CHAPTER V

INDUSTRIAL RELATIONS

This chapter deals with the miners, the conditions under which they live and work and the human side of a number of technical problems, as well as with the relations of the miners with their employers. In brief, the term industrial relations is used in its broadest sense. The first section of the chapter describes the miners and their living and working conditions and the second outlines the major problems of industrial relations in the industry.

THE MINERS

Locations, Origins and Family Circumstances

About 25,000 men earn their living in Canada getting coal out of the ground and started on its way to market. About half of them are in Nova Scotia, a third in Alberta, and the balance in British Columbia, New Brunswick and Saskatchewan. Ninety-five per cent of the mine workers belong to the United Mine Workers of America and there are a few small independent unions at individual mines.

These men work for some 350 operators, of whom in 1944, 196 were in Alberta, 89 in Saskatchewan, 26 in British Columbia, 19 in New Brunswick and 19 in Nova Scotia. The number of bargaining units on the employers' side is however considerably smaller than these figures would indicate, as in the major areas the operators are associated for various purposes including collective bargaining.

Substantial differences stand out as between coal mining in eastern and in western Canada. The nature of the coal deposits, the organization of mining, backgrounds of the miners and the histories of industrial relations are all different. The people of the mining communities in the two regions, and the mine operators, have different attitudes to similar problems. Even in the United Mine Workers of America, which might at first sight appear to be one standardizing element in the industry, substantial differences exist between East and West. District 26 (Maritime Provinces) and District 18 (Western Canada) both subscribe to the general constitution of the U.M.W.A. They are otherwise completely independent of one another, and their policies and attitudes diverge substantially. For instance, District 26 urged nationalization before this Commission as the only solution to the problem of the coal miners in that area; District 18 approved maintenance of the private ownership of coal mining operations, and stated its general satisfaction with existing industrial relations.

Part of the difference in the attitudes of the miners is a difference of background. The Maritime miners, and particularly those of Cape Breton, have long associated in the same communities, and have a strong tradition of local pride. Most of them are descendants of settlers who came in the eighteenth and nineteenth centuries from the British Isles. Four-fifths of the men employed in the coal mining industry of Nova Scotia at the time of the 1941 census were born in Canada, and 14 per cent in the British Isles. Three-quarters of them had always lived in Nova Scotia, and virtually all the rest had been there for over ten years. Since the West was not opened up for general settlement until the late nineteenth and early twentieth centuries, the mining population does not have the long community traditions, the similarity of background or the same degree of attachment to locality that characterize the Maritime

mining areas. Half of the Alberta miners were born in Europe, 21 per cent in the British Isles, 4 per cent in the U.S.A., and only about 25 per cent in Canada. Only 15 per cent of the mine workers have lived all their lives in Alberta, although 81 per cent have been there over ten years.

These facts are not noted with any intention of disparaging the more recent arrivals. They do perhaps help to explain why the Maritime miner appears to be more reluctant than his western counterpart to leave his own immediate district in search of other employment. In the West, not only are there more coal fields for a man to seek work in, and possibly better opportunities for alternative employment, but the western miner also appears to be less reluctant to change his place of residence.

Similar differences appear between East and West with regard to marital and parental status. Larger proportions of miners in Nova Scotia than in Alberta are married and have children, and the average number of children per family is higher. Thus the Nova Scotian is more likely to have family ties which make it difficult for him to move when his job vanishes or is unsatisfactory to him.

The following table, drawn from 1941 census data, indicates the situation in the coal producing provinces as to natal origin, marital and parental condition, and home ownership of mine workers.

—	Nova Scotia	New Brunswick	Saskatchewan	Alberta	British Columbia
Birthplace—					
Canada.....Per cent	79	83	39	25	27
British Isles.....Per cent	6	5	16	21	38
Other.....Per cent	15	12	45	54	35
Residence in Province—					
Always.....Per cent	74	70	26	15	20
10 years and over.....Per cent	99	93	94	96	93
Heads of Families.....Per cent	70	57	65	61	62
Families with Children.....Per cent	83	81	78	77	72
Average Number of Children (All Families).....	2.8	2.6	1.7	1.8	1.6
Householders Owning Homes...Per cent	55	49	36	63	56

Census data indicate a marked decline since 1921 in the proportion of men under 35, and a marked increase in the proportion of men 45 and over. For instance in 1921, 55 per cent of the mine workers in both Nova Scotia and Alberta were under 35; in 1941 the proportion was only 41 per cent in Nova Scotia and 26 per cent in Alberta. The greater part of this decrease occurred in the decade between 1931 and 1941. The proportion of older men rose accordingly: whereas in 1931 the proportion of men over 45 was 29 per cent in Nova Scotia and 28 per cent in Alberta, in 1941 it was 37 per cent in Nova Scotia and 46 per cent in Alberta. This increase in the proportion of older men is significant in relation to productivity, and also has an influence upon the attitude of the men toward change in their working and social organization.

Part of this trend was a result of the depression of the 1930's, when the labour force diminished and there was little recruitment. Part of it was also due to heavy enlistments from among the physically fittest miners and to the curtailment of the normal entry of young men into the mines because of enlistments and the increased availability of other employment. It is probable that the average age of the men in the mines increased after 1941.

Their Unions

The long and troubled history of collective organization of mine workers in Canada affects present labour-management relationships. Members of the U.M.W.A. face current issues conscious of the struggles and dissensions which have endangered their union in the past. Management remembers by what steps the union grew. Contract negotiations and daily relations alike are influenced by the past.

Labour Organization—The Past

Nova Scotia

The first coal miners' union in Canada was formed in 1879 at Springhill, Nova Scotia, when the employees of the Cumberland Railway and Coal Company organized the Provincial Workmen's Association to resist a proposed wage cut. The miners were successful. Lodges of the Association were promptly established at Westville and Stellarton in Pictou County, but it was not until 1887 that the Association succeeded in organizing the mine workers of Cape Breton. It sought to secure a peaceful settlement of disputes, and supported compulsory arbitration. In 1888 the principal demands placed by the P.W.A. before a Nova Scotia Royal Commission on Labour were for a legal minimum age of twelve years for mine workers, tests of physical fitness and literacy, an apprenticeship system and mining schools. The loss of a steel strike at Sydney in 1904 and the acceptance by the union executive of wage adjustments proposed in 1908 by a Federal conciliation board encouraged dissatisfaction among the membership of the Association. This assisted the growth of the United Mine Workers of America.

In 1908 the U.M.W.A. was the recognized bargaining agent for over half the men producing bituminous coal in the United States, and since 1903 had been active in western Canada. In December, 1908, the first U.M.W.A. local in the Maritimes was established at Springhill, Nova Scotia, and in the early part of 1909 Nova Scotia was designated District 26 of the U.M.W.A. Shortly afterwards the Provincial Workmen's Association took a referendum vote on the question of affiliation or amalgamation with the U.M.W.A., the result being 2800 votes in favour and 2400 against. The referendum was overruled by the Grand Council of the Provincial Workmen's Association and the question of affiliation remained unsettled.

The Nova Scotia coal operators opposed the U.M.W.A., on the grounds that it included in its membership the lower grades of officials and that it was a foreign organization. The P.W.A., being only a provincial organization, was financially weak in comparison to the U.M.W.A., and consequently less able to endure a long strike and less able to make a strong stand against the operators on any issue.

During 1909 strikes of U.M.W.A. members, arising out of the rivalry between the unions, started at Glace Bay and Inverness on Cape Breton Island and Springhill on the mainland, and the militia was called in. The strike at Glace Bay ended in April, 1910, but Cumberland County was tied up completely until January, 1911, the strike being called off in May, 1911. At Inverness there was a two-year struggle ending in a compromise. There was no strike at Sydney Mines. Nowhere did the U.M.W.A. secure recognition by the operators as the men's bargaining agent. The use of company police, the withdrawal of maintenance men by the U.M.W.A. at some points, and violence and legal action between members of the rival unions, contributed to the bitterness against the employers and the dissension among the men which characterize industrial relations in the Nova Scotia mines.

