction between refineries and other property, and some companies, including Standard of New Jersey, do not issue a balance sheet.

Standard of New Jersey owns six refining plants with total capacity of over 125,000 barrels of crude oil a day. Standard of California has three big refineries with total daily capacity of 95,000 barrels.

Standard Oil of Indiana has had to increase refining facilities greatly, owing to rapidly growing business in its territory and the introduction of motor spirits, a substitute for gasoline. It has had to spend several millions in installing the new refining process.

Atlantic Refining Co. is one of the biggest refiners, having three plants with about 64,000 barrels daily capacity. Galena Signal Oil Co. which supplies 98 per cent. of the railroads and 75 per cent. of the street railways with lubricating oils, owns six refining plants, with annual output of 800,000 barrels of special oils.

Standard Oil of New York has four plants with total capacity of about 22,000 barrels daily. Most of this oil goes to New York and New England. The company obtains its requirements for its Far East business from Standard Oil of California.

Vacuum Oil has three big refineries in the United States, and two in Austria and Hungary.

Standard Oil of Kansas has come to the front as a big refiner. In 1913 it constructed 52 new stills at its Neodosha, Kans., refinery, increasing the number to 65. It sells a large part of output to other Standard companies, principally the Indiana.

Standard Oil of Ohio has a plant at Cleveland with a capacity of about 2,000,000 barrels yearly. This is said to be the most complete for refining of gasolene in the United States, and turns out about 35,000 gallons daily.

Solar Refining Co. has a plant at Lima, Ohio, with 10,000 barrels daily output, distributed in Ohio, Kentucky, Indiana and Michigan.

Pierce Oil Corporation (formerly Waters-Pierce) which broke away from its Standard affiliations, has five refineries with capacity of about 35,000 barrels daily. One is at Tampico and one at Vera Cruz.

Standard Oil's market is the world. The 34 companies have distributing stations in every part of the United States and Canada, and throughout Europe, as well as in Asia, Africa, Australia and South America.

THE ILLINOIS OIL FIELDS*

By H. A. Wheeler.

Illinois has so recently attained the third place in the oil production of the United States that few realize its great importance, or are aware of its highly profitable character. Since 1907 Illinois has furnished about 15 per cent. of the United States output and about 10 per cent. of the world's production. The value of the output in 1913 is estimated at $30,000,000, of which about $20,000,000 is profit.

The present prosperity dates from 1905, but efforts have been made since 1865 to develop production and geologists have been very sanguine as to its future for over 25 years. Had the oil operators been as confident as the geologists, the field would have been opened at least 30 years earlier. For the rich Eastern Illinois oil field is located along the La Salle anticline, that was mapped 46 years ago by Professor Worthen in the first geological survey of the State. Prof. T. B. Comstock enthusiastically wrote in 1887 about the highly promising character of this anticline, to which he again called attention in 1889.

The writer's studies in 1888 were convincing as to its oil future, yet to have then advocated drilling would have earned the reputation of being a dreamer. In fact, as late as 1903 the writer's suggestion to a prominent Pittsburg oil operator to prospect in Illinois met with contempt and derision, which was representative of the general feeling then held by the oil fraternity, yet this same party made a large fortune four years later out of a block of Illinois oil leases.

The first commercial wells were brought in at Litchfield, 50 miles northeast of St. Louis, where in 1882, in drilling for coal, gas was discovered that supplied the town several years. Later, some oil wells were brought in that until 1902 produced a lubricating oil that sold for $5 a barrel.

In 1887, at Sparta, 40 miles southeast of St. Louis, in drilling for water, gas was discovered that supplied the town about 20 years, and in 1906 several oil wells were brought in half a mile northeast of the gas wells.

In 1890, in drilling for water, gas was discovered near Pittsfield, in Pike county, that later developed into a field over 10 miles long.

The present highly prosperous era dates from 1904, when a small gas well was drilled near Casey, in Clark county, by J. J. Hoblitzell, who was induced to prospect at Oilfield on the showing of oil and gas made by some old wells that had been drilled in 1865 by Chicago parties. The latter drilled several wells on the evidence of oil and gas seepages, but, although a little was found, the wells were a failure from not casing off the water; i. e., they were drowned out. Several more small wells were brought in, but they were so discouraging that they failed to interest the scouts that flocked in when leases were only $5 to $10 an acre. When a 40-barrel well was subsequently brought in, the "talent" promptly scurried after leases, which rapidly advanced to $100 to $200 an acre, and since then the Eastern Illinois field has rapidly developed along the La Salle anticline. The southern extension was discovered in February, 1906, in Crawford county and by midsummer the adjoining Lawrence county began producing. The Allendale pool, at the south end, was discovered in September, 1912. Shipments by tank cars started in June, 1905, and within a year the first pipe line reached the field, followed by four others that had a daily capacity of 112,000 barrels by 1909.

*Extract from a paper presented at the New York meeting, A.I.M.E., February, 1914.

On the western side of the State, the Butler oil and gas was discovered in 1907, the Centralia pool in 1908, the Greenville, Carlinville, and Sandoval pools in 1909, and the Carlyle pool in 1911.

The total production to Jan. 1, 1914, is 209,018,914 barrels, valued at $156,025,398. This record for output and values has never been equalled by such a young field, as it requires time, as well as capital, to develop a new field, especially where there was such a lack of confidence. While the latter has disappeared since 1906 on the eastern side of the basin, it still holds as regards the western side of the basin.

MINING AS A PROFESSION*

By Hennen Jennings.

To consider man without the earliest primitive contributions of the miner and metallurgist takes us back to savagery. Man's greatest endowment is his wonderful and crafty brain cells with their latent powers of development, which has shown him the necessity of supplementing his own strength by outside aids, and then gradually and persistently obtaining the materials for his needs and fashioning them into tools of power, and finally incorporating and making them a veritable part of his being. His first great advances were the commanding of fire, the use of stone implements, then wooden bow and arrow. By these he worked himself into the stone age, but was still brutal, weak, and with little historical recording power. It was not until he delved below the surface of the earth for materials that he was able to fashion the sword, spear, fire arms, protective armor, plow, hoe, pruning-hook, scythe, pitchfork, tires, axe, saw, plane, etc. It was only with metal tools that great agricultural development began, and it only reached its present magnitude when further supported by the metals in the form of railroads, steam vessels, harvesting machinery, etc. Mining and agriculture are the only basic productive pursuits of man, and they are both fostered each by the other, and both dependent on mother earth. The one skims her surface, the other goes deeper. Agriculture furnishes man with food for existence, but mining gives him the materials for power, art and civilization. Without metals the scientists' tools for experimentation and determination would not be possible, nor the diffusion of knowledge and thought by means of the printing press, photographic appliances, telegraph, cable, and the telephone.

The mining engineer must have some sound general knowledge of all other branches of engineering inasmuch as in the equipment and running of great mines and metallurgical plants he must make use of the training of engineers in almost all the other branches, and to obtain from them their best and hold their respect it is necessary for him to at least appreciate the foundations of their specialties to intelligently confer with them and decide upon merits rather than dicta. In addition, he must have special knowledge and training in all pertaining to the discovery, working and valuation of ore deposits. He must have also sound business experience and judgment to gauge the payability of new ventures, and this in turn requires that he should have had in some period of his career a successful experience of management, requiring a knowledge of accounts and faculty of handling men. In distant lands he must have general information of many kinds, and linguistic attainment. The legitimate uncertainties of mining throw peculiar temptations in his path, as these can be twisted to excuse failures of indolence and unfitness, and also be used as narcotics to conscience when temptation to dishonesty presents itself. His work, especially in metalliferous mining, is often far afield from the observances and guidance of owners or directors, and his work is not of a character that erects lasting monuments or stimulates either admiration or criticism. Thus character, industry and tact are even greater requisites for true success than brilliancy of intellect. Mining as a profession requires varied knowledge and gives scope for ability and character, and is a profession befitting the true gentleman as well as the adventurous strong man. It affords absorbing and interesting work, and, being basic and productive, extends opportunity for clean money prizes. Each branch of engineering is based upon metallic foundations; each is dependent upon the other, and none could have reached its present magnitude without the others, but the miner gives to all the other branches the materials that knit them together in common bond of usefulness, making them effective in the art of "Directing the great sources of power in nature for the use and convenience of man."

THE INTERNATIONAL NICKEL COMPANY.

The Canadian Copper Co., the largest producer of nickel in the Sudbury district, is controlled by the International Nickel Co. The Sudbury mines are the chief source of the world's nickel, and their successful operation is reflected in the recently issued report of the controlling company. Comparatively few shares are owned by Canadians; but the operation of the mines and smelter in Canada makes the industry a very important one, and it is fortunate that it is in a prosperous condition.

The report of the International Nickel Co. for the year ending March 31, shows a profit of $4,792,664.75. Earnings of all properties, after deducting manufacturing and selling expense and ordinary repairs and maintenance, totalled $6,452,758.01. Other income amounted to $114,028.55. Administrative and head office expense, $376,665.27. Corporation and capital stock taxes $61,146.71. There was deducted for depreciation of plant $636,915.20, and for mineral exhaustion $687,394.63.

The capital stock of the company is: Preferred $8,912,600, and common $38,031,500. All but $706.25 preferred and $1,781.25 common is issued. There was paid in dividends during the year: preferred $534,756, and common $3,803,150.

The profits are computed on the sales actually made to customers, and all inventories are taken at cost. All purchases of materials, supplies, etc., are paid for in cash.

President Monell reports that owing to the unsatisfactory conditions obtaining in the steel industry, and a lower price for copper sold, the earnings were slightly less than in the previous year.

Of the stock allotted to employees on Jan. 2nd, about 92 per cent. was taken.

The directors of the company are: R. M. Thompson, A. Monell, E. F. Wood, J. R. DeLamar, W. N. Cromwell, A. Jaretzki, D. Coulson, B. Strong, Jr., S. H. P. Bell, E. C. Converse, W. T. Graham, W. H. Brownson, S. Prosser, W. A. Bostwick and J. L. Ashley.

*Abstract of a speech delivered at the fiftieth anniversary of the School of Mines, Columbia University, May 29, 1914.

HAMMER DRILLS VS. RECIPROCATING DRILLS

By P. B. McDonald.

The term "hammer-drill" was formerly applied only to those unmounted air-feed drills better known as "stopers," which have so revolutionized over-hand stoping and raising, since they require practically no rigging-up and can be carried around and operated by one man. Next, the hammer principle found favor for "hand sinkers" in little plug-drill types, some of which require to be rotated by hand, but others being automatically rotated. Almost simultaneously a hammer drill of mounted, screw-feed type, for drifting, began to attract attention. In this type the "water" principle and hollow drill steel is used.

A hammer-drill is one in which the drill-steel does not reciprocate. It is stationary, except for feeding ahead, while it is pounded by the action of the piston. This is in contrast to the older types of drills in which the drill-steel, tightly gripped in the chuck, reciprocates back and forth in "slugger" fashion. The new, screw-feed, hammer type of drill, mounted on bar or column for drifting, looks peculiar when in operation to a miner accustomed only to reciprocating drills, as the parts seem unnaturally still. The principle is exactly like hand drilling with "hammer-and-drill," since in that case also the drill-steel is stationary. On the other hand the "reciprocating" type of power drill is similar to "jumper" drilling, in which two men work a long drill-steel, perhaps 20 ft. long, up and down in a deep hole, usually in soft formations.

The success of the mounted, screw-feed hammer drill for drifting has been partially due to the "water" principle. A stream of water and compressed air is forced through the hollow drill steel to wash the rock chippings from the hole and to lay the dust. The success of the Leyner-Ingersoll drill, particularly in hard-rock has been noteworthy, good results being obtained in the Lake Superior Copper Country, the Black Hills, Colorado, and on the Rand. It is understood that other drill manufacturers will use the hammer principle for drifting drills, and that more of that type will be put on the market. Since it is likely that the type has come to stay, it is worth while to compare it with the ordinary reciprocating drill, as to advantages and disadvantages.

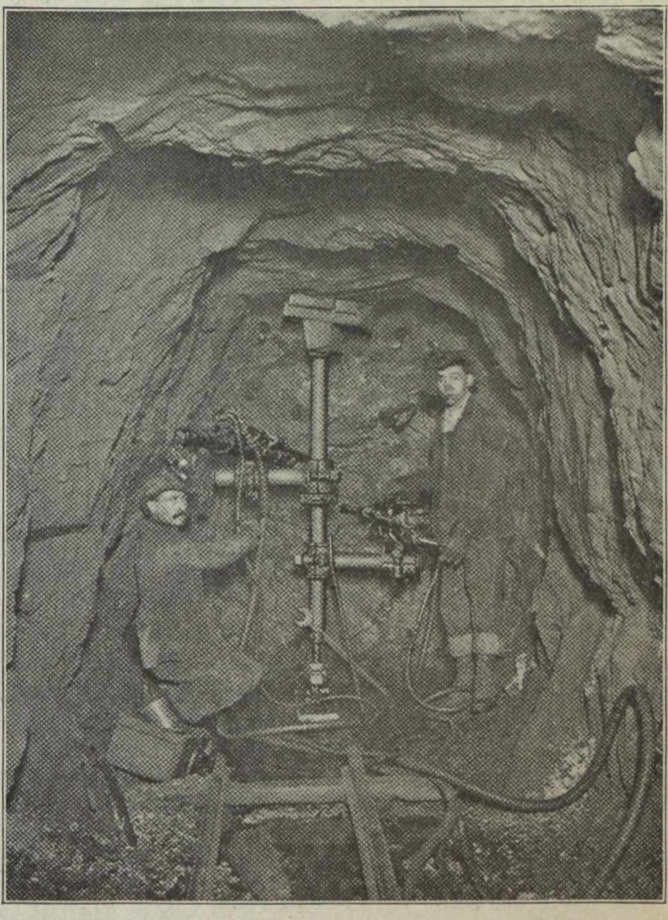
In a competitive test recently conducted in a mine in the Lake Superior district, in medium ore, the Leyner-Ingersoll and a reciprocating drill did as follows:

Leyner-Ingersoll drilled 7 holes, total depth 29 ft. 9 in., in net drilling time of 23 1-2 min., requiring 15 changes of steel taking 12 min. The time consumed shifting the machine to new set-up was 23 1-2 min.

The reciprcoating drill, in the same ground, drilled 7 holes, total depth 27 ft. 6 in., in net drilling time of 25 min., requiring 20 changes of steel taking 13 1-2 min. The time consumed in shifting the machine to new set-up was 31 1-2 min.

Average drilling speed per minute (net drilling time) with the L.-I. was	15.19 in.
Average drilling speed per minute (net drilling time) with the Recip. Drill was..	12.69 in
Average drilling speed per minute (total lapsed time) with the L.-I. was	6.33 in.
Average drilling speed per minute (total lapsed time) with the Recip. Drill was	4.71 in.

While this was by no means a thorough test extending over a long period of time, it is a typical case, and goes to show some of the advantages of the hammer principle. The Leyner-Ingersoll only drilled a trifle faster in net drilling time than the reciprocating drill, but it gained considerably over the other in time of changing drills, making new set-ups and in depths of holes. The incidental operations of changing steel, setting-up, etc., have been proven to take up an average of 50 to 60 per cent. of a miner's time, and are therefore fully as important as the net time spent in drilling.



Drifting with mounted Hammer Drills, Homestake Mine

Drill steel can be changed more quickly with a hammer machine than with a reciprocating machine because the steel rests loosely in the chuck and does not require the careful tightening which a reciprocating drill chuck does. The time spent changing drills may seem only a small detail; but notice in the above records that half as much time was consumed in doing that as in net drilling time, so that for 2 hours of actual drilling as much as one hour might be spent in changing steel. It is wise to economize on such an important detail.

The mounted, screw-feed, hammer drill can be set-up, adjusted to the correct distance from the face of the rock, and the holes pointed advantageously, with greater facility than a reciprocating drill, because the stroke of the machine is taken care of in the cylinder and does not affect the drill steel or chuck. It helps to save time in several of these auxiliary operations. In starting a new hole with a reciprocating drill, especially a "cutting-in" hole at a glancing angle to the face of the rock, the air can only be turned on half-force for a few minutes or the blows would slide off the rock. As a hammer drill uses many light blows in place of a smaller number of heavy blows, the holes can be started with more precision, and inequalities on the surface of the rock are not so likely to deviate the drill.

There can be little doubt that a hammer type drill is theoretically a more efficient and scientific machine for cutting a hole than is a reciprocating type. In the latter type power is consumed in overcoming friction and inertia of the drill-steel. This in a six-foot length of hole may be a considerable item, due to the drill steel rubbing against the sides of the hole as it is reciprocated and turned. In the hammer type the only weight moved is the hammer alone, which imparts all its energy through the drill-steel to cut the rock. More practical, if smaller, considerations are that the miner's helper is not liable to have his knuckles barked by a reciprocating and rotating chuck, and the miner can feed the machine ahead until the chuck fairly touches the rock, whereas with a reciprocating drill, he would probably stop it an inch from the limit of the feed, due to not being able to distinguish the whereabouts of the swiftly moving chuck. There are small points, but it is on record that miners have refused to use a certain make of machine because the crank-handle was not rounded, but was so sharp-ended as to hurt the hand of the man who turned it.

The hammer types have some disadvantages. In the earlier makes difficulty was experienced in keeping the cutting of the drill-steel close against the rock, so that the full force of the blows was sometimes lost. The latter types, more carefully made, have improvements which obviate this.

In a hammer drill, the drill-steel may be struck over a thousand blows per minute. From 10 to 15 per cent. of these blows may be struck when the bit does not touch the bottom of the hole, because a piece of hard steel cannot be hammered and pressed against rock without bouncing back. The troubles of broken drill-steel are due partially to this, but are not serious with good steel.

Also there are some varieties of rock, clayey or sticky, which drill better with a drill steel churning and plunging in the muddy chippings, which refuse to wash away, than with the hammer drill. The reciprocating drill splashes the hole clean, better than the hammer type, in such rock.

As to the advantages of the "stoper" hammer drills or of the hand sinkers, such as the Jackhamer, little need be said. It is pretty well accepted that the one-man stoper drill has revolutionized over-hand stoping and raising all over the world. In many mining districts, as on the Marquette Range, Michigan, an enormous number of stopers are in use. In a few districts, such as the Birmingham iron mines, Alabama, they were tried and not liked. The little hand sinkers have risen suddenly to fame for down-holes, especially since automatic rotation types came out. For shaft-sinking they are time-savers, as much for the facility with which they can be taken out of the way at blasting time as on account of the much greater number of machines which can be operated in the confined space.

CHAMBERS-FERLAND.

Cobalt, June 10.

The adjourned meeting of the Chambers-Ferland Mining Company was held to-day at the mine office of the company in Cobalt, and after one of the hottest meetings ever held by a Cobalt mining company, a further adjournment was made to the Salisbury House in London, England, July 1. The bone of contention was a proposed by-law for the transfer of the entire stock and assets of the Chambers-Ferland Mining Company for 115,000 $5 shares in the Aladdin Mining Co., the assets of which, so far as can be learned by Chambers-Ferland stockholders, consist of a lease on the Silver Queen mine and a small amount of cash in the bank, while the assets of the Chambers-Ferland represent liquid assets to the value of $150,000, consisting of mine plant, ore on hand, cash in the bank and 124 acres of mining property and ground rents, totalling $6,000 per year. At the meeting Mr. Alfred A. Ames, of Toronto and Haileybury, representing the minority stockholders, strenuously objected to the by-law as being unfair to Chambers-Ferland stockholders. The only ones to oppose the by-law at the meeting were Mr. Ames and Mr. Henry Cecil, the latter representing himself and a number of stockholders. Mr. C. Jorgenson, Mr. Sedgwick of London, England, and associates hold three-fourths of the Aladdin stock, and had a great preponderance of the voting power at the meeting, but in spite of that fact the by-law was not passed. It will come up for discussion at the adjourned meeting in London. Only two directors of the Chambers-Ferland were present, Mr. Robert Shillington, M.L.A., of Haileybury, and Mr. C. A. Richardson, of Toronto. Mr. Alex. Fasken of Toronto acted as secretary of the Chambers-Ferland. The meeting after adjournment for lunch was attended only by the directors and employees of the company and the mine employees, and lasted only about fifteen minutes. The directors for the year were elected, with Mr. C. Jorgenson president, and Messrs. Herbert and Gould of London, Eng., and C. A. Richardson of Toronto. The latter is the only Canadian on the board. One of the features of the meeting was the serving of a writ upon the company by Mr. Henry Cecil to restrain the company from closing the deal with the Aladdin Company for the Chambers-Ferland assets. The minority stockholders are also preparing to take separate action, and will make an application to the courts to force the Aladdin directors to show officially the assets behind the Aladdin stock.

The Chambers-Ferland is an Ontario company, and the proposition of the majority interest to hold the next meeting in London will be also subjected to review by the courts. It is said that the Chambers-Ferland shareholders may receive a cash offer for their holdings.

MOTOR SPIRITS.

The great consumption of gasolene for motor purposes has caused a tremendous increase in the production of crude oil. Products other than gasolene have consequently been produced in excess of the demand. Motor spirits can be extracted from the surplus left after the refining of gasolene, but owing to its disagreeable odor it is not used in automobiles. It is cheaper than gasolene and can be used to advantage where the odor is not very objectionable.

A dividend of 3 per cent. has been declared on the stock of the Beaver Mines, payable July 20 to shareholders of record July 2nd.

NATURAL RESOURCES OF CANADA*

By F. D. Adams

It is in many ways an exhilarating experience, that of living in a new country and in a time of rapid development. We, the Canadian people, have entered into a great heritage—half a continent—standing midway between two of the most densely populated areas of the earth, Europe and Eastern Asia, and having to the south one of the most progressive nations of the world. We are blessed with a most liberal form of government and have ample room for expansion, and are thus free from the many limitations which beset the densely crowded peoples of other countries. We are also free from the ever-present danger of war and invasion which, like the sword of Damocles, hangs over the head of every nation of the older world. This gives a sense of security which is never felt in the countries across the seas. We have, moreover, the advantage of the protection of a great Empire while bearing less than our proper share of its burden.

The population which is rapidly flowing into the Dominion is furthermore of a relatively high quality. Of the 384,867 immigrants who came to Canada in the year 1913, 65 per cent. were from Great Britain and Ireland or from the United States, and consequently spoke the English language as their native tongue, while of the immigrants entering the United States a relatively much larger percentage come from Southern Europe.

Canada is often referred to as being in her "constructive period." The United States is somewhat more advanced in its material development, having now nearly completed its "constructive period." Its chief lines of railway were built some years ago; its free lands are taken up and the country is settled. The crops, once largely exported, are now for the most part required to feed its own people. Canada may read its own immediate future by studying the present situation in the United States—a generation ago her West was as ours is now.

We find, however, that in the great republic to the south a very strong note of warning is already being sounded in respect to its future. This took form in an address delivered by President Roosevelt to the Society of American Foresters in 1903. In September, 1906, Mr. James J. Hill delivered an address which presented for the first time in popular form, under the title of "The Future of the United States," a remarkable collection of economic facts. Let me give a brief summary of its contents:

The supply of coal and iron, a prime factor in the nation's industry and commerce, was being exhausted at a rate which made it certain that before the end of the century the most important manufacturers would be handicapped by a higher cost of production. The supply of merchantable timber was disappearing at a much more rapid rate. But far more serious than all other forms of wastage was the reckless destruction of the natural fertility of the soil. Within a period for which the present generation was bound to provide, the United States would be hard pressed to feed its own people. Mr. Hill told his hearers that the danger which threatened the future food supply of the nation could be averted only by the intelligence and industry of those who cultivated the farm lands, and that they had it in their power to provide a perfectly practicable and adequate remedy by applying the discoveries of physical science to the business of farming.

Many other leading men of the United States, among whom Mr. Gifford Pinchet must be especially mentioned, became impressed with the importance of these great questions, and in May, 1908, President Roosevelt called at the White House in Washington a conference of the governors of all the States in the Union, members of the Cabinet, justices of the Supreme Court, together with the heads of the great scientific bureaus of Washington and other leading citizens, to consider the question of "the conservation of our natural resources." stating that in his opinion this was "the weightiest problem now before the nation." The importance which was attached to this conference was marked by the fact that, for the first time in the history of the nation, the governors of all the States were assembled to consider a great national question. This led to the appointment of a National Commission of Conservation.