After the strikes, the membership of the United Mine Workers of America decreased until in 1915 the Charter of District 26 was withdrawn by the International Executive. In 1916 a new organization, the United Mine Workers of Nova Scotia, was formed. Early in 1917 the United Mine Workers of Nova Scotia and the P.W.A. each applied to the Federal Minister of Labour for a conciliation board to consider labour and working conditions in the mining industry. A Royal Commission known as the Chisholm Commission was appointed, and its investigation resulted in the amalgamation of the two unions into one, the Amalgamated Mine Workers of Nova Scotia, which was recognized by the operators as the bargaining agent of the men.

In 1918 a referendum submitted to the membership of this union indicated that 98 per cent were in favour of joining the United Mine Workers of America. Following conferences of representatives of management, labour and government, the principal operators agreed to recognize the U.M.W.A. as the bargaining agent of the employees, on certain conditions, the principal ones being that the U.M.W.A. would recognize the disability of Nova Scotia coal in competition with United States coal, and never try to force Nova Scotia wages to the level paid in the United States, and that the autonomy of the Nova Scotia district within the U.M.W.A. would be maintained. The U.M.W.A. since that time has been the recognized bargaining agent of the employees in the coal mining fields of Nova Scotia, with the exception of a few small mines.

The U.M.W.A. negotiated wage increases in 1919 and 1920, the latter increase bringing rates to the highest level prior to the recent war (basic day rate $3.90). When this agreement terminated at the end of 1921, the British Empire Steel Corporation, employing about 90 per cent of the Nova Scotia mine workers, negotiated for a reduction of $33\frac{1}{3}$ per cent, and, negotiations failing, put the reduction into effect without an agreement. The men in retaliation adopted for a time the policy of "striking on the job", now known as the slow-down. There were also acts of sabotage in the mines. During the ensuing 18 months, the recommendations of two successive conciliation boards, and two agreements tentatively reached between the operators and the union executive, were rejected by the men. In August, 1922, the men struck, and at the same time elected a new executive. The new officers instituted the "100 per cent strike", removing the maintenance men from the mines, contrary to the policy of the U.M.W.A. Mediation by the Provincial Government resulted in September, 1922, in the end of the strike and an agreement which was to run at least until January 15, 1924.

Early in 1923 the District Executive enquired of the International Executive whether affiliation with the Red International of Labour Unions would be permissible. The International Executive, which has always been opposed to revolutionary political movements, warned that such affiliation would result in the withdrawal of District 26's U.M.W.A. charter.

In July, 1923, the miners of Cape Breton and Pictou struck in sympathy with steel workers striking at Sydney. In some mines the maintenance men struck with the rest. The International President, having without effect warned that this strike was in breach of the existing contract and therefore contrary to the policies of the U.M.W.A., revoked the charter of District 26, deposed the officers, declared them ineligible for re-election, and appointed a provisional slate of officers to carry out the existing contract. In 1924 the autonomy of the District was restored and a new slate of officers elected. At the termination of the contract in January, 1924, no agreement could be reached until after a strike lasting about a month. Again at the end of the 1924 contract, no agreement could be reached and a four-month strike with outbreaks of violence ensued, the maintenance men again stopping work. Finally the Provincial Government was successful in arranging an interim contract to be in force pending a full enquiry into the coal industry of Nova Scotia.

The enquiry was conducted by the Royal Commission known as the First Duncan Commission, which recommended a 10 per cent cut from the 1924 wage level. This was made effective and remained in force until the end of 1928. Provision for profit-sharing with the employees was made in the two contracts covering the next four years, but no profits were shown.

In 1932, another Royal Commission known as the Second Duncan Commission was appointed to examine the Nova Scotia coal industry in the light of the depression conditions then prevailing, and particularly because of protest by miners and municipalities against a proposed reorganization of the Cape Breton mines which would reduce employment. The report of the Commission noted an improvement since the last enquiry in the relationship between operators and men, and approved the former's proposals for reorganization. In the same year, however, an attempt was made by a dissident faction of the men to supplant the U.M.W.A. with another union. This new organization, which took the name of the Amalgamated Mine Workers of Nova Scotia, gained some strength in Cape Breton for a time, but in 1935, its membership returned to the U.M.W.A.

The U.M.W.A. has not since been challenged by any other union and apart from a small union in the Pictou field represents all the workers in Nova Scotia mines. It has, however, had internal troubles of a serious nature. Dissatisfaction among some of the men in Cape Breton with the contract made in 1941 resulted in a slow-down which seriously reduced output and the men's earnings. The slow-down was carried out against the will of the executive and in spite of warnings from the International President that such tactics were contrary to U.M.W.A. policy. The present executive, elected in 1942, is composed largely of men who were leaders in the slow-down or the Amalgamated Mine Workers movement or both.

New Brunswick

No union was recognized as the bargaining agent of the mine workers in New Brunswick until 1938. There had been numerous unsuccessful attempts to organize unions, many of them involving strikes for recognition. In 1918 the American Federation of Labour tried to organize; in 1919 the U.M.W.A.; in 1927 the One Big Union; in 1934 the Amalgamated Mine Workers of New Brunswick; and in 1937 the U.M.W.A. again. In 1938 an independent union, the Rothwell Mine Workers Union, composed of the employees of the Rothwell Coal Company Limited, was organized and recognized by the Company as the men's agent. In 1940 the U.M.W.A. secured its first contract with a New Brunswick operator, and it now has contracts with all operators except the Rothwell Coal Company Limited.

Alberta and British Columbia

Organization of coal mine workers in the western coal fields commenced in 1900 when the Western Federation of Miners, a union operating in metal mines in the western United States, started organizing the employees of the Crow's Nest Pass Coal Company at Fernie, B.C. In 1902 and 1903 the Federation extended to the mines at Coleman and Frank in Alberta, and in 1903 it attempted to organize the Vancouver Island mines.

In the same year the Federation called a strike in both the Crowsnest Pass and Vancouver Island fields, primarily for recognition as the men's bargaining agent, but partly in sympathy with the strike of the United Brotherhood of Railway Employees against the Canadian Pacific Railway. The Federation and the United Brotherhood of Railway Employees were both constituent parts of the American Labor Union, a labour association with headquarters in Butte, Montana. Between 3,000 and 3,500 men were involved in this strike which lasted at the various mines for periods ranging from 10 days to several months. On Vancouver Island the strikes were unsuccessful, and the Western Federa-

tion of Miners lost what strength it had had there. In 1905 the Western Fuel Company, one of the principal operators on Vancouver Island, negotiated an agreement with a committee of its employees not affiliated with any outside union.

The United Mine Workers of America first entered the western Canadian coal fields in 1903, the organization in this area being set up as District 18 of the union. In the Crowsnest Pass field the Western Miners' Federation advised the men to transfer to the U.M.W.A. on the grounds that the Federation, being primarily a metal miners' union, was less able to handle the coal miners' problems than was the U.M.W.A. Between 1903 and 1905 the U.M.W.A. secured agreements with all the operators in the Crowsnest Pass field. In 1906 they organized the employees of the Galt collieries at Lethbridge and after a strike lasting from April to December secured a contract to run until March 31, 1909.

Development of the U.M.W.A. as a single organization dealing with all the operators in the Crowsnest area led to formation by seven Crowsnest operators in 1907 of the Western Canada Coal Operators' Association. In 1907 this Association signed the first collective agreement made between the U.M.W.A. and a group of coal operators in Canada. The Association and the U.M.W.A. then expanded their membership to the "domestic" coal mines in the Lethbridge and Taber fields and continued with the making of collective agreements for all the larger mines in southern Alberta.

In 1910 a local union called the Canadian Federation of Miners was organized at Cumberland and Ladysmith, British Columbia. This union is reported to have requested affiliation with the U.M.W.A.: in any case, in 1911 the U.M.W.A. began to organize the field, and in 1912 struck unsuccessfully for recognition. The field remained unorganized by a large union until 1938, although there were local unions at some Vancouver Island mines.

During World War I there was great development in mining of "steam" coal in the Brazeau and Mountain Park areas, and of "domestic" coal in the Drumheller area. Virtually all coal miners were organized by the U.M.W.A. and virtually all the operators were members of the Association. During the war the Federal Director of Coal Operations dealt among other things with labour relations, wages and prices in coal mining. Although collective bargaining was, in effect, under his control, the Western Canada Coal Operators' Association and the U.M.W.A. were recognized as representative of the operators and men respectively.