Following this the Governments of Canada, Newfoundland and Mexico were invited to join with the government of the United States in appointing representatives to a North American conference to meet in Washington in February, 1909. Upon the receipt of the report of the Canadian representatives our Government decided to appoint a permanent Commission of Conservation in Canada, which has been actively at work since that time under the able chairmanship of Mr. Clifford Sifton.

If the conservation of their natural resources is a question of such importance in the United States, it is of equal, if not of greater importance here in the Dominion of Canada; it is of the greatest moment for the future of Canada that the leaders of our national thought and through them all the citizens of our Dominion should be seized with the importance of the principles underlying this great movement. I therefore desire this evening to bring to your attention certain salient facts concerning our natural resources, their proper development and their conservation.

It is a common idea that the conservation of our natural resources means hoarding them for the use of future generations. This is an entire misconception. Most of our natural resources are best conserved by working and developing them. Our forests, our lands and our fisheries will, if properly worked, not only yield this generation a larger profit, but they will be handed on to our successors in a more highly productive condition than that in which we received them. We are prosperous now, but we must not forget that it is just as important that our descendants should be prosperous in their turn. Each generation is entitled to the interest on the natural capital, but the principal should be handed on unimpaired.

The area of the Dominion of Canada is about 3,730,000 square miles, which is somewhat greater than that of the United States, including Alaska, and rather less than that of Europe.

In Canada, as in every other country of the world, the physical features have played, are playing and will continue to play a most important part in the development of the history of the country and the character of its people.

Looking back into the abyss of past time, we find that that part of North America which we now call Canada originally consisted of three widely separated land areas arising from the waters of the primeval

*Extracts from Presidential Address, Royal Society of Canada, Montreal, May 26.

ocean. These areas are sometimes termed the protaxes or primitive axes of North America. I refer to them at the present time because, while the eastern and western protaxes, marking the lines along which our mountain ranges were subsequently developed, became more or less buried beneath the blanket of sediments which filled in this early outline of the continent, the great northern protaxis, composed of the hard granite and crystalline schists of that ancient time, has remained exposed to the present day. Its enormous expanse of 2,000,000 square miles represents more than half of the whole area of the Dominion of Canada. Driven down like a wedge into Southern Canada, it separates the older settlements of Eastern Canada from the new provinces in our west. Owing to its peculiar character it has in this way exerted a most potent and in some respects sinister influence in the development of our Dominion. It will be noted that this northern protaxis or Canadian shield, as it has been called by the great Austrian geologist Suess, barely passes south of the Canadian boundary line. The problems which it presents in Canada are, therefore, non-existent in the United States.

Physiographic Divisions.

Canada falls naturally into the following physiographic divisions:

The Canadian Shield, to which reference has just been made. This is a great plateau with an average elevation of 1,500 to 2,000 feet above sea level. A somwhat undulating, rocky country, in the south well wooded but containing little farming land.

The Appalachian Mountain System, represented in Canada by the Notre Dame and Shickshack Mountains —which crosses the boundary line from New Hampshire and runs in a curving north-easterly course through the provinces of Quebec to the extremity of the Gaspe peninsula.

The Area of the Maritime Provinces. This lies to the east of the Appalachian Mountain system—a diversified tract of country containing considerable areas of good farming land and with important coal deposits.

The Great Plain of Central Canada. This lies along the southern margin of the Canadian Shield and stretches from the Appalachian Mountains on the east to the Rocky Mountains on the west. Its eastern portion lies in the provinces of Quebec and Ontario, its western and larger portion in Manitoba, Saskatchewan and eastern Alberta. It contains the greater part of the farming land in the Dominion.

The Cordilleran Mountain System, of which the Rocky Mountains are the eastern range. This system of mountain ranges with its intervening valleys and plateau land bounds Canada on the west and embraces British Columbia and western Alberta. It has the finest surviving forests of the Dominion and is rich in minerals. It contains, however, only a relatively small amount of farming land which can be cultivated without irrigation.

Natural Resources.

The natural resources of the Dominion, on which the population of Canada must depend for their support are six in number:

1. Agriculture and the cattle trade.
2. Forest products, timber, pulpwood, etc.
3. Water powers.
4. Products of the mines.
5. Fisheries.
6. Fur trade.

Speaking generally, our manufacturers and transportation systems are dependent upon these and, therefore, stand or fall with them.

The relative importance of these several sources of national wealth, as expressed in the monetary value of their respective products, is shown in the accompanying table. The figures are obtained from the Government returns for 1913. In the table there is also given, for purposes of comparison, the value of the exports of each of these national products:

	Output.	Exports.
Agriculture (field crops).........	$552,771,500	$194,930,254
Forests, (1912) ..	182,300,000	43,255,060
Mines..........	144,031,047	57,442,546
Fisheries........	33,389,461	16,336,721
Furs..........	....	5,415,118

Agriculture.

Agriculture is and must always remain the chief industry of the people of Canada. The population which the Dominion can support in the future will depend chiefly upon the area of land suitable for farming which exists in Canada and the manner in which this is cultivated. The fact that Canada occupies more than half of the continent of North America and has an area almost identical with that of Europe is sometimes mentioned as carrying with it the implication that it would afford support to an almost unlimited population. It is impossible at the present time to arrive at an accurate estimate of the actual area of arable land in the Dominion, but there are certain salient facts which, while not generally recognized, have a very important bearing on this question. The first of these is that there is practically no land which can be properly cultivated in that portion of Canada which lies north of the area covered by a forest growth. Secondly, with the possible exception of the clay belt in northern Ontario, there is no part of the Canadian Shield which can support more than a very sparse farming population or in which farming can be made a really profitable industry. The recent report of the Commission of Conservation on the condition of the farming community on the southern margin of the shield on the watershed on the Trent Valley Canal in southern Ontario, shows a state of affairs long recognized by those familiar with the Laurentian country. Thirdly, the area of arable land in British Columbia, as compared with the size of the province, is quite small.

There are only two great areas of land capable of continuous cultivation throughout their entire extent and of thus supporting a large agricultural population. The first of these is the plain lying between the southern margin of the Canadian Shield and the boundary line of the United States in Quebec and Ontario, extending from the hilly or mountainous district of the Appalachian folding in eastern Quebec to the Great Lakes. The second is the southern portion of the plains in the provinces of Manitoba, Saskatchewan and eastern Alberta. These, in referring to the physiographic divisions of Canada, were classed together as the Great Plain of Central Canada.

Forest Products.

The forests of Canada were its chief source of revenue in the early days of the settlement of the country. Year by year the great rafts of timber were floated down the St. Lawrence and Ottawa rivers past Montreal, and were loaded on fleets of ships at the port of Quebec. Later, with the advent of railways, the same lumber was brought in immense quantities by rail to Montreal or shipped directly to its market in the United States. The following table shows the total forest products of Canada for census years, going back to the year 1871, expressed in cubic feet:

1871	1,386,122,654
1881	1,999,544,178
1891	6,955,024,616
1901	4,762,235,878
1910	2,084,000,000

Notwithstanding this continuous drain upon our forests and the tremendous losses which they have sustained by fire, the general opinion of the people of Canada, an opinion to which from time to time expression is given in the utterances of our public men, is that the great northern forests of Canada are so extensive that they are practically exhaustless and will afford an abundant supply of timber for all future time, a supply which will not only meet our own needs, but will be amply sufficient to make good the increasing demand of the United States, due to the disappearance of its own forests, and also afford a surplus for export to Great Britain, South America, the West Indies and other countries as at the present time. A closer examination of the facts of the case obtained by investigations carried on during recent years, however, reveals a number of interesting and very important results.

A careful study of the question by the official forester of the Dominion shows that so far from being exhaustless, the reserves of merchantable soft timber in the forests of Canada are only between one-quarter and one-fifth of that remaining in the forests of the United States. Of these reserves in Canada, about one-half is in the old provinces of Eastern Canada and the other half in British Columbia. The evidence goes to show that at the present rate of cutting the supply of timber will within a comparatively few years be sufficient only for the needs of the Dominion itself, leaving no surplus for export.

Mines.

Mining is the only industry in a country which from the very nature of the case cannot be permanent. Other industries—like money well invested—can be made to yield an annual return in interest while the capital remains unimpaired or even increases in value. The mineral wealth of a country may be compared to a sum of money hidden in the ground. It does not renew itself and every dollar abstracted leaves just so much less for future use. "Yet it is a singular fact," as remarked by a recent writer referring to the United States, "that among a people supposedly grounded in the rudiments of political economy, the progressive exhaustion of this precious resource is everywhere heralded as a triumph of enterprise and a gauge of national prosperity. The nation publishes periodically the record of its scattering of assets never to be regained and waits with a smile of complacence for general congratulation."

Great mining regions in the older countries of the world worked for many years have now become exhausted. Among these may be instanced the Kongsberg mines in Norway, which at one time produced great masses of native silver rivalling those now obtained from Cobalt; the lead mines of Great Britain, now completely abandoned; the celebrated mines of the region about Freiberg, in Saxony, the last of which is now about to be closed down; and the great diamond fields of India, which no longer yield these precious gems.

In Canada our mineral deposits are of great extent and importance. The value of the mineral output is increasing rapidly year by year. Our coal resources, as shown by the investigations undertaken in connection with the International Geological Congress, which was held in Canada last year, are in extent second only to those of the United States. The geological structure of the Dominion, moreover, is such as to lead to the confident belief that as detailed exploration is carried forward in Northern Canada, large deposits of the metallic minerals will be found in that portion of the Dominion—so that the mining industry of the Dominion, there is reason to believe, will play a very important part in the future history of the country. It is, however, of the greatest importance that we should avoid all waste in the development of these resources. The losses sustained in other countries from lack of care and thought in this respect are enormous. Dr. Douglas estimates, for instance, to take only one example, that at the Rio Tinto mines in Spain in a period of some thirty years, through the unskilful treatment of the ore, about 7,000,000 tons of sulphur, valued at not less than $70,000,000, were wasted, while with modern improvements in the method of handling the ore, about 1,000,000 tons of sulphur are annually saved to the world which would otherwise have been burned and served simply to pollute the atmosphere The same writer points out that only some 60 per cent. of the hundreds of millions of dollars yielded by the Comstock lode was recovered at the time and at first the enormously rich tailings were not even collected, such was the haste of the miners to empty that stupendous deposit which should have made Nevada prosperous for generations instead of whirling the whole country into a mad dance of reckless speculation. The primary cause of a large part of this waste is over-capitalization, which involves a large output at any expense if the value of the shares is to be raised and their price maintained. Over-capitalization generally demands over-production, which in its turn almost invariably involves waste at some stage of the progress of the metal from the mine to the consumer.

Perhaps the most serious waste which is taking place in the Dominion at the present time in connection with its mineral resources is presented by the mining and utilization of coal. In the first place, in mining a coal seam from 50 to 90 per cent. of the coal is left in the workings for the purpose of supporting the roof. Of the coal which is taken out and burned under boilers in the usual manner, only about 12 per cent. of the total energy is developed. That is to say, we secure for useful purposes only about 5 per cent. of the total energy contained in the coal contained in the area. If the coal is burned in gas producers and the gas so obtained used in internal combustion engines, these, having a higher efficiency, develop about 30 per cent. of the energy in the coal actually mined, or about 12 per cent. of the energy locked up in the coal of the whole area. This is an improvement, but still represents an enormous waste.