After the war many mine workers, including most of the executive of District 18 of the U.M.W.A., joined the One Big Union movement, which sought to encompass all workers of all industries and advocated fundamental changes in the organization of society. An international commission, appointed by the U.M.W.A. International Executive Board to administer the affairs of the U.M.W.A. in District 18, maintained the contract with the operators despite local strikes called by the One Big Union. In 1922 and 1924 there were prolonged strikes in opposition to wage reductions. The 1922 strike was successful in preventing a reduction at that time; the 1924 contract provided for a reduction of roughly 15 per cent instead of the 50 per cent proposed by the operators.

Following the 1924 strike the employees of the Crow's Nest Pass Coal Company at Fernie, B.C., negotiated a new agreement with that company which provided for further reductions in wages. The men withdrew from the U.M.W.A., and the Company from the Operators' Association. This break from the seventeen year old practice of maintaining a single contract for the whole District was followed by the employees at the Michel operations of the Crow's Nest Pass Coal Company, and quickly spread through the other coal fields. The U.M.W.A. signed contracts on the reduced scale with some operators

in Drumheller, the only western field in which any membership or contracts were retained. In most cases the employees at the various mines formed local unions not affiliated with any central organization.

During 1925 various local unions throughout Alberta and southeastern British Columbia grouped together as the Mine Workers Union of Canada, District No. 1. It was never successful in getting a district-wide agreement with the coal mine operators. Some time after its organization the M.W.U.C. became affiliated with the All-Canadian Congress of Labour, but in 1931 it adhered to the Workers' Unity League, which described itself as the Canadian section of the Red International of Labour Unions.

In 1932, the Edmonton field, where there had been only intermittent organization, voted to join the U.M.W.A., and some local units elsewhere withdrew their affiliation from the M.W.U.C. The two principal unions were competing quietly for prestige each with the membership of the other, with the independent local unions, and with the unorganized mine workers. In 1936 a conference, called by the Alberta Federation of Labour, and including representatives of these two unions and of unaffiliated local unions, agreed that a vote be taken by the membership of the M.W.U.C. and of local unions not affiliated with either major union on the question of rejoining the U.M.W.A. As a result of this vote all the local units of the M.W.U.C. and some independent unions were absorbed in the U.M.W.A., and in the following two years the U.M.W.A., District 18, became the bargaining agent for virtually all the mines in Alberta and British Columbia Crowsnest. In 1938 the miners on Vancouver Island were fully organized in the U.M.W.A., and after reference of a dispute to a conciliation board, the U.M.W.A. signed its first contract with Canadian Collieries (Dunsmuir) Limited, the sole remaining large operator on the Island. The interior British Columbia mines were also organized during the 1930's and now recognize the U.M.W.A. as the bargaining agent for their employees.

The Western Canada Coal Operators' Association disintegrated at the same time as the U.M.W.A. in 1925. After the reorganization of the U.M.W.A., the operators of the bituminous mines in 1937 organized the Western Canada Bituminous Coal Operators' Association including all "steam" coal operators except those at Coleman and Hillcrest, where the employees were not members of the U.M.W.A. The employees at both Coleman and Hillcrest have since become members of the U.M.W.A. and the operators have become members of the Western Canada Bituminous Coal Operators' Association. The Association since 1938 has represented the bituminous operators in negotiations with the U.M.W.A.

The "domestic" coal operators in Alberta in 1938 met jointly with the union, but negotiated contracts as individual companies without a formal organization. The Drumheller operators in 1944 organized the Drumheller Coal Operators' Association which functions like the Western Canada Bituminous Coal Operators' Association, for the negotiation of wage contracts covering the operations of the members.

Saskatchewan

The U.M.W.A. attempted unsuccessfully in 1907, 1908, and again in 1915, to organize the Saskatchewan lignite field. In 1920 the One Big Union entered the field, also unsuccessfully. In 1931 the Mine Workers' Union of Canada attempted to organize; a strike for recognition was called and during it there was rioting in which three miners were killed. The outcome was a series of agreements between operators and mine committees, or company unions, which with variations, continued in effect until 1938.

In that year the U.M.W.A. once more entered the field, and, having secured the adherence of a majority of the men, struck for recognition, the eight-hour day and a uniform contract for the field. The strike was called off to permit a Federal conciliation board to function. Protracted negotiations, interrupted by

another strike and reopened by the Saskatchewan Government, resulted in December 1939 in agreement that a new union, the Mine Workers' Central Union, would be set up to represent the employees of the various operators in the field, and would be recognized by the operators, and that the U.M.W.A. and the Canadian Federation of Labour (which had a small affiliate in the field, the Saskatchewan Coal Miners' Union) would withdraw from the field for the duration of the war, and one year thereafter. Subsequently Western Dominion Coal Mines Limited refused to accept the application of this agreement to their stripping operations at Taylorton, and the Saskatchewan Coal Miners' Union continued as the bargaining agent of the employees there. In 1945, after the end of the war in Europe, the Mine Workers' Central Union amalgamated with the U.M.W.A., which thereby became the bargaining agent for the majority of the men in the Saskatchewan mines.

Labour Organization—The Present

Of 13,400 coal miners in the Maritime Provinces, about 13,200 are members of the United Mine Workers of America; in western Canada almost 10,000 of the 11,800 coal mine employees are members. Eight small unions represent men working at mines, but their total membership is less than four per cent of such men, and includes junior officials and men employed on stripping operations as well as miners. The U.M.W.A. is recognized by the operators as the bargaining agent of the employees of all but a very few coal mines in Canada.

The principal function of the U.M.W.A. is to bargain on behalf of the men in negotiations concerning their wages and working conditions, but its objectives, as set out in the constitution of the International Union, are not limited to this:

> "First: To unite in one organization, regardless of creed, colour or nationality, all workers eligible for membership, employed in and around coal mines, coal washeries, coal processing plants, coke ovens, and in such other industries as may be designated and approved by the International Executive Board, on the American continent.
>
> "Second: To increase the wages, and improve the conditions of employment of our members by legislation, conciliation, joint agreement or strikes.
>
> "Third: To demand that not more than six hours from bank to bank in each twenty-four hours and not more than five days per week shall be worked by members of our Organization.
>
> "Fourth: To strive for a minimum wage scale for all members of our Union.
>
> "Fifth: To provide for the education of our children by lawfully prohibiting their employment until they have at least reached eighteen years of age.
>
> "Sixth: To secure equitable statutory old-age pensions, workmen's compensation and unemployment insurance laws.
>
> "Seventh: To enforce existing just laws and to secure the repeal of those which are unjust.
>
> "Eighth: To secure by legislative enactment, laws protecting the limbs, lives and health of our members; establishing our right to organize; prohibiting the use of deception to secure strike breakers; preventing the employment of privately armed guards during labour disputes; and such other legislation as will be beneficial to the members of our craft".

In addition to these formal objectives, the union carries on certain mutual benefit activities, through which Union members and their families may be assisted when in distress.

The U.M.W.A. is an international organization, in the form of a voluntary and unincorporated association. It has its headquarters in Washington, D.C., and is divided on a geographical basis into thirty districts, of which two are in Canada, District 26 covering Nova Scotia and New Brunswick, and District 18 covering Saskatchewan, Alberta and British Columbia. Each district is divided into sub-districts, and each sub-district includes a number of local unions. The

local union embraces the union membership among the employees of one or more mines. In general, each local union elects by secret ballot at intervals of two years its president, vice-president and secretary-treasurer, and its members may vote in the elections for the executives of the sub-district and district in which it is located and for the international executive. The International Executive consists of a board composed of a member elected or appointed from each district, together with the President, Vice-President and Secretary-Treasurer. Similarly there are district boards with one member elected from each sub-district*, and sub-district boards with one member from each local. The powers and duties of the executive officers and the various boards are set out in the constitution of the International Union, which can only be altered by the International Convention, or by a special referendum vote.

International conventions are held biennially or at the call of the Executive Board. Delegates to international, district and sub-district conventions are chosen by direct vote of the local unions. The International Convention is the supreme policy-making body of the U.M.W.A.; between conventions the International Executive Board, or when it is not in session, the President of the U.M.W.A., is the final authority. Locals, sub-districts and districts may make such by-laws and regulations for the government of their members as do not conflict with the constitution and regulations of the higher authorities of the organization.