On the other hand, the coal may be mined for the production of coke for metallurgical purposes. About three-fourths of the coke produced for this purpose in North America and all the coke made in Western Canada is manufactured in Bee Hive furnaces, which yield a relatively low percentage of coke, while the other products of the coal—gas, tar, ammonia, benzol, etc.—go to waste. All these products may be saved by making the coke in by-product ovens, representing in localities where the surplus gas can be sold at a reasonable rate a gain which is estimated by Mr. F. E. Lucas, manager of the coke ovens of the Dominion Coal Company, at $1.98 per ton of coke made. This figure will, of course, vary with the locality in which the coke is produced, but it emphasizes the great saving which may be effected by the use of the modern by-product oven. The tar and ammonia obtained by this process, moreover, meet with a ready market. The former is already being used extensively in the Dominion for a variety of purposes, among them as a binding material in the manufacture of briquettes from slack coal, thus enabling this waste product to be successfully utilized, while the ammonia is a fertilizer of the greatest value, for which there is a great demand abroad and for which an ever-increasing demand will arise in Canada as the necessity of employing improved methods of agriculture is brought home to our farmers.

Fisheries.

Not only is Canada richly endowed with natural resources which have their locus upon the land but she is bounded on three sides by the salt waters of the sea and running through her domain are many streams and great rivers which have their origin in thousands of inland lakes, some of these being among the largest bodies of fresh water in the world. These waters abound—or should abound—in fish and other living creatures which constitute another of our great natural resources. Canada ranks well among the nations of the world in the yield of its fisheries, in which it is estimated that 90,000 men are engaged, whose labor yields from 26 to 30 million dollars annually. The fishing industry at the present time is carried on in three distinct and separate portions of the Dominion—The Atlantic Coast, the Coast of British Columbia, the inland waters. There are also the oyster and lobster fisheries of the Atlantic coast and the fishing or rather hunting for whales and porpoises on the Arctic shores of Canada and in the waters of Hudson's Bay and the Gulf of St. Lawrence.

The fishing industry in the Maritime Provinces could be very considerably developed and be made to yield larger returns if improved methods of curing, packing and shipping were employed under proper government inspection, in this way improving the quality of the salt fish sent to market. The Dominion Government has recently made an appropriation of $10,000 for the establishment of a fisheries intelligence bureau with the object of bringing before the fishermen in some concrete way information with reference to the best methods of curing and packing their fish. The Government has also made provision for the encouragement of the trade in fresh fish between the Atlantic and Pacific seaboard and the interior parts of the Dominion by paying a portion of the regular express charges on all shipments of fresh fish from the Atlantic coast to all points in Ontario and Quebec and from the Pacific coast to all points as far east as Manitoba. While owing to certain local causes certain kinds of fish, such as shad, are less abundant than formerly, there seems to be no indication of depletion of our Atlantic fisheries as a whole. The fact that the catch has not increased more rapidly in recent years is owing largely to a restricted market.

The fishing industry in British Columbia presents a marked contrast in many respects to that of our Atlantic coast. Salmon is by far the most important fish taken and it is for the most part canned for shipment. The fish are taken when coming in from the sea to spawn in the rivers and are thus easily secured. The value of the salmon catch in British Columbia has increased enormously in recent years, amounting on an average in the years 1908 to 1911 to considerably over $7,000,000. Year by year the canneries are increasing the number and size of their plants and the number of their boats, while across the mouth of the Fraser River the nets form a veritable barricade. With such intensive fishing it can hardly be expected that the industry will not suffer. Although the run varies greatly in different years, the fish being especially abundant every fourth year, a careful study of the subject by Professor McMurrich goes to show that the supply of fish is gradually diminishing and this opinion is shared by most of the canners, although the extension of their plants is contributing all the more rapidly to the extinction of the supply. The question as to what can be done to conserve this most lucrative industry on our Pacific coast is one which presents peculiar difficulties. The salmon coming in from sea to spawn in the Fraser River pass by the coast of the United States on the south side of the Gulf of Georgia and are there taken in enormous numbers by United States fishermen. Up to 1908 the Canadian canners on the Fraser River were catching more than the Americans, but now the state of affairs is reversed and the Americans are catching twice as many as the Canadians. The conservation of these fisheries, therefore, is an international question and one which should be made a subject of immediate consideration by the governments of the countries concerned, if the industry so valuable to both countries is to escape destruction.

The Fur Trade.

The rise of the fur trade was almost coincident with the discovery of Canada, and with the establishment of the great fur trading companies, their agents penetrated ever farther into the interior of the country until fur trading stations had been established in every accessible part of the area now embraced within the borders of the Dominion of Canada.

In recent years the ever advancing network of railway and steamboat communication have made it possible for hunters to carry their provisions and supplies into remote recesses of the continent which have hitherto been practically inaccessible. The last retreats of the furbearing animals have been invaded by their remorseless enemy, man. The musk ox, for instance, has only figured in the London sales during the last forty years—before that time the hunters of the Arctic regions were unable to reach its habitat; the continued invasion of its territory makes its extinction more than probable in the not distant future. As a result of these inroads, the fur-bearing animals are everywhere decreasing in number and notwithstanding the fact that hunting is everywhere being carried on with increasing vigour by the aid of modern guns, smokeless powder, improved traps and the most alluring baits and scents, the supply of furs obtained is constantly diminishing. Coincident with the falling off in the supply, there has been a remarkable increase in the demand for furs, especially for the most costly varieties. This has been most marked during the past twenty years owing to the increase of population and wealth among the people of northern countries where furs are required not only for comfort but also to satisfy the requirements of fashion. The value of the furs exported from Canada in the year 1913 was $5,415,118. This increased demand has, of course, been accompanied by a steady rise in price.

While the most costly furs are in ever-increasing demand notwithstanding their ever-increasing price—for the mere fact that they are enormously expensive creates an inextinguishable desire for them on the part of certain people—there has arisen an increasing demand for cheaper furs also. Scarcely any animal that has a furry coat, is now safe to walk around, for some one seizes and slays it, although the pelt continues its existence under a name and often under a guise in which its original possessor would never recognize it. Thus, goats become transformed into bears, hares or minks into sables, muskrats and rabbits into sables, or seals or electric seals; opossum into beaver, white rabbits into ermine, white hares into chinchilla, racoons into silver bear. Even the domestic cat, hitherto an unappreciated national asset, having changed its plebian designation for one which finds more acceptance in good society, "arrives," and in so doing often helps its wearer to do so also.

Furs can, of course, only be produced under certain climatic conditions, and these are nowhere more favorable than in our Dominion. The breeding of fur-bearing animals is an industry of great promise, which should, if carried on in a conservative and rational manner—as any other industry must be to meet with success—have a great future in Canada and be an additional source of wealth to the Dominion. It is not, I think, generally recognized that a number of the more important of these animals are already being bred in captivity—several of them in Canada—with success, although as yet only on a small scale. Among these are foxes of several varieties, mink, martin, fisher, muskrat, racoon and skunk. The skins of the animals bred in captivity bring a higher price in the market than the skins of the same animals taken in the forest. Fox farming, especially in Prince Edward Island, indeed, although more or less discredited by the excessive speculation with which it has been associated, has proved to be a successful industry and one which is capable of great expansion. There are now on Prince Edward Island 233 fox "ranches," containing 2,480 foxes, of which 1,325 are silver-black foxes. The sworn value of these was slightly over $3,700,000, from which the Provincial Government derived an income of $37,000. The black and dark silver skins from foxes produced on the Prince Edward Island ranches have rarely brought less than $500 apiece and frequently over $2,000 at the London auction sales.

Much also could be done to prevent the extermination of our fur-bearing animals by making all our national parks and forest reserves "sanctuaries" for the animals who are their natural denizens. A sanctuary has been defined by Colonel Wood as a place where man is passive and the rest of nature active. This can be done by maintaining a really efficient system of patrol, with the prompt arrest and punishment of all who break the forest laws. Some of our parks are so protected and it is found that the animals rapidly increase in them and spread out into the surrounding forest. Many of our forest reserves, however, are absolutely without protection or patrol.

Conclusions.

In conclusion it may be said that we have seen that Canada has been blessed with great natural resources. Each and all of these, however, already show signs of serious depletion.

Our mineral resources, like the mineral resources of every country, are in the very nature of the case being depleted in direct proportion to the growth of our annual output of the products of mine and quarry.

Our forests, which are by no means so extensive as is generally supposed, have been cut, slashed and burned in a reckless manner.

Our agricultural lands, although showing an ever-increasing output on account of the opening up of new tracts of virgin soil, are not yielding even approximately the returns of which they are capable were they farmed according to more improved modern methods.

The maintenance of our water powers at their maximum efficiency is threatened if the forest areas of their catchment-basins are not preserved.

The fisheries of British Columbia and of our inland waters are in serious danger.

With the continued advance of settlement our wild fur-bearing animals are in course of extermination.

Each and all of these resources of our national domain, (with the exception of the mineral deposits), can, however, not only be restored to its original condition but may, if we take vigorous action at the present time, be conserved, cultivated and not only be made to yield a higher annual return than at present but while doing so to increase in value year by year, and be handed on by each generation to the succeeding one in a better and more productive condition than it received them.

It is time for the people of Canada to awake to the realization of these facts, and in so doing to remember that in the last analysis the success of any policy of conservation depends upon the efficiency of the human unit. The instinct of the savage which still survives in the ordinary man inclines him to seize what he can now and for himself and let others, including posterity, take their chance. The national instinct for the preservation of the state does not, however, lend itself to any such practice of personal aggrandizement and selfish waste. Canada should learn the lesson exemplified in the rise of such a powerful state as Germany—relatively poor in natural resources, but becoming rich by their careful conservation and able husbanding.

This conservation is part of that "righteousness which exalteth a nation." And finally, let us remember that—in the words of Dr. James Douglas—we should be preservers of the gifts with which a beneficent Providence has stored our world, for next to being a creator man reaches his highest position in being a saver—a saviour.

On the occasion of the 50th anniversary of the School of Mines, Columbia University, May 29th, 1914, Carl A. Meissner, among others, had conferred on him the honorary degree of Master of Science in recognition of his services in the manufacture of iron and steel. Mr Meissner is Chairman of the Coke and Blast Furnace Committees of the United States Steel Coporation and was formerly connected with the Dominion Iron and Steel Co., Sydney N. S.

MR. D. A. THOMAS' PROJECTS.

London, June 10.

With regard to D. A. Thomas, the Welsh coal magnate who has just returned to this side from New York, the Financial Times says: "With reference to the important projects which D. A. Thomas, chairman of the Consolidated Carribian Company, has recently had under negotiation for the development of the coal mining industry on the other side of the Atlantic, it appears that arrangements have already been entered into involving a capital sum of nearly £3,400,000, which amount may quite possibly be added to hereafter.

"The net result of Mr. Thomas' operations will be to explore some thousands of miles of land in Canada, while certain areas in the United States are also being taken in hand and great expert coal miners from Great Britain will be induced to try their fortunes in the United States and the Dominion.

"It is probably upon this aspect of the situation that the Canadian authorities put the greatest store. Owing to his prominent position in the English coal trade. Mr. Thomas is not likely to find any difficulty in financing his schemes, on the contrary, it is thought he has already made necessary arrangements in this country, by means of private negotiations.

"This may possibly be followed by an appeal for public support, but the policy to be pursued in this connection has not been made known. It is satisfactory to find that Mr. Thomas' incursion into the United States and Canadian coal fields has been well received, and is regarded in both countries as a development with which they may be well satisfied. As enterprising as are the coal operators in the United States they practically admit that they have something to learn from the English experts and particularly from one who has shown himself to be one of the most astute organizers in the world."

CALUMET AND HECLA.

Boston—The report of Calumet and Hecla Mining Co. for the year ended Dec. 31, 1913, shows production of 45,016,890 pounds of copper, produced at cost of 14.25 cents per pound. Previous year's production was 67,856,429 pounds, and cost 9.86 cents.

The report contains a statement by President Shaw, to the effect that the re-treatment of the company's tailings by regrinding and leaching, is expected to show a total net profit of about $20,000,000.

All the buildings for the new recrushing mill have been finished and about one-half the machinery erected. The work of installation should be finished this summer. It has been estimated that the above mill, working at its capacity of about 3,000 tons a day, would retreat the available sands in Torch Lake in about 30 years and save five pounds of copper per ton at a cost of about six cents, giving a profit if sold at 13½ cents per pound, of something over $10,000,000, less the cost of the mill and power equipment. Experiments that have been carried on during the past two years show that a leaching process has been developed which can be applied to a large proportion of the waste tailings of this recrushing mill.

The results so far obtained by the use of this process indicate a further saving of copper at a cost which will give an additional profit from the sands of about $10,000,000, or a total net profit of about $20,000,000. This process can also be used in further re-treatment of a large portion of the tailings that will result from milling the balance of the Calumet conglomerate rock as yet unmined. It also will be effective in making large savings and increased profits in the re-treatment of the Tamarack sands and the milling of White Pine rock, in which companies the company is a stockholder.

TECHNICAL EDUCATION IN NOVA SCOTIA.

The Mining Society of Nova Scotia at a recent meeting made the following resolution:

Whereas, One of the most pressing needs of the present time in the mining and other industries in Canada, is an increase of facilities for our workmen for technical education, and whereas, The provision for general industrial training in foreign countries has been one of the largest factors in the phenomenal increase in industry and commerce, and in the general happiness and well being of the people; and, whereas, The Royal Commission of Technical Education and Industrial Training has recently made certain recommendations to the Dominion Parliament for the increase of facilities for technical education throughout Canada.

Resolved, That the Mining Society of Nova Scotia, assembled in its annual meeting at Sydney, Nova Scotia, do urge the Dominion Government to take favorable action on the recommendations of this Royal Commission; and further resolves, That this society also urges the Government of the Province of Nova Scotia to cooperate with the Government of Canada in such manner as will bring about definite results in regard to the recommendations of the Commission; and further resolved, That copies of this resolution be sent to the Premier of Canada, including all members of the Cabinet, Premier of Nova Scotia, and representatives of the Province, in both Federal and local Parliaments.

An oil-fired blast furnace has been put in at the Copper King mine, Chewelah, Washington, by Mr. J. J. Anderson, patentee. It is stated that this is the first furnace of the kind installed in the Northwest for smelting copper ore on a commercial scale. For some time several years ago, experiments were made at Van Anda, Texada Island, British Columbia, under the direction of Mr. Thos. Kiddie, metallurgist, formerly superintendent of the Northport Smelting and Refining Co's smelting works at Northport, Washington, and on his recommendation Mr. Anderson made improvements suggested by the experience gained in the demonstration at Van Anda of the suitability of the Anderson oil-fired furnace for reducing copper ores, but the several runs were short ones—of only a few days each. The installation at Chewelah is, however, intended to be for continuous operation, so results will be looked for with much interest. The treatment capacity of this furnace is stated to be about 100 tons a day. As the United Copper Co. has more than 7,000 tons of ore, averaging 5 per cent. copper, ready for smelting, there is no question of insufficiency of ore supply, so the oil-fired furnace will be given a fair trial.

Thus far petroleum has been utilized mainly for illuminating and lubricating and of recent years as motor fuel. It is principally in demand for motor fuel which has resulted in the rapidly increased production. For some years oil has been used as fuel for locomotives in several countries, but principally on roads where heavy oil is found, such as in California, where Atchison and Southern Pacific adopted liquid fuel. The great navies are adopting petroleum without waiting for the perfection of the internal combustion engine. Principal reasons are greater radius of action, increased speed, reduction in labor and absence of smoke, making location of a ship more difficult for the enemy.

PERSONAL AND GENERAL

Col. A. M. Hay has returned to Toronto after examining mining property in Nova Scotia.

The Duluth office of the H. W. Johns-Manville Co., has moved to larger quarters at No. 327 W. First Street, in order to take care of its increased business.

Mr. W. A. Thomas, who for several years past has been Commercial Engineer in charge of all sales of mining apparatus for the Westinghouse Electric & Mfg. Company with headquarters at East Pittsburg, resigned his position with this company on June 1st, and has taken up the practice of Consulting Engineering in Pittsburg with office in the Second National Bank Building .

Mr. J. C. Houston, manager of the Schumacher mine, has returned to the mine after being in Toronto for a few days.

Mr. A. A. Hassan has completed an examination of the Crimora Manganese Mine Augusta Co., Virginia, and is now examining gold mines in Esmeralda Co. Nevada.

Mr. J. W. Astley has been spending a few weeks in Victoria, B. C.

Prof. J. W. Bell was in western Canada last month with the McGill senior students in mining engineering. The summer school itinerary ended at Rossland, whence the students dispersed and went their several ways.

Mr. Lorne A. Campbell, of Rossland B. C., general manager for the West Kootenay Power and Light Co., endeavored to make an automobile trip to Fort George, but did not reach his intended destination with his motor car. There are good roads for many miles through Cariboo district, but not as far north as Fort George in the early spring.

Mr. C. G. F. Carlston has left the employ of the British Columbia Copper Co., operating in Boundary and Similkameen districts of British Columbia and has gone to Tonopah, Nevada.

Mr. James Cronin, of Spokane, Washington, for years manager of the St. Eugene lead-silver mine in East Kootenay, B. C., was at Halcyon hot springs on Arrowhead lake, B. C., late in May.

Mr. R. E. Hore has returned to Toronto after visiting mining districts in the Maritime Provinces.

Mr. J. Victor Culbert, formerly at the Hollinger mine, Porcupine, was at Nelson recently, after having been travelling in Mexico and Alaska.

Mr. R. W. Brock, deputy minister of mines, made a somewhat hurried trip to Alberta and British Columbia last month. At Calgary he made enquiries concerning the reported discovery of oil in commercial quantity, and afterward went to Nelson, B. C., to look into the zinc-smelting question there.

Mr. S. Duncan Ellis, who recently graduated in mining engineering from Toronto University, has gone to the Braden copper mines, near Santiago, Chile.

Mr Harry A. Guess, of New York City, who some years ago was associated with his brother, Prof. Geo. A. Guess, of Toronto University, in assaying in British Columbia, was in the Coeur d'Alene district, Idaho, about the middle of May.

Mr. J. M. Harris, long known in connection with the Reco and other mines in Slocan district, B. C., has returned to Sandon, Slocan, from a three months' trip to Mexico and other countries.

Mr. Howard W. Kitson is now general superintendent for the British Columbia Copper Co., at the group of mineral claims on Copper mountain, Similkameen, B. C., the company has for two or three years been developing under option of purchase.

Prof. Arthur Lakes has returned from a lengthy visit to England, and is now with his son, Mr. Arthur Lakes, Jun., who is manager of the Ymir-Wilcox gold mine, near Ymir, B. C.

Mr. Harold Lakes is superintendent of the Silver Hoard mine, near Ainsworth, B. C.

Col. N. E. Linsley, of Spokane, Washington, during the latter part of May examined the new development workings at the Payne mine, Slocan, B. C., whence he was accompanied by one of the owners.

Mr. T. L. McAllister, for years superintendent of the Noble Five group of mines near Cody, Slocan, B. C., has retired from that position and gone ranching in the Coast district. Mr. Paul Lincoln, late of Chihuahua, Mexico, is now in charge at the Noble Five.

Mr. Geo. C. Mackenzie, chief of the metallurgical division of the Mines Branch, Canada Department of Mines, has returned to Ottawa from Nelson, B. C., the experiments in electric smelting of lead-zinc ores of which he had supervision at the latter place having been discontinued.

Prof. J. Bonsall Porter, of Montreal, has returned from a trip to western Canada with his McGill summer mining school of senior students in mining engineering. After a visit to Cobalt and other parts of Ontario, the party went to coal mines in Alberta and Southeastern British Columbia, and afterward spent a week in Boundary and Rossland districts at mines and smelting works there.

Mr. R. J. Spry, who last year was superintendent at the Eureka mine, near Nelson, B. C., has returned to British Columbia from a trip to eastern Canada, and is now at Victoria.

Mr. Stuart J. Schofield, of Ottawa, has commenced his season's geological survey work in East Kootenay district, B. C. He is scheduled to complete the mapping of the area situated between that included in the Cranbrook map and Kootenay lake, and to afterward study the silver-lead ore bodies in Ainsworth camp and the recently discovered deposit of tin ore in Lardeau district.

Mr. Wm. Thomlinson, for years actively engaged in prospecting and mining in Slocan district of British Columbia, has been engaged by the Dominion Government to collect representative specimens of the ores. and other minerals of the province for the Canada exhibit at the Panama-Exposition next year.

Mr. E. E. Ward, formerly superintendent of the Silver Hoard mine, near Ainsworth, B.C. ,is now with the Granby Consolidated Co., at its Hidden Creek mines, near Anyox, Observatory inlet.

Mr. Roy Wethered, who for some time was with the Consolidated Mining and Smelting Co., at mines in Ainsworth camp, has opened an office, as consulting mining engineer, in Spokane, Washington.

Mr. Clyde B. White, formerly superintendent at the Idaho Alamo mines in Slocan district, B. C., has taken a similar position in the Portland Canal district of the same province.

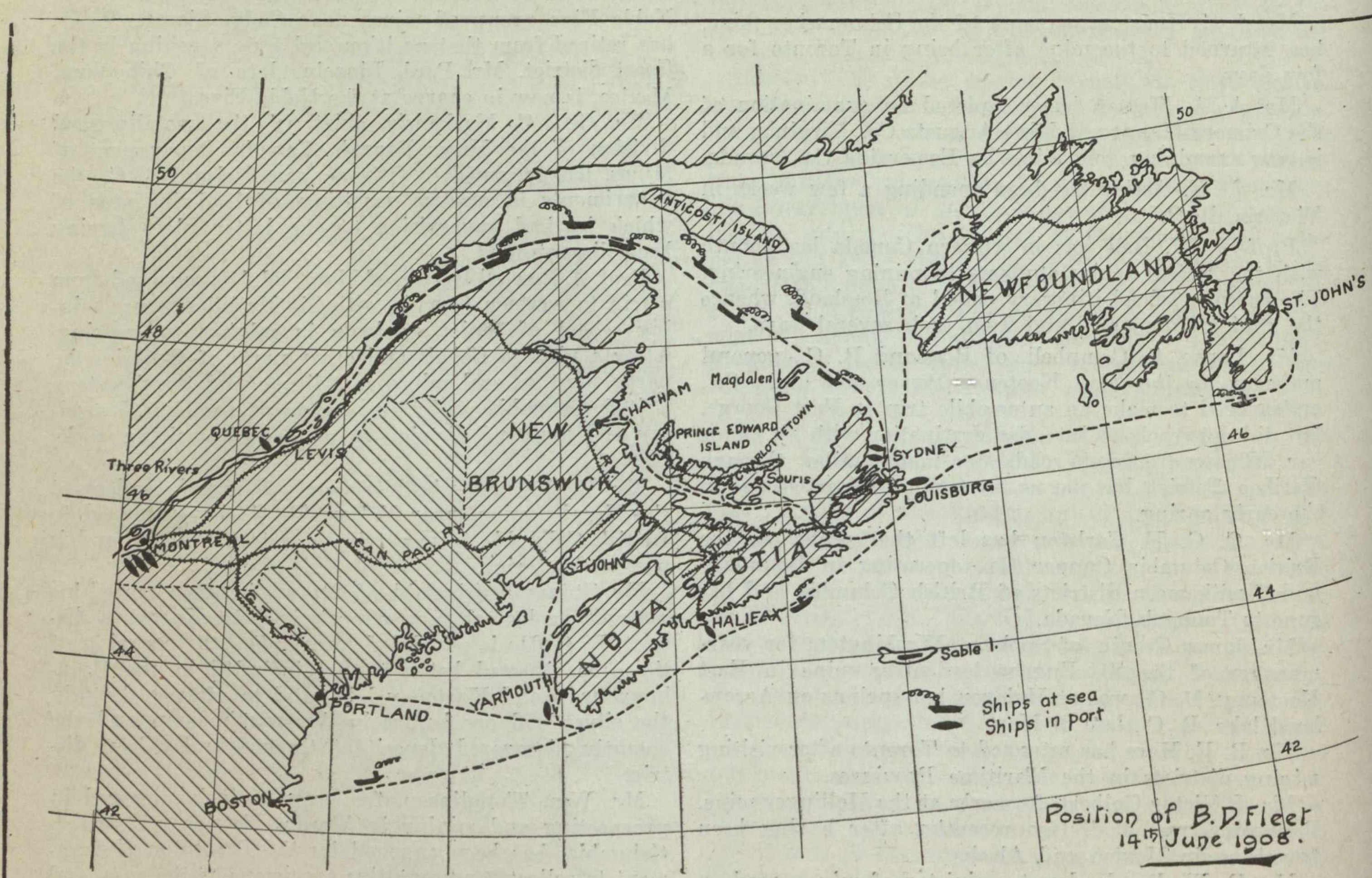
Mr. James Wilding, Jun., formerly of Parral, Mexico, has been at the mill on Four-mile creek, Slocan, of the Silverton Mines, Ltd., operating the flotation plant put in there by the Minerals Separation American Syndicate, Ltd. It is stated that the flotation process is making a satisfactory recovery at the mill just mentioned.