This general outline of the internal government of the Union must be modified with respect to the district executives. These are of two types: those in which the district executive is elected by the membership of the local unions, and those in which the district executive is appointed by the International Executive Board. In the first case, the district is said to be autonomous. In Canada, District 26 is autonomous; District 18 is not.

The union is financed by monthly membership dues. In District 26 monthly dues are $2, of which 30 cents is retained by the local union, 80 cents by the District organization, and 90 cents paid to the International organization. In District 18 the dues vary between $1.90 and $2.25; the locals retain from 40 to 75 cents, some locals by their own decision having set up funds for such purposes as the provision of special medical services; the payment to the District organization is 60 cents, and to the International organization 90 cents. In both Districts dues are collected on behalf of the union by the operators from the wages of the individual members (the check-off), and transferred monthly to the local Secretary-Treasurer, who forwards the appropriate amount to the District and International offices. All these officials are bonded, their accounts are subject to audit, and the auditor's report is submitted to the union members.

The principal purpose of the funds so accumulated is to build up reserves against the cost of strikes, but they are also used to pay the administrative expenses of the union, and for welfare and research work. The International Union and the Canadian Districts also publish their own periodicals, and District 26 supports financially the Glace Bay *Gazette*.

The question is often asked whether the Canadian Districts draw from the International organization benefits proportionate to the dues they pay. The International Union may, by agreement, finance all or a part of the cost of a strike which is beyond the capacity of the District and local treasuries, and may also contribute to the cost of organizing in non-union fields. In District 18 the experience has been that the International Union has paid out in strike benefits and in organizing costs more than it has received from the District in dues. District 26 has had no "approved" district-wide strike since 1925, and has drawn no money from the International for that purpose in recent years;

* In District 18 the representative of each sub-district is appointed by the District Executive.

the earlier situation was much different and substantial strike benefits were received. Financial assistance of other varieties has, however, been given District 26 by the International from time to time.

In Canada, each District organization negotiates the wage contracts for its member locals with the operators or operators' associations as the case may be, and is responsible for the maintenance of the contracts by the union members. Both are independent of the International in negotiations except for requiring its prior approval for a strike which will require financing from the International funds.

The International Executive, however, does accept responsibility for the maintenance of the contract: it will be recalled that when District 26 struck in 1923 in breach of its contract, and withdrew the maintenance men from the mines, the International President removed the District Executive from office and installed a provisional executive to maintain the contract. The International President also attempted to end the slow-down in the Cape Breton mines in 1941. In District 18, the fact that the District officers are appointed by the International Executive means in effect that the International considers itself responsible for District policies, as regards maintenance of contracts and all other matters.

The U.M.W.A. has its own system of regulations and its own means of enforcing them. Any member accused of violating any of the organization's laws may by vote of the local union be penalized by fine, debarment from union office, suspension of union membership, or expulsion from the union, subject to the right of appeal to each successive level of authority in the organization.

The Canadian Districts of the U.M.W.A. are at present affiliated with the Canadian Congress of Labour, the policies of which are framed by its Canadian members although it has an affiliation with the Congress of Industrial Organizations in the United States. In the United States the U.M.W.A. recently renewed its affiliation with the American Federation of Labor, after having left it some years ago and taken a prominent part in the development of the C.I.O.

As Subjects of Labour Laws

Government activity, Dominion and provincial, has in peacetime affected the Canadian coal miner in his work in three major respects: it has provided by legislation for his maximum hours of work, his safety and his compensation in case of accident; it has provided machinery for conciliation of his disputes with his employer; and it has provided machinery to facilitate collective bargaining with his employer. Working conditions, safety and workmen's compensation are the responsibility of the provincial governments, and both Federal and provincial legislation has from time to time provided conciliation and collective bargaining facilities.

In wartime, government intervention has gone much further; in World War I wages and working conditions in the coal mines were controlled by the Dominion, and in the second World War, these things and also the miner's liberty to leave his job and the employer's liberty to discharge him have been subject to Federal regulation. The Federal Government made its principal contribution to the development of collective bargaining during the second World War. For this Commission's purposes, however, it is the peacetime interest of government in the coal mine workers that is of primary importance.

Safety, Hours of Work, and Compensation for Accidents

Provincial safety and compensation regulations were the first activity of government to affect the miner in his work.

At Confederation, regulation of the work of miners was placed under the jurisdiction of the provinces, by Section 92 of the B.N.A. Act. The provinces in which coal mining was conducted all enacted laws regulating minimum ages and maximum hours of work in coal mines early in their development. For instance, Nova Scotia in 1873 forbade the employment of boys under ten and limited the hours of boys under thirteen to ten in a day and sixty in a week; in 1877 British Columbia imposed a minimum age of twelve for work in the coal mines and limited the hours of boys under fifteen to thirty in a week. Provisions for the health and safety of miners have been added from time to time, and are now fairly uniform in substance. These safety laws establish definite qualifications for employment in jobs involving the safety of others, and regulate such matters as standards of ventilation; use of electric power, explosives and safety lamps; standards of timbering; provision of rescue and first-aid equipment; and investigation and reporting of accidents.

Similarly, the provinces have established laws providing for the compensation of workmen in many industries, including coal mining, for accidents and certain diseases arising out of their employment, payable out of a fund collected from the operators in the industry and administered by a Provincial Board. All mine operators are required to pay to the fund a sum generally calculated as a percentage of payroll, the percentage being varied from time to time as experience indicates to be necessary to meet the cost of compensation payments incurred within the whole industry. The rate for coal mining is generally highest among industries, reflecting the dangerous nature of the work of the miners; it ranged in 1945 from 11 per cent of payrolls in Alberta to 5.25 per cent in Nova Scotia, being 6 per cent or 7 per cent in the other coal mining provinces.

Conciliation

In providing machinery for conciliation of disputes, both the federal government and the provincial governments have been active. The provinces were first in this field. In 1888 and 1890 Nova Scotia adopted laws requiring compulsory arbitration, later repealed. Most of the early provincial laws provided for conciliation, and for arbitration if agreed to by both parties.

The first Dominion legislation on the subject, the Conciliation Act of 1900 (now known as the Conciliation and Labour Act) was merely permissive. It authorized the Minister of Labour to appoint conciliation officers or a conciliation board whose services could be placed at the disposal of either or both parties to a dispute: it has proved useful both in the early stages of disputes and after a strike or lockout occurred.

A coal miners' strike in Alberta in 1907 was the immediate occasion of a further statute, the Industrial Disputes Investigation Act, which prohibited strikes and lockouts pending investigation, and which was based on the theory that informed public opinion will have beneficial effects. The Act applied directly to coal mining and certain other industries, but could apply to a dispute in any industry if both parties consented.

Under this Act (as amended) there was to be appointed on the application of either party to a dispute or at the request of a municipality or on the Minister's own initiative, a Board of Conciliation and Investigation consisting of one representative each of employers and workers and an independent chairman. If the parties agreed to be bound by the recommendation of a Board, it could be made a rule of court and enforceable; otherwise the process terminated with the publication of the report of the Board, whereupon the right to strike or lockout revived. Notice of an intended change in wages or hours was required to be given in advance, and in the event of a dispute neither party could alter the wages-and-hours conditions until the dispute had been dealt with by a Board.

In 1925 the Judicial Committee of the Privy Council held the Act ultra vires as primarily affecting "property and civil rights", a subject normally within provincial jurisdiction. The Act was therefore amended in 1925 to restrict it in the first instance to disputes in connection with works within Dominion jurisdiction and, secondly, to enable its application to disputes within the jurisdiction of any province which enacted a statute declaring the Act to apply. It was the second field which included coal mining.

Between 1925 and 1932 all the provinces, except Prince Edward Island, enacted enabling laws bringing the Dominion statute into force therein; but in 1937 British Columbia repealed its enabling Act and replaced it with an Act setting up similar provincial machinery.

Early in the recent war, under the emergency powers of the Dominion the application of the I.D.I. Act was extended to defence projects and war industries (regardless of the normal jurisdiction of the provinces) and various related matters were brought within Dominion authority by Orders in Council. In 1944, however, the I.D.I. Act and certain of these Orders in Council were suspended, and, in effect, incorporated in the Wartime Labour Relations Regulations of February 17, 1944. The Regulations cover all industries normally within Dominion jurisdiction and all war industries as therein defined. They also cover industries normally within provincial jurisdiction, any deficiencies of jurisdiction in this respect having been thought to be overcome by provincial legislation "applying" the regulations to industries within provincial authority, except as to Alberta, Prince Edward Island and Quebec, and since 1944 to Saskatchewan. Subsequent to the war these Regulations were continued under the National Emergency Transitional Powers Act. With the lapsing of this Act early in 1947 jurisdiction will revert to the provinces.

Meanwhile there are on the statute books of various of the coal mining provinces measures relating to conciliation and collective bargaining enacted in the last ten years. To what extent these measures will become operative when the Wartime Labour Relations Regulations become inoperative is a matter which will turn largely upon the outcome of the Dominion-Provincial Conference of Labour Ministers called in November, 1946, to consider the whole jurisdictional situation; thus there is little point in describing the various provincial enactments here.

It is enough to note that, apart from wartime measures, British Columbia, Alberta and Nova Scotia have statutes providing machinery similar to that of the I.D.I. Act and forbidding strikes or lockouts while the machinery is operating; that a Saskatcheawn act sets up somewhat different machinery; and that in New Brunswick a new act based on the Dominion Wartime Labour Relations Regulations may be brought into force by proclamation.

Collective Bargaining

Before the recent war several provinces enacted measures designed to establish the right of labour organizations to bargain collectively with their employers as to wages and working conditions; to facilitate the bargaining process; and to give some legal effect to the resulting contracts. Nova Scotia was the first province to establish by law the right of employees to organize; this was done by the Trade Union Act of 1937. These provincial measures have been suspended, however, during the currency of the Wartime Labour Relations Regulations, which deal in part with the same subjects, and the form they will take in the future depends upon the outcome of the Dominion-Provincial discussions on labour jurisdiction now under way. The pattern of coal mining labour relations was fairly clearly established before these provincial regulations were enacted, and does not appear to have been materially affected either by them or by the Dominion Wartime Labour Relations Regulations.

Of other types of legislation affecting coal-miners, such as those relating to the status of trade-unions, picketing, *et cetera*, it is not necessary here to speak except to note the fact that in all the coal-mining provinces there is legislation authorizing the check-off by the employer of union dues and other designated deductions. Nor is it necessary to stress the fact that mine workers participate in the benefits of social legislation, such as unemployment insurance and family allowances.

Their Working Conditions

Organization of Work

Most Canadian coal is mined underground, although in 1945 about 16 per cent of it came from stripping. There were in 1945 about 19,000 underground workers among the 25,000 men employed in and around the mines. Approximately 5,000 men were working in the various surface operations required to keep the underground mines operating, and the remaining 1,000 were engaged in stripping operations.

Only about 8,000 men were actually working at the face. These face workers, sometimes called the producers, are the front line troops of coal production. All the other men around the mine are engaged in preparing and maintaining the shafts and tunnels by which the coal is approached and hauled away, in supplying air and power for the men at the face and those behind them, in preparing and maintaining the transportation system for conveying the coal to the surface, and in cleaning, sizing and shipping the coal at the surface.

Whether mining is done by room-and-pillar or longwall method depends partly on local preference but principally on underground physical conditions. To the miners it makes a substantial difference which method is used. In the older system of room-and-pillar mining, in each two or three man team the members are highly dependent on each other, but the team as a whole is highly independent of other teams. The pace at which the team works and the way it does its work is largely a matter for its members to decide for themselves. Within the general wage rate structure they themselves determine how much they earn, for they are paid according to the tonnage they load out. Subject to supervision, they protect or risk their own lives, by the degree of skill and care with which they timber their workplace and do their work at the face, where the greatest number of mining accidents occur. These men develop a strong sense of independence and self-reliance.

Admirable as independence may be, for the present day mining operation it raises serious problems. In recent years the development of efficient coal cutting and loading machinery has made possible a substantial increase in the productivity of miners. A high degree of teamwork is essential to the success of mechanized mining, and particularly mechanized longwall mining. If one or two men on a thirty-man mechanized longwall team are absent, the whole team may be unable to complete its scheduled work; if a team on one shift does not complete its work, the succeeding shifts may be disrupted. Mechanization, which if successful makes possible higher wages for lighter work, requires substitution of a high degree of discipline for the old pioneer individualism, and the miners sometimes find the transition difficult. This problem of teamwork in longwall mining even where the operation is not fully mechanized is one of the causes of the present low productivity in Cape Breton, where the work of a shift is often disrupted by the absence of a few key men from large longwall teams. In Alberta on the other hand the absence of any one man usually affects much fewer fellow workers, because of the room-and-pillar system there prevalent. Further reference to the subject will be made in the detailed discussion of pro-

ductivity: the point to be made here is that modern technology is in conflict with the traditional habits of the miner, and that the conflict has an important bearing on the conduct of the industry.

Hazards of Coal Mining

The rate of accidental death among coal miners is higher than in any other occupation of similar size and nature, more than three times that for all Canadian males aged 20 to 64 years, according to a Special Report on Occupational Mortality covering the years 1931-32 published by the Dominion Bureau of Statistics. The mortality rate of coal miners in Canada from causes other than accident is also somewhat above that of the general male population, although lower than that of metal miners. Coal miners appear to be more subject to pneumonia and bronchitis than the general population, but tuberculosis of the lungs is relatively low.

An average of 68 men have been killed by accident in Canadian coal mines in each of the last twenty-four years. The personal risk that this has involved for the miners can be expressed in terms of the time men were exposed to the dangers of the industry, by showing the ratio of fatalities per million man hours worked. However, comparison of fatality records for particular provinces or even for the Dominion on an annual basis gives deceptive results, because one mine disaster can cause a violent fluctuation. A more useful comparison is given by the average numbers of fatalities per million man hours worked for the ten-year periods ending in 1931 and each subsequent year, which are as follows:

Ten Years Ending	Nova Scotia	New Brunswick	Sask-atchewan	Alberta	British Columbia	Canada
1931	1.34	1.11	1.14	1.50	2.34	1.64
1932	1.36	1.54	1.52	1.40	2.23	1.61
1933	1.33	1.53	1.73	1.38	1.90	1.53
1934	1.29	1.50	1.73	1.34	1.92	1.49
1935	1.26	1.42	1.76	1.39	2.07	1.51
1936	1.23	1.39	1.38	1.21	2.20	1.44
1937	1.22	1.38	1.30	1.18	2.29	1.43
1938	1.27	1.33	1.30	1.20	2.48	1.49
1939	1.23	1.05	1.34	1.13	2.36	1.41
1940	1.16	1.00	1.24	1.19	1.45	1.26
1941	1.01	.82	1.28	1.39	1.42	1.25
1942	1.00	.61	1.06	1.38	1.51	1.23
1943	1.05	.57	1.06	1.48	1.58	1.29
1944	.99	.53	.99	1.42	1.46	1.22
1945	.95	.71	1.02	1.29	1.47	1.17

This clearly indicates that the coal mining fatality rate for Canada and most of the coal producing provinces has declined substantially over the last fifteen years. For all Canada, the fatality rate in the ten years ending in 1945 was only 71 per cent of the rate for the ten years ending in 1931. The Nova Scotia ratio, which has consistently been lower than that for all Canada, decreased by the same proportion. British Columbia shows the highest rate among the provinces, but it decreased by more than a third over the last fifteen years. The Alberta rate decreased until 1939, then increased almost to the 1931 level.

The Canadian fatality rate per million man hours has in most years been lower than the United States rate but higher than the United Kingdom rate. In U.S. bituminous mines the rate has ranged in the last twenty-four years between 2.23 in 1924 and 1.23 in 1945, with a fairly steady downward trend. In the six years 1938-1943, the U.K. rate ranged between 0.58 and 0.45.

Pay Basis

The men at the face, whether on longwall or room-and-pillar mining, are customarily paid in Canada on the basis of the weight or measure of the coal they win from the face and load onto conveyers or cars. This pay basis is known as the contract system: the miners contract with the operators to dig coal for so much per ton or per yard of coal mined. The other men, engaged in maintenance, development and haulage work, are customarily paid a fixed sum per shift or day: this is known as the datal basis. In United States mines, producers on mechanized mining teams are paid on the datal basis, as are the relatively few mechanized loading teams in operation in Western Canada.