SPECIAL CORRESPONDENCE

NOVA SCOTIA

Coal Freighting in the St. Lawrence River.

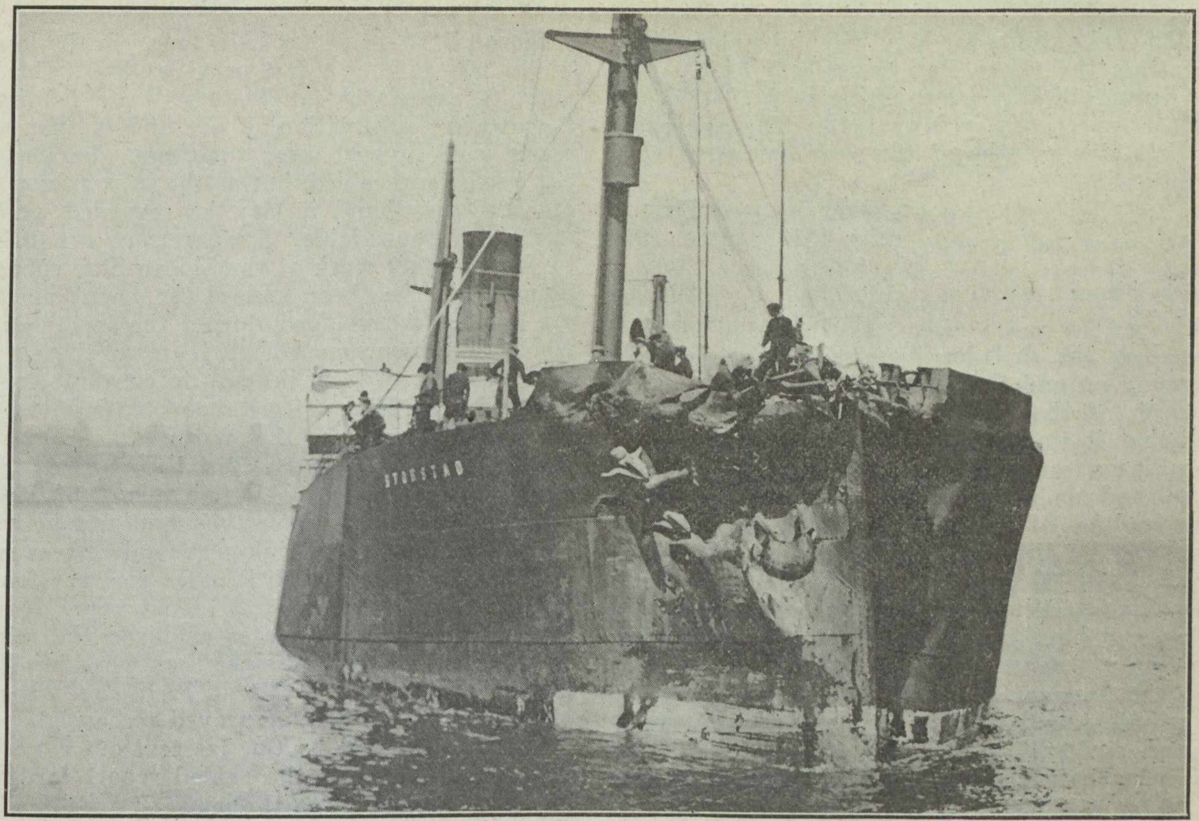
The recent disaster to the "Empress of Ireland" has brought into prominence a feature of the St. Lawrence shipping route that is very familiar to those who have occasion to sail these waters, but on which the general public is but little informed. Between the beginning of May and the end of October the Dominion Coal Company expect to dispatch no less than two million tons of coal from Cape Breton to Quebec and Montreal,



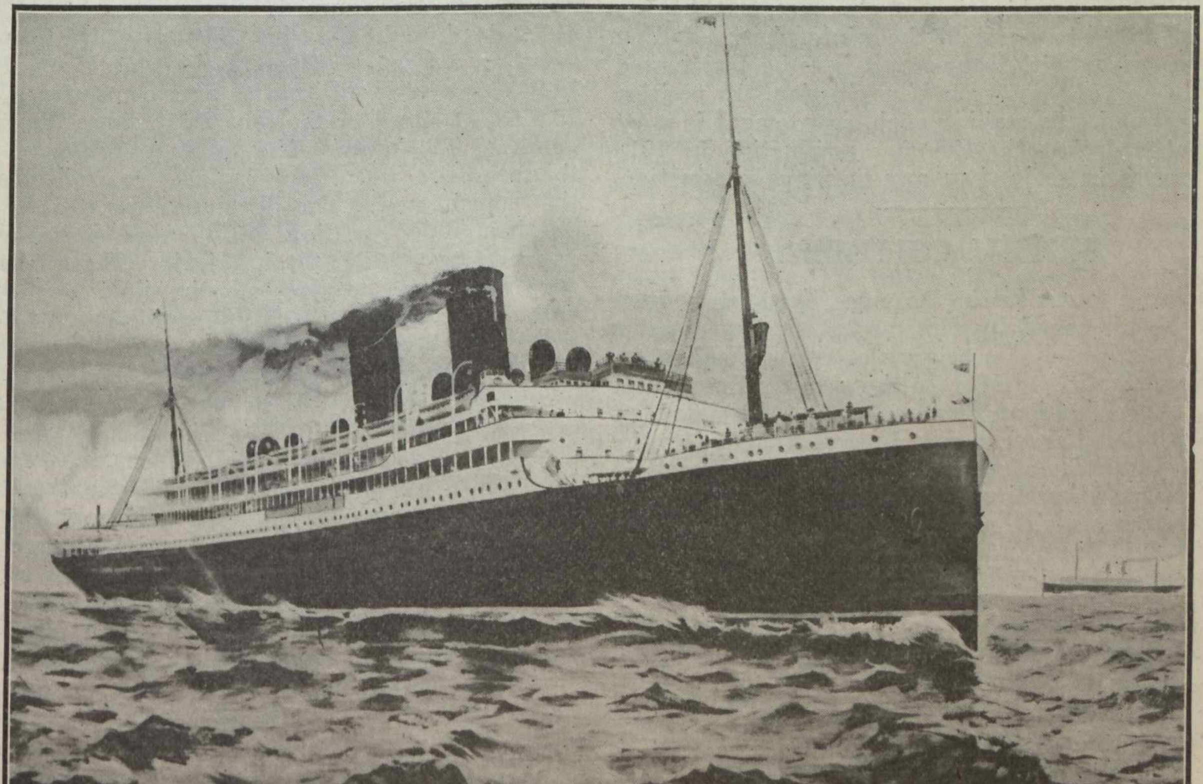
and the Nova Scotia Steel Company will ship about 350,000 tons in the same period. In the week ending the 30th May the Dominion Coal Company sent out from Sydney almost 100,000 tons—to be exact 99,000 tons of coal destined for the St. Lawrence ports, contained in 14 steamers of between 7,000 and 10,000 tons capacity each. This is the best shipping record the company has yet achieved, but it is only typical, on a slightly larger scale, of what has taken place every week throughout every Summer during the past ten years. It is within the mark to state that 80 per cent. of the shipping tonnage plying the St. Lawrence route is engaged in the transportation of coal. From the time that the drift-ice will permit of navigation until the buoys are taken up in the Autumn the procession of coal-boats coming and going from Sydney to Montreal is a continuous one, and these boats are loaded, sail, discharge and are returned with a regularity approaching that of a well ordered railway.

As to the question of blame in the recent appalling event, it would be premature to anticipate the deliberate pronouncement of the investigating authorities, except that from the meagre details which have transpired it appears to be the outcome of an unfortunate concatenation of circumstances, and there is dreadful irony in the fact that such a catastrophe could occur to a well-found steamer like the "Empress" within sight of land, and that a thousand people should find death in a little over one hundred feet of water. The small percentage of accidents that have occurred in connection with the coal-freighting trade in the St. Lawrence is evidence of the careful and competent navigators that are employed in this trade, a fact that the "Empress" accident but serves to throw into greater prominence, when the circumstances are properly considered.

Members of the mining profession in Canada will be filled with regret at the death of Dr. and Mrs. A. E. Barlow, particularly those who heard Dr. Barlow give his valedictory address at the close of his Presidency of the Canadian Mining Institute in March last. Nova Scotia members of the Institute and the members of the Nova Scotia Mining Society remember Dr. Bar-



The Collier "Storstad" entering Montreal Harbor.



The C. P. R. Liner, "Empress of Ireland"

low's presence in Haliafx when he accompanied a deputation from the larger Institute looking towards the affiliation which it is hoped may be brought about before very long, and it is with great sorrow that the Nova Scotia members of both Institutes hear of Dr. Barlow's name among the many who are missing.

Dominion Coal Outputs.

Dominion coal outputs for May will show about 406,000 tons from the Glace Bay mines and 34,000 tons from the Springhill Mines, comparing with 403,000 and 31,000 tons respectively in May 1913. The aggregate for the first five months of the year compares with 1913 as follows:

	First 5 mths. 1913 tons	First 5 mths. 1914 tons
Glace Bay Mines	1,899,683	1,803,000
Springhill Mines	163,836	166,000

During May the drift-ice interfered most seriously with shipping around the coasts of Cape Breton. On the fifteenth of the month the ice-blockade was so thorough that it was necessary to lay idle the whole of the collieries, an unprecedented occurrence from this cause, and on several other occasions the mines had less complete enforced idleness. But for the hindrance imposed by the drift-ice the production would have reached 440,000 tons.

The Springhill Mines silghtly exceeded the 1913 production and have now completely recovered from the reduction in output caused by the fire.

During the Summer months it is expected that the Glace Bay mines will produce considerably in excess of last year, and will overtake the decrease of 96,000 tons shown by the aggregate at the end of May. Daily outputs of over 19,500 tons are now being obtained, and during the Summer the long coveted production of 20,000 tons in one day from the Glace Bay collieries will probably be realized. The collieries of the company were never in better physical shape for the production of coal, and although the figures at the end of May, owing to a combination of circumstances having no relation to the capacity of the mines, show a falling off in comparison with last year, it is to be anticipated that by the end of the season of navigation, the position will be reversed. In making such a statement it must be remembered that the Summer production in 1913 was on a greater scale than any previous production.

BRITISH COLUMBIA

Two mining towns in the Province have lately been considerably damaged by fire, and a similar disaster has been experienced at a colliery at South Wellington, Vancouver Island. On May 14 there was a fire loss at Stewart, at the head of Portland Canal, estimated at about $75,000. The property destroyed included the Dominion Government telegraph office, the Portland Canal "Miner" building and plant, Mr. George A. Clothier's assay office with appliances and supplies, and other buildings and their contents. On May 23 much damage was done to the business section of Atlin, in Cassiar district, where the buildings consumed included the post office, Dominion telegraph office, seven or eight stores, three hotels, the Overseas club, Presbyterian church, and a number of residences. Both Stewart and Atlin are distributing points for their respective mining districts, so the indirect as well as the direct loss is considerable, and the inconvenience great for the time being. The Pacific Coast Coal Mines, Ltd., lost its South Wellington colliery, tipple and other property, and there incendiarism is suspected, the company having for more than a year had much trouble with strikers, members of the United Mine Workers of America, and having during its recent months operated its mines with non-union labor.

Slocan.

Slocan Star.—Ore has been found in the lowest level of the Slocan Star mine, near Sandon. This development is especially satisfactory, since it proves the downward continuation of ore shoots that at higher levels were opened some time ago. Particulars have not yet been received, but as the information has been obtained first-hand it may be regarded as authentic and quite dependable. Preparations are being made to shortly start work at the Slocan Star concentrating plant, which has been unused for years; much milling ore has been developed during the last year, so that when a commencement shall be made there will be an ample supply to keep the mill in constant operation.