The contract basis becomes extremely complicated, by reason of special allowances in addition to the basic rate per ton or yard. For taking out rock, for working in places made difficult or unusually uncomfortable by water or by a steep pitch in the coal seam, for timbering, for pushing mine cars a distance greater than normal, and for many other things, the miner may be paid a bonus, either per ton or per shift. These special allowances vary from field to field and mine to mine. For instance, the contract between District 18, U.M.W.A., and the Western Canada Bituminous Coal Operators' Association includes general clauses relating to minimum wages for "deficient places", miners doing company work, wet places, rock mining, and miners working in more than one classification: the contract goes on to schedule separately the wage rates and special provisions of each operator member of the Association, and in these individual schedules there are as many as fifteen possible special allowances provided for, aside from the prescribed rates for timbering, tracklaying, and similar jobs normally done from time to time by the miners. These allowances and special payments complicate tremendously the calculation and recording of the miners' earnings, and provide fertile ground for disputes.

The contract rates are customarily designed to enable a miner who does a good day's work to earn more for that day than all but a few highly trained specialists among the men paid on the datal basis. How much more the contract miner earns depends primarily on the amount of effort he puts into the job, but also of course upon the physical conditions of his work place and upon the adequacy of the mine cars and supplies made available to him. It is in an attempt to compensate for the inequalities in the physical conditions of the various work places, and for non-productive work which the miner is required to do, that the above mentioned special allowances have grown up.

Jobs paid at contract rates are normally sought after because of the better earnings. They are the jobs which demand the most skill. A "typical" history of a fully qualified miner working at the face might be that he started as a boy in a surface job (September 1946 rate in Cape Breton $4.74 per day, in western bituminous mines $5.07), worked around at various surface jobs for a few years (September 1946 rates in Cape Breton $5.84–$7.86 per day, in western bituminous mines $6.67–$8.11), then did underground datal work for a few years (September 1946 rates in Cape Breton $5.84–$6.96, in western bituminous mines $6.67–$9.77). While working underground he would have taken his miners' examinations, which are conducted by provincial authorities. As a first class miner, he could be given charge of a working face when a vacancy arose. Having received his miner's certificate, our "typical" miner is eligible for contract work at the face. The opportunity for such work may come soon or very slowly, depending on conditions in the industry. Average earnings of contract miners for a day's work, as reported by the Department of Labour, were, in 1944, slightly over $9 in Cape Breton; between $10 and $11 in Alberta.

The rates quoted above are wartime rates, representing all-time peaks for the areas to which they apply; but the description of the miner's career must be qualified as regards the war period, when a shortage of face workers led to special measures to speed up the progress of the worker to the face. In Nova Scotia, for instance, a man may now receive a certificate of competency as a miner after six months' intensive training as an apprentice.

Seasonal Variations in Employment

Daily earnings are not a good index of the income of coal miners. The industry has always been a highly seasonal one in Canada. In Cape Breton the summer is the busy season; on the Nova Scotia mainland and in the western provinces the autumn and winter are the busy time. For the rest of the year the miners have in peacetime often had work for only one, two or three days a week.

The seasonal variation in employment is worst in the western "domestic" coal mines. For instance, employment in the western "domestic" coal fields fell in June, 1939, to about one-fifth of the peak employment for that year. The western bituminous mines, which sell most of their coal directly to the railways, have worked more regularly than the mines producing coal for domestic heating, but even the bituminous mines have their slack periods. In eastern Canada there has not been nearly as great a decline as in the western "domestic" fields in the number of men on the payroll, but there have been great differences from month to month in the number of days work available per week.

On days when the mines are not hoisting coal there are at least a few men engaged in maintenance work. Frequently advantage is taken of the slack season to do development and repair work underground and in the surface facilities. There is a resulting seasonal shift in the composition of the working force, with underground workers becoming a lower proportion of total wage earners in the slack periods, in addition to the overall decline in employment. This trend, like the other seasonal shifts, is most marked in the Alberta "domestic" coal fields.

The causes of seasonal unemployment are in general related to the seasonal nature of consumer demand; in Cape Breton the cause is the closing of the St. Lawrence River in the winter. In the case of western "domestic" types of coal, remedial action has been complicated by technical difficulties of deterioration of the coal in storage.

Alternative Employment

The men seasonally unemployed must either seek employment in other industry, or live on whatever savings or unemployment insurance credits they have been able to accumulate. In Alberta, farm work has been the traditional alternative employment for seasonally unemployed coal miners, and the same is true to a greater extent in Saskatchewan. This alternative is, however, difficult for the man in the western bituminous and some of the sub-bituminous mines, for whom farm employment generally means migration to a different area whenever he is laid off at the mines. In the Maritimes, and particularly in Cape Breton, alternative employment is usually scarce.

Their Social Environment

Housing

Housing in coal mining communities has a bad reputation, but, except as to Nova Scotia, it is difficult to evaluate this reputation. The qualities that make a home as distinguished from a dwelling can not be measured by statistics, but even those physical characteristics which can be so

measured are not generally recorded separately so far as miners' dwellings are concerned. In the West, the miners live either in communities of less than 4,000 population, which do not receive separate statistical treatment in the Dominion Bureau of Statistics Census of Housing, or are part of larger communities of varied occupational composition, for which no statement concerning coal miners alone can be drawn from the census data. Glace Bay is the only coal mining town of over 25,000 persons; Sydney Mines, New Waterford, Springhill, Stellarton and Westville, all in Nova Scotia, are the only other towns in Canada of over 4,000 population which can be regarded as purely coal mining centres.

In these circumstances it is impossible to compare housing conditions as between the various coal mining areas of Canada, or, except for Nova Scotia, to compare housing as between miners' dwellings and other housing. From the 1941 Census Bulletin "Preliminary Housing No. D-5" it is possible to compare, as between the coal mining and non-coal mining towns of Nova Scotia, certain aspects of housing and related facilities.

The following table shows ranges of values and rents, and ranges of percentages of homes with certain characteristics and conveniences, for the two groups of Nova Scotia towns. The "mining town" group consists of Glace Bay, New Waterford, Sydney Mines, Stellarton, Westville and Springhill; the "non-mining town" group consists of Sydney, North Sydney, New Glasgow, Truro, Amherst, Dartmouth and Yarmouth, that is to say all Nova Scotia towns of more than 4,000 persons which are not almost exclusively coal mining towns. Halifax is also excluded because it is so much larger than the other towns.

—	Mining Towns	"Non-Mining" Towns
Average monthly rent, tenant-occupied dwellings ($)	8 - 13	15 - 29
Average value of owner-occupied dwellings ($)	1,142- 2,808	1,752 - 3,676
Percentage of dwellings owner-occupied	39 - 71	44 - 60
Percentage of dwellings needing external repairs	21 - 39	12 - 29
Percentage of dwellings with furnace heating	17 - 57	37 - 83
Percentage of dwellings with running water	87 - 99	90 - 96
Percentage of dwellings with flush toilet	47 - 70	83 - 95
Percentage of dwellings with electric lighting	95 -100	85 -100
Percentage of dwellings with gas or electric cooking	- 5	4 - 25
Percentage of dwellings with refrigeration, ice or mechanical	24 - 58	47 - 79

Company Houses

In both eastern and western mining areas it has long been a practice of the mining companies to build houses themselves and rent them to the miners. In some provinces the company held all land in its mining area under lease from the Province, and could not sell it: the only way in which housing could be made available was therefore on a leasehold basis. Uncertainty of employment and earnings have tended to deter miners from purchase of homes, even where purchase was legally possible. These reasons have applied with varying force in all mining areas, and in some areas it was, in addition, the past policy of the operators to keep control of the men through ownership of their living quarters.

Naturally the quality of company housing varied according to the resources of the operator and also according to his policies. In some of the western mining camps the bunkhouse was long the principal form of housing. In some other areas, Cape Breton for one, some houses which were roomy, solid, and modern in their time were built. Whatever the standards, the mere fact that the houses were owned by the employer has tended to cause a feeling of insecurity and resentment among the tenant-employees, a sense that their lives were dominated in every respect by "the company". Many operators, realizing the strength of

this sentiment, are taking steps to discontinue the practice of building company houses; some are gradually selling the company houses to their employees at reasonable prices.

However, the conditions which in the past discouraged ownership by employees of their homes continue to operate, and it is not reasonable to expect that in remote communities, or at mines which are not assured of long life, or in areas where employment is irregular, adequate housing will be provided in the future any more than in the past by the miners themselves.

The National Housing Act as recently amended includes provision for direct loans from the government's Central Mortage and Housing Corporation to operators of mines, to assist them to provide housing for employees. It is understood that this change was made because certain mines were unable to obtain sufficient labour because of housing shortages which neither the miners themselves nor any private lending agency would overcome. These loans may be for terms up to fifteen years; interest 4 per cent; security a first mortgage or, on leasehold land, a first charge upon the project and the interest of the borrower in the land on which it is built. Profits from rental of houses so financed are limited, and any earnings above this limit must be used to reduce rents. Dwellings built under such loans may be sold to occupants, and there is provision for the release of such home owners from the general mortgage on the project. At the time of writing some of the western mining operators were negotiating for such arrangements but none had made final commitments.

Closed Towns

Closed towns were an outgrowth in the West of control by the mine operator of all land within convenient distance of the pithead, and in some cases of a practice of employing only men who lived in company quarters. In such towns, not only living quarters but stores, hotels and service facilities were run either by the operator or under license from him. In addition to resentment at such monopolization of commercial activities, a common complaint was that town utilities such as lighting, sewage disposal and water supply were arranged at the will of the company rather than through usual municipal organization. Even where these complaints were not justified by any substantial difference between what the company provided and what a free municipality could have provided, there often remained that sense of insecurity and domination which in lesser degree has characterized the attitude of miners to company housing. The abuses which once characterized some closed towns have largely been done away with through provincial government action and collective bargaining.

Pensions

Among the coal miners in Canada the only ones eligible for a pension arising out of their employment are the employees of the Dominion Coal Company and the Old Sydney Collieries. The Dominion Coal Company plan was instituted in 1923: the payment of pensions is purely voluntary on the part of the company and the employees do not contribute to the pension fund. Pensions may be granted after twenty-five years of service to any male of 65 or any female of 55 years of age, with a maximum of $75 per month. In 1945 the pension fund was paying at the rate of $109,500 per year to 247 pensioners, an average of $36 per pensioner per month. However, there were in the employ of the company at

that time over 700 men over 65, most of whom were estimated to be qualified by length of service for pension and 115 of whom had actually applied for pension. The situation was that the funds of the company available for pension payments were so limited that they could not take care of all the employees eligible for pension, and consequently eligible men were faced with the choice of stopping work without a pension or continuing work until deaths amongst those receiving pensions made way for them on the pension list.

A similar pension plan was put into effect at January 1, 1946, by the Old Sydney Collieries. The employees do not contribute to the fund and have no legal right to the pension. By May, 1946, some 70 past employees were receiving the pension. There is not yet sufficient experience to show whether the funds available will be adequate to afford pensions to all eligible men.

Elsewhere in Canada the coal miner is dependent on his own savings or upon the federal Old Age Pension to provide for the years when he can no longer earn his living. Both District 18 and District 26 in their submissions to this Commission advocated an industry-wide pension plan to be financed by joint contributions from men, operators and government. A plan of this nature would assist in the recruitment of men in the industry by providing the sense of security which is lacking in the minds of the mine workers to-day. Moreover it might improve industrial relations in the industry, as the contributions of the operators would help to convince the miners of the operators' interest in their welfare. We are aware that there are difficulties in creating adequate pensions based on earnings when these fluctuate as widely as they do in the coal mining industry but these difficulties would not appear to be insuperable. We are of the opinion that an immediate study should be made of the practicability of a three-way pension plan covering all mine workers and that every effort be made to implement such a scheme.

General Welfare

Growing attention has been paid in various countries in recent years to methods of providing for the improvement of the social conditions of coal mining communities and for the support of miners in times of incapacity, unemployment and special hardship. Recent arrangements for welfare funds in the coal mining industry in the United States increased Canadian interest in the subject. In the summer of 1946 District 18 of the U.M.W.A. secured the establishment of a similar fund in most of that District, and at the time of writing District 26 has announced its intention to negotiate with the operators for the establishment of a similar fund.

The District 18 welfare fund is financed by payment by the operators of three cents per ton of coal mined, commencing October 1, 1946. The rules governing the administration of the fund are still being worked out by a committee representing the union and the operators, and pending completion of its work the accumulating contributions are being held in trust by representatives of the union and the operators. Although the purposes for which disbursements from the fund will be made have not yet been precisely defined, it is expected that they will be similar to the comparable funds in the United States. The United States welfare funds (one for the bituminous and one for the anthracite mines) are to be used for making payments to miners and their dependents and survivors with respect to wage loss not compensated or not adequately com-

pensated under the provisions of Federal or State law and resulting from sickness, permanent disability, death or retirement, and also with respect to other related welfare purposes as determined by the trustees. A comparable fund was created in the United Kingdom in 1920 for the improvement of social conditions for colliery workers and for miners' education.

MAIN PROBLEMS INVOLVING THE MINE WORKERS

This section deals with the principal problems in the field of industrial relations in coal mining: the maintenance and improvement of the mine workers' living standards, the maintenance and improvement of their productivity, and the achievement of mutual understanding and the highest possible degree of co-operation between labour and management. These are described as the main problems, because any of the multitude of problems that arise in industrial relations in this industry can be brought under one or another of these headings. These three problems, or groups of problems, are closely interwoven, so that action directed to any one of them is likely to affect the others in some degree.

Mine Workers' Living Standards

From the viewpoint of the men, the chief problem is to improve or at least maintain their standard of living. So far as living standards depend on money income, they depend not only on wage rates, but also on the number of days' work available per man per year.

Wage Rates

The vast majority of Canadian coal miners are paid either a daily wage rate or a rate based on the tonnage of measure of coal mined. Only supervisory staff and clerical workers are paid by monthly salary. The following table shows the daily wage rates for labourers and the average daily earnings for contract miners in selected years for the Canadian coal mining provinces and in Western Canada for some of the principal coal fields, as recorded by the Department of Labour. There are of course a large number of occupational classifications in the coal mining industry, but the classifications selected are basic and sufficient to indicate the range of wages. Apprentices and boys are paid lower rates than those paid to labourers, and a few highly skilled technicians are paid more than contract miners, but the vast bulk of mine workers fall in or between the classifications here shown.

Historically wage rates have been lower in Nova Scotia and New Brunswick than in Alberta and British Columbia, although the gap has narrowed substantially in recent years. These differentials reflect differences in productivity. Lower rates have also customarily been paid in Saskatchewan. Wage rates were higher immediately following World War I than at any time prior to the recent war years. Between the two wars, however, they never fell to the pre-1914 level.

From the point of view of the industry, the significance of the recent wage increases is their effect on the cost structure. Labour cost per ton as shown by some operators more than doubled between 1939 and 1944. The proportion of labour cost to total cost also increased somewhat; as shown in the chapter Financial Aspects of Production, labour cost was 58 per cent of total cost of