Wonderful Mine.—It is reported that underground exploratory work in the Wonderful mine, situated about two miles from Sandon, has resulted in the discovery of ore in considerable quantity. Some years ago much surface wash on this claim was hydraulicked, and 400 to 500 tons of high-grade galena was recovered, but the vein from which it came was not found in an adit driven in search of it. Last year Mr. Clarence Cunningham and associates acquired the mine under option of purchase, and since then work has been done under the direction of Mr. J. P. Keane, whose efforts are now reported to have proved successful.

The Van-Roi Mining Co. has sent out from its office in London, England, the cabled report for the month of April received from the managers of its silver-lead-zinc mine and concentrating mill in Silverton camp, Slocan district. The mill report shows that the total quantity of ore crushed during the month was 2,128 tons of an average assay of silver 13.3 oz. to the ton, lead 1.9%, and zinc 4.9%. This yielded 11 tons of picked ore averaging 481.9 oz. of silver to the ton, 61.7% lead, and 8.6% zinc; 65 tons of lead concentrate assaying 216 oz. of silver to the ton; 47.6% lead, and 14.9% zinc; and 90 tons of zinc concentrate assaying 75.8 oz. of silver to the ton; 2.8% zinc. The mill was operated 456 hours. The total approximate value of the products was $13,967. The expenditure during the month was: On development, $3.926; ore-production, $4,665; milling, $3.736; and capital and other expenditure, $2,121; total, $14,448. These figures compare with three previous months thus: January, total value of products, $18,329; expenditure, $14,194. February, total value of products, $15.776; expenditure, $12.729. March, total value of products, $21,889; expenditure, $17.823. The balance to credit for the four-months' period is $10,767. There was done in April 303 ft. of development work. In one raise from No. 5 level there was 36 in. of ore which for 4 ft. averaged 48 oz. of silver to the ton, 4% lead, and 4% zinc; in another raise from the same level a stringer yielded 1.25 tons of high-grade ore and 79 tons of concentrating ore. In still another raise from No. 5, favorable ground was encountered at 147 ft. up; development was similarly favorable in a drift being run at 98 ft. below that level.

Nelson.

Work has been resumed at the Consolidated Mining and Smelting Co.'s Molly Gibson mine, situated at the head of Kokanee Creek, a tributary of Kootenay River which it enters about a dozen miles above Nelson. The snow lies very deep during several months of the winter at the high altitude of this mine, and there are snow-slides to reckon with, so it is not advantageous to work it during the first three or four months of the year. A repair gang of men is putting the aerial tramway into working condition, so that shipment of ore over it may be resumed shortly.

For test purposes, a shipment of about 40 tons of complex lead-zinc ores has been made from Nelson to Hartford, Connecticut, so that it may be treated in a Johnson electric furnace. The ore was selected by Mr. W. McA. Johnson, when he was at Nelson a few weeks ago; including in the lot is ore from the Sullivan mine, the Standard mine near Slocan Lake, carbonate ore from the H. B. mine near Salmo, some of the old stock ore left over from the time when several years ago the Snyder electric process was being experimented with at Nelson by the Canada Zinc Co., and some zinc-iron middlings from the Bluebell concentrator on Kootenay Lake.

An action for damages before the Supreme Court of British Columbia at Nelson late in May was of much interest to miners in the district. A miner named Harrison sued the Consolidated Mining & Smelting Co. of Canada, Ltd., for $3,000 as compensation for injuries he received while working for the company at the Silver Dollar mine, near Salmo, in Nelson mining division. Prior to commencing proceedings under the Employers' Liability Act, he had, however, accepted an offer of compensation made to him by an agent of the company and had afterward received payment of sums of money under that arrangement for compensation. Chief Justice Hunter gave judgment in effect that acceptance by plaintiff of payments of money as compensation from his former employers constituted an election or choice of precedure and was a waiver of all right to further action for damages under the Employers' Liability Act. The defendant company, accordingly, was successful in resisting Harrison's attempt to recover damages after he had agreed to a settlement of his claim.

Rossland.

The Le Roi No. 2, Ltd., has sent out from its office in London, England, the cabled report for the month of April received from the managers of that company's Josie group of mines in Rossland camp. The included information relating to ore shipments and receipts and expenditure follows: Shipped to smelter at Trail 1,530 tons of ore and 168 tons of concentrate. The receipts from the smelter were $19,375 in payment for 1,413 tons of ore and $815 for 111 tons of concentrate; sundry receipts were $694; total, $20,884. Estimated working expenses for the corresponding period were $8,500 for development, $11,500 for ore production, and $1,100 for milling; total, $21,100. These figures compare with three earlier months of the current year, thus: January, total receipts $31,662, expenditure $20,400; February, total receipts $9,977 (hoisting plant shut down for a week for repairs), expenditure $17,770; March, total receipts $23,846, expenditure $18,300; totals for four months are: Receipts $86,269; expenditure $77,570; balance to credit for period $8,699. There was done in April 359½ ft. of development work on the 600, 700, and 900-ft. levels. Assay value of ore opened varied from 1 dwt. gold and 1% copper for 23 ft. in one drift on the 900-ft. level, to 4 dwt. gold and 6.5% copper for 25 ft. in a drift on the 700-ft. level. Outside of that range of value, there was in another drift on the 900-ft. level 5 in. of ore that for 6 ft. averaged 1 oz. 6 dwt. gold and 1.5% copper.

Mr. L. Shaw, managing director for the Richmond Consolidated Mines Co., has been at Rossland lately, endeavoring to arrange for more work being done on the company's group of mineral claims, situated in the south belt of Rossland camp and including the Lily May, which was the first mineral claim located in this neighborhood, its discovery dating back to several years prior to that of the Le Roi and adjacent claims on Red Mountain.

Boundary.

Developments on the 400-ft. level of the Jewel gold mine, near Long lake, eight miles from Greenwood, having proved satisfactory, it has been decided to sink the main incline shaft another 100 ft. and to drive for ore at 500 ft. depth. Where first cut on the 400-ft. level the vein was pinched and it was not until after exploratory work was done beyond a fault that was encountered that a shoot of ore was found. This ore proved to be of higher grade than any taken out at shallower levels; it averaged about $30 a ton. Approximately 1,400 tons of ore is being milled monthly and sufficient gold is recovered to pay operating expenses of mine and mill and leave a fair margin of profit beside. No gold is saved on plates, but all ore is pulped and cyanided and the product melted in the crucible, the bullion being shipped to the Dominion Assay Office, Vancouver, B.C. Mr. Chas. A. Banks, formerly of New Zealand, general manager for the Jewel-Denero Mines, Ltd., has succeeded in placing this property on a paying basis after it had for seven or eight years been non-productive.

General Notes.

The "Chahko Mika" celebration committee, in connection with a carnival to be held at Nelson on July 13-18 next, has decided to offer $1,000 for a machine-drilling contest there, and arrangements have been made for the use of a compressor to supply power, etc., for the drilling.

The mining committee of the Revelstoke Board of Trade has decided to arrange a series of business men's excursions to visit mining camps within easy reach from Revelstoke, to get in touch with the situation, the chief object being to endeavor to foster the mining industry. The first trip has been made; a number of business men went to Trout Lake City and neighborhood, and the trip was both enjoyable and a success from a business point.

The Lynch Creek Gold Mining Co., which is a reincorporation of the Handy Gold Mines Development Co., owning mineral claims in the neighborhood of Gerrard, at the south end of Trout lake, has been organized under the laws of South Dakota, U.S.A. Mr. H. A. Stratte is president, Mr. A. A. Stensund, treasurer, and Mr. H. O. Holverson, Dawson, Minnesota, secretary. It is intended to levy an assessment on the shareholders for money to do development work.

Now that the spring is well advanced, the Motherlode Sheep Creek Mining Co. has its 10-stamp Merrill mill again in operation, after three months' inactivity owing to lack of water during the severe winter weather for power purposes. Work was done in the mine all through the winter, though, so that there is now about 6,000 tons of ore available for crushing. During the fourth quarter of the company's last fiscal year there was milled 8,781 tons of ore of an average value of $13.37 a ton. The total extraction was 97.1 per cent., of which 72.1 per cent. was by amalgamation. The total cost of milling was $1.40 a ton.

The Utica mine, on Paddy's mountain, some half a dozen miles from the Twelve-mile siding on the Kaslo

& Slocan Railway, has been much hampered for the greater part of the last year in regard to transportation matters, reconstruction work in connection with changing the gauge of the railway having prevented ore being shipped last autumn, and during the winter the snow was too deep for the line to be kept open. Now, however, there is a prospect of transportation facilities being provided ere long, so the wagon road from Twelve-mile to the mine is being repaired and other preparations for mining and hauling ore are also being made.

COBALT, SOUTH LORRAIN, ELK LAKE AND GOWGANDA

Kerr Lake—As a result of the trenching on the Kerr Lake mine slope of Kerr lake, the prospects of that property have been materially brightened. On the surface the No. 10 system—which is a network of small veins admitting of profitable stoping for a width of thirty or forty feet at the 140 ft. level—has been opened up on the surface for about 300 ft. On an average it is four to five inches wide of bonanza ore. To the west the vein is good up to the Crown Reserve boundary and on the other side of the line it is being mined as No. 17 system. To the east there is good ore as far as it can be trenched until the whole slope is hydraulicked. In one spot for about forty feet it is lean calcite, but a parallel vein has been discovered, which, while not as wide, is quite as rich. It is remarkable that when the main vein loses its silver, the parallel vein becomes rich, and when the bigger ore body is again enriched the smaller loses its values. It is anticipated that between these veins there will be good milling ore as there is on the levels below. The No. 10 vein has been stoped up to, but not above the 140 ft. level. During the year ending August 31, 1913, the No. 10 vein system yielded 263,814 ounces. The discovery of the vein on the surface should at least make positive the ore stated to be blocked out in the last annual report on this vein, and there is every possibility that it will increase it since it is much richer on the surface than at any of the levels underground. It is most interesting to learn that a discovery has been made in the Keewatin formation under the diabase at the No. 3 shaft. Since this Keewatin is at the same horizon as that at the Timiskaming and the Beaver which yielded those mines their richest ore. The vein is one or two inches wide of high grade ore and was cut at the sixth level in a long crosscut.

On the second level a new vein has also been found in the diabase. It is from one to five in. wide, and is high grade ore.

At least one new vein has been found by the Kerr Lake Company as the result of dewatering the lake. It averages about 3½ in. for 75 ft., and is good at both its extremities. It will be possible to trace it further when it is hydraulicked. The vein is of bonanza ore on the surface. Crosscuts are being commenced on levels in the mine to pick up this vein and prove its depth. Trenching is also proceeding on No. 8 vein which shows a much higher grade of ore than on the levels below.

There is no water now in Kerr lake, and the two pumps are making good progress in pumping the mud. Two 6 in pipes are being laid for the purpose of hydraulicking off all the detritus on the slope and also with the intent of rendering more liquid the mud in the basin. The pumps under the circumstances will make much quicker progress in freeing the lake from mud, which near the pumps is yet from twenty to thirty ft. deep.

Gould—At a special meeting the Gould Consolidated mining company decided to accept the offer of General Assets, Limited, for their two leases on Cart Lake. The General Assets company had already purchased the control of the Porcupine Syndicate stock and the Porcupine Syndicate held control of the Gould. To operate these leases General Assets, Limited, with Mr. Garnett Grant at the head, has formed a company known as the Cart Lake Cobalt with a capitalization of $2,000,000.

Up to the end of April the Gould lease, which is now controlled by the General Assets, Limited, produced 60,220 oz.

Frontier—The assets of the Haileybury Frontier mining company, owning claims in South Lorrain have been seized. A writ of execution has also been served against the York Ontario, which last year operated under lease the old King Edward mine.

Bailey—All but four or five men have been withdrawn from the underground workings of the Bailey Cobalt mine, and these few are employed in the shaft so that development has entirely ceased. The reason is stated to be that Mr. E. A. Benson, of Chicago, the president, has decided to obtain some definite recognition of his claims against the company. For the past three or four years he has provided all the money required for development without securing either a lien or mortgage. Now he is moving for one. The company owes him between $60,000 and $70,000. Reorganization will probably follow and possibly the Bailey may be merged with other and adjacent claims.

Buffalo—The Buffalo mill in the month of April treated 6,767 tons of ore, average assay per ton before milling 17.00 oz., ounces of silver recovered 85,371, ounces of silver paid for during month 51,162, Buffalo dividends now amount to $2,737,000. In the course of underground development two narrow but rich stringers have been picked up recently.

McKinley-Darragh-Savage.—For the quarter ending April 30, the production from the McKinley and Savage mines amounted to 411,954 oz. Of this about 100,000 oz. came from the Savage in high grade and mill rock. At the McKinley the mill is treating 210 tons a day on an average. No new veins have been discovered, but at the 200 ft. level several blocks of ore on the Lake and 1st Swamp vein are yielding a much bigger tonnage than was anticipated in the last annual report.

Coniagas.—After a great deal of dickering with the town the Coniagas mining company declined to accede to the measurements prescribed by the council for the trestle to be run across the street, and the shaft will be sunk at the corner of Silver street and Prospect ave. The rock will be dumped on the west side of the street and it will entail the destruction of some town property. The shaft will be sunk to the 175 ft. level to connect with the third level of the Coniagas, and crosscuts will be run to cut the two veins, which the City of Cobalt are working under the Bilsky Block and Harmony Hall respectively.

Power—By the completion and operation of the Fountain Falls plant of the Northern Ontario Light and Power company, the shortage in electrical power has been overcome. The Fountain Falls plant is now providing 3,000 horse power from its two units which should be enough to prevent any serious lack of power in future. The lack of air remains unrelieved. Several companies who are desirous of opening up new mines or prospects cannot do so, and many of the old customers are curtailed in their operations, although they are all exceeding their original contracts. The power company, it is anticipated, will not provide more compressed air and the mines will have to instal their own compressors. In many cases the mines are running their compressors as auxiliaries now.

PORCUPINE AND KIRKLAND LAKE

Porcupine Pet.—Owing to the enterprise of Buffalo capitalists whose representative in the north is Mr. C. L. Sherrill, there is a marked activity on claims adjoining and near the Dome. The claims belonging to the Little Pet mining company have been taken over by a company known as the Porcupine Pet Mine, Limited, and the shaft has been pumped out and several drills are working at the first and the second level. The same group have taken over the Fogg and other claims and organized them as the Porcupine Porphyry Hill Gold Mines. These latter claims are quite undeveloped.

Tough-Oakes—After considerable delay the Charlton Englehart power company has been able to deliver power in the Kirkland Lake camp and the Tough-Oakes compressor is now driven by electric power. The power plant consists of two units each of 454 h.p. consisting of two water wheels separately driven. The current is generated at 2200 volts, stepped up to 33,000 volts for transmission and stepped down to 2,300 volts at Kirkland Lake. The advantage to the Tough-Oakes mine will be immediate. Heretofore the mine has only been able to work three drills, with the new plant it will be possible to operate ten.

The shaft at the Tough-Oakes mine is now down to 320 ft., the last level being at 300 ft. Here the vein does not show as yet the phenomenal high grade values of the upper levels, but it does contain a good grade milling ore, and it is anticipated that the high grade will be picked up again soon. On the 100 and 200 ft. levels the vein in the west drift is still of the remarkable high grade in the face, to the east it has faulted and to date there has not been sufficient power to endeavor to pick up the vein again. There are one or two branch veins showing remarkable ore which will be followed at once. The No. 3 vein was followed down in an inclined shaft, but faulted at 90 ft. It was picked up again at the 116 ft. level, and here shows 14 in. of over $300 ore.

Dome Lake.—At a special meeting of the Dome Lake Milling and Mining company a by-law was passed authorizing the issuance of 100,000 shares of treasury stock at 50 cents a share.

The Huronia in Gauthier township, midway between the Kirkland Lake mine and Larder Lake is now running its mine and mill with its own power, generated at a station on Beaver House lake. The plant furnishes 300 horse power to the mine at 2,200 volts, and it is stepped down to 550 for distribution to the motors.

Energetic development is proceeding at the mine.

Hunton—Mr. Harry Cecil has commenced diamond drilling the Hunton claims at Kirkland Lake, which he has under option. Mr. Chas. Spearman is in charge of operations.

Improved Service.—It is practically certain that when the new time table is arranged the Timiskaming and Northern Ontario railway will announce that the Cobalt special, the morning train from Toronto, will run through to Kirkland Lake and the Porcupine camp. This will be of great advantage to the mining industry and all that have to do business with these sections.

McIntyre—The annual report of the McIntyre Porcupine mines showed that $232,824 in bullion had been shipped during the year. The costs per ton milled were as follows: general charges, $.98.51; mining, $2.12.47; mine development, $1.95.92; milling, $1.53.64; total, $6.60.54. Total extraction is given as 91.65 per cent. The March report shows an extraction of 96.4 per cent. and milling costs $1.38.8. Mining costs for March are not given.

BOOK REVIEW.

ENGINEERING GEOLOGY, by Heinrich Ries and Thomas L. Watson. John Wiley & Sons (Canadian agents, Renouf Publishing Co., 25 McGill College Avenue, Montreal). Price, $4.00.

This book has been written primarily for civil engineers. The authors have for some years been giving to students of civil engineering in their respective universities a special course in geology as applied to engineering.

The chapter headings are, rock-forming minerals, rocks, structural features and metamorphism, rock-weathering and soils, surface waters, underground waters, landslides, wave action and shore currents, lakes, glacial deposits, building stone, limes, clay and clay products, coal, petroleum and natural gas, road foundations and materials, ore deposits.

There are 631 pages in the text. Illustrations are numerous and the book is well printed.

The authors have endeavored to keep before the reader the application of the topics treated to engineering work.

COBALT ORE SHIPMENTS.

Ore shipments were higher for the week ending June 5 than they have been for two years past for the same period. No less than twelve mines contributed and of these four despatched more than one car. The Coniagas despatched four cars of high grade concentrates so that the silver value of the shipments as well as the tonnage will be high.

The Aladdin Cobalt and the Trethewey each shipped two cars. The Aladdin, which controls the Chambers-Ferland, contributed one car of high grade and one car of table concentrates, which would not run very high in silver. The Trethewey also shipped one car of low and one of high grade ore. The Crown Reserve despatched 18 tons.

The ore shipments from the Cobalt camp for the week ending June 5 were:

	High.	Low.	Pounds.
Nipissing.	......	247,510	247,510
Aladdin-Cobalt.	64,730	43,100	107,830
Trethewey.	48,470	58,300	106,770
Coniagas.	310,340	......	310,340
McKinley-Dar.	80,880	......	80,880
Cob. Lake	64,480	......	64,480
Hudson Bay	......	65,050	65,050
La Rose	78,780	......	78,780
Dom. Red.	......	84,600	84,600
Cr. Reserve	36,000	......	36,000
Casey Cob.	60,000	......	60,000
Townsite.	85,500	......	85,500
	829,180	498,560	1,327,740

MARKETS

STOCK QUOTATIONS.

(Courtesy of J. P. Bickell & Co., Standard Bank Bldg., Toronto, Ont.)

June 8, 1914.

New York Curb.	Bid.	Ask.
American Marconi	1.25	1.75
Alaska Gold	27.50	27.87
Braden Copper	7.75	8.00
British Copper	1.62	1.87
California Oil	326.00	328.00
Chino Copper	41.00	41.25
Giroux Copper	.50	1.00
Green Can.	32.00	34.00
Granby	82.00	82.50
Miami Copper	22.12	22.50
Nevada Copper	14.25	14.37
Ohio Oil	181.00	182.00
Ray Cons. Copper	21.37	21.62
Standard Oil of N. Y.	217.00	218.00
Standard Oil of N. J.	411.00	413.00
Standard Oil (old)	1400.00	......
Standard Oil (subs)	990.00	......
Tonopah Mining	6.75	7.00
Tonopah Belmont	7.00	7.25
Tonopah Merger	.48	.51
Inspiration Copper	17.25	17.50
Goldfield Cons.	1.37	1.50
Yukon Gold	2.62	2.87
Porcupine Stocks.	Bid.	Ask.
Apex	.02½	.03
Dome Extension	.07¾	.08
Dome Lake	.42	.42½
Dome Mines	7.75	8.00
Eldorado	...	...
Foley-O'Brien	.28	.28½
Hollinger	17.50	17.60
Jupiter	.10¼	.11
McIntyre	.27½	.28
Moneta	.02	.04
North Dome	...	...
Northern Exploration	2.25	2.75
Pearl Lake	.03½	.04
Plenaurum	.40	.50
Porcupine Vipond	.28	.28½
Imperial	.01½	.02
Porcupine Reserve	...	...
Preston East Dome	.01½	.02
Rea	.10	.20
Standard	...	...
Swastika	.01	.02
United	...	...
West Dome	.06	.10
Porcupine Crown	.85	1.00
Teck Hughes	...	.10
Cobalt Stocks.	Bid.	Ask.
Bailey	.00⅞	.01
Beaver	.29	.29½
Buffalo	1.10	1.25
Canadian	.08	.10
Chambers-Ferland	.18	.18½
City of Cobalt	.43	.46
Cobalt Lake	.45	.50
Coniagas	7.25	7.40
Crown Reserve	1.18	1.20
Foster	.06	.08
Gifford	.01	.02
Gould	.01	.02
Great Northern	.07	.07½
Hargraves	.01	.02
Hudson Bay	72.00	76.00
Kerr Lake	4.22	4.25
La Rose	1.42	1.44
McKinley	.81	.83
Nipissing	6.15	6.30
Peterson Lake	.38	.38½
Right of Way	...	.05
Rochester	...	.02
Leaf	.01	.02
Cochrane	.30	.40
Silver Queen	...	.02
Timiskaming	.15	.15½
Trethewey	.17	.20
Wettlaufer	.05	.06
Seneca Superior	2.50	2.80

TORONTO MARKETS.

June 10—(Quotations from Canada Metal Co., Toronto).

Spelter, 5¼ cents per lb.
Lead, 5.15 cents per lb.
Tin, 34 cents per lb.
Antimony, 8½ cents per lb.
Copper, casting, 15 cents per lb.
Electrolytic, 15 cents per lb.
Ingot brass, 10 to 15 cents per lb.

June 10—Coal—(Quotations from Elias Rogers Co., Toronto).

Anthracite, $7.50 per ton.
Bituminous, lump, $5.25 per ton.

GENERAL MARKETS.

June 8—Connellsville Coke, (f.o.b. ovens).

Furnace coke, prompt, $1.75 to $1.85 per ton.
Foundry coke, prompt, $2.35 to $2.65 per ton.

June 8—Tin, straits, 30.80 cents.

Copper, Prime Lake, 14.12½ to 14.37½ cents.
Electrolytic copper, 13.90 to 14.00 cents.
Copper wire, 15.25 cents.
Lead, 3.90 cents.
Spelter, 5.10 to 5.20 cents.
Sheet zinc, (f.o.b. smelter), 7.00 cents.
Antimony, Cookson's, 7.25 to 7.35 cents.
Aluminum, 17.75 to 18.00 cents.
Nickel, 40.00 to 45.00 cents.
Platinum, soft, $43.00 to $44.00 per ounce.
Platinum, hard, 10 per cent., $46.00 to $47.50 per ounce.
Platinum, hard, 20 per cent., $49.00 to $51.50 per ounce.
Bismuth, $1.95 to $2.15 per pound.
Quicksilver, $38.00 per 75-lb. flask.

SILVER PRICES.

	New York cents.	London pence.
May 23	57¼	26 5/16
" 25	56½	25 15/16
" 26	56¾	26 1/16
" 27	57⅛	26¼
" 28	57	26 3/16
" 29	56⅞	26⅛
" 30	Holiday	26
June 1	56½	Holiday
" 2	56⅛	25 13/16
" 3	56⅛	25 13/16
" 4	56½	25 15/16
" 5	56⅛	25 13/16
" 6	56¼	25 13/16
" 8	56⅝	26
" 9	56½	25 15/16
" 10	56⅞	26⅛