COAL MINING WAGE RATES

Year	Nova Scotia		New Brunswick		Sask-atchewan		Alberta										British Columbia					
							Province*		Lethbridge		Drumheller		Edmonton		Crowsnest* and Mountain Park		Vancouver Island		Princeton		Province†	
	U.	S.	U.	S.	U.	S.	U.	S.	U.	S.	U.	S.	U.	S.	U.	S.	U.	S.	U.	S.	U.	S.
Datal Rates for Labourers—																						
1921	3.90	3.80	.....	.....	.....	.....	6.89	6.58	.....	.....	.....	.....	.....	.....	.....	.....	4.71	4.54	.....	.....	.....	.....
1925	3.35	3.25	.....	.....	.....	.....	4.35	4.10	.....	.....	.....	.....	.....	.....	.....	.....	3.97	3.76	.....	.....	.....	.....
1929	3.35	3.25	3.35	3.00	.....	.....	4.54	4.28	.....	.....	.....	.....	.....	.....	4.47	4.39	3.97	3.76	.....	.....	.....	.....
1933	3.14	3.12	2.89	2.71	2.66	2.53	.....	.....	4.45	4.25	4.20	4.00	3.46	3.14	4.47	4.39	4.14	3.77	3.90	3.87	.....	.....
1939	3.36	3.36	2.83	2.61	3.24	3.08	.....	.....	4.85	4.62	4.85	4.62	3.78	3.70	5.01	4.90	4.60	4.00	3.90	3.87	.....	.....
1944	5.67		5.18		5.00		.....		6.58		6.58		6.58		6.67		.....		.....		5.1	
Weighted Average Daily Earnings for Contract Miners—																						
1921	7.22		.....		.....		9.57		.....		.....		.....		.....		8.10		.....		.....	
1925	6.08		.....		.....		7.00		.....		.....		.....		.....		6.78		.....		.....	
1929	6.65		3.83		.....		7.85		.....		.....		.....		8.72		6.75		.....		.....	
1933	5.60		3.54		4.37		.....		7.17		6.23		5.10		8.17		5.70		.....		.....	
1939	6.67		3.56		4.28		.....		7.95		7.79		6.79		7.85		6.65		.....		.....	
1944	9.14		6.79		7.79		.....		10.76		10.76		10.76		10.57‡		.....		.....		10.37	

U.—Underground.
S.—Surface.
* Including B.C. Crowsnest.
† Excluding B.C. Crowsnest.
‡ This figure appears to be too low.

NOTE: For contract miners daily earnings are shown rather than rate per ton because variations in physical conditions affecting productivity from field to field make it meaningless to compare tonnage rates from field to field.

SOURCE: Research and Statistics Branch, Department of Labour.

production at Dominion Coal Company over the years 1936–1939, 60 per cent over 1940–1944, and in 1944 was 64 per cent. At the other major Nova Scotia operations the comparison of the proportion of costs attributed to labour was:

—	1936-39 Average	1940-44 Average	Year 1944
Cumberland	59	61	64
Acadia	57	62	66
Old Sydney	59	62	61

In the other coal mining areas, labour costs formed roughly the same proportion of total costs over the period 1940–1944 as over 1936–1939, ranging between 50 per cent and 62 per cent; but for the year 1944 increases over the 1936–1939 level were shown in most cases. There was one notable exception: in Saskatchewan labour costs declined from 39 per cent to 24 per cent of total costs as between 1936–1939 and 1940–1944.

It should be borne in mind that labour cost per ton is not affected by wage levels alone, but also by productivity, according to the general formula

$$\frac{\text{average daily earnings}}{\text{tons per man day}} = \text{labour cost per ton.}$$

For example, recent wage increases in Nova Scotia, having been accompanied by decreases in productivity, have been followed by increases in labour costs per ton proportionately greater than the wage increases.

Coal mining wage rates advanced further between 1939 and 1945 than did the rates for most other industry classifications, as indicated by the following Department of Labour calculations showing 1945 wage rates as percentages of 1939 rates for major industrial groups:

	Per cent
Coal mining	145
Metal mining	128
Logging	161
Construction	131
Manufacturing	143
Transportation and Communication	129
Service	136
General Average	140

In discussing Canadian coal mining wages, reference is often made to the higher level of wages in the United States. This comparison is virtually valueless unless due weight is given to the comparative levels of general wage rates, annual earnings and cost of living patterns of the two countries, and to variations in the productivity of coal mining labour as between Canada and the United States.

Changes in cost of living levels modify the importance of changes in the level of wage rates, since real wages depend on prices. However, a more important relationship, discussed later, is that between average annual earnings and the cost of living. This is mentioned here only because the miners, and the operators, tend to place primary emphasis upon wage rates rather than annual earnings.

Regularity of Employment

Steadiness of employment is of central importance to the miners' living standards. It depends, however, upon regularity of demand for coal and upon technical problems of production scheduling, which are matters beyond the

scope of this chapter. They are also matters beyond the control of the miners, except to the degree to which their wage demands, their productivity and their contribution to the industrial relations of the industry affect the cost structure and the reliability of the industry in relation to competing coal and other fuels.

A full working year for a mine worker, on the basis of the 5-day week and 52-week year requested by the miners, would be 260 days, less statutory holidays; absences from work for good reasons would probably bring the average somewhat below 250 days. If a less hopeful view is taken, and some seasonal inactivity is considered inevitable because of the seasonal nature of demands for coal, 200 days of work per year might be taken as a rough standard of what the average miner could reasonably expect in peacetime. During the war years many mines have been working more than 260 days.

To learn the actual experience of the industry in terms of days worked per man the Commission through the co-operation of the industry collected a sample of the distribution of shifts worked per man in the years 1931, 1936 and 1939–1944. The summarized results of this sample are reproduced here.

DISTRIBUTION OF SHIFTS WORKED
SAMPLE MINES, SELECTED YEARS 1931-1944

(Canada by Regions, Weighted According to Regional Coal Mining Employment)

Region	Year	Percentage of Men Working			
		Less than 100 Shifts	100–199 Shifts	200–299 Shifts	300 Shifts and more
Nova Scotia	1931	18	62	17	3
	1936	8	41	45	6
	1939	5	42	47	6
	1942	16	25	44	15
	1944	9	20	49	22
Saskatchewan[1]	1940	64	11	10	15
	1942	61	13	10	16
	1944	46	12	29	13
Alberta Domestic Coal Fields[2]	1931	68	26	6	.....
	1936	44	42	13	1
	1939	47	39	13	1
	1942	36	27	31	6
	1944	31	22	42	5
Western Steam Coal Fields[3]	1931	23	61	13	3
	1936	8	56	30	6
	1939	11	47	37	5
	1942	16	17	53	14
	1944	14	13	62	11
Vancouver Island	1931	29	30	35	6
	1936	13	14	65	8
	1939	15	20	62	3
	1942	28	21	47	4
	1944	15	23	58	4
Canada[4]	1931	31	51	15	3
	1936	16	42	37	5
	1939	16	40	40	4
	1942	22	23	43	12
	1944	15	19	50	16

[1] No data available for years prior to 1940.
[2] By "domestic" coal is meant high volatile "B" bituminous and lower rank coals.
[3] By "steam" coal is meant high volatile "A" bituminous and higher rank coals.
[4] In the Canada figures, the Nova Scotia weight is increased to allow for coal mining employment in New Brunswick.

In 1931 only 18 per cent of Canadian coal mine workers worked 200 shifts or more; in 1936 there were only 42 per cent who had this much work, and in 1939 only 44 per cent. This group included maintenance men, who work full time whether the mine is hoisting coal or not. During the war years the percentage working 200 or more shifts has increased rapidly, until in 1944, 50 per cent of the men worked between 200 and 300 shifts and a further 16 per cent worked 300 or more.

In 1931 almost a third of the men worked less than 100 shifts. The fact that during the war years the percentage of men working less than 100 shifts increased from the 1939 level is a reflection not so much of under-employment as of high turnover; the men in this group in the war years when employment was generally available were principally those who were on the payrolls of the reporting companies only for short periods. For this reason, while in the thirties the less than 100 shifts classification is a partial reflection of the importance of seasonal employment in the various fields, in the years following 1939 it is of little significance in most areas. Exception to this statement must be made in the cases of Saskatchewan and the Alberta "domestic" coal fields, where many men are employed for three months or less in the year. In these fields the high proportion of the men shown to be working less than 100 shifts in the war years reflects seasonal unemployment as well as turnover.

Among the various areas shown separately in the summary, Nova Scotia and the western "steam" coal fields showed the highest level of activity. In Nova Scotia in 1931 only 20 per cent of the men worked 200 or more shifts, but in all the subsequent years sampled more than 50 per cent worked 200 or more shifts, and the proportion reached 71 per cent in 1944. Conversely, Nova Scotia shows the lowest proportion in the less than 100 group, reflecting a relatively low rate of turnover, relatively low seasonal variation in activity, and the high level of activity of the recent years. In the western "steam" coal fields the long-term problem is similar: the proportions of 84 per cent, 64 per cent and 58 per cent of the men working less than 200 shifts in the years 1931, 1936 and 1939 suggest that the real problem here also is to make full use of the capacity of the men dependent upon the industry, and thereby to provide them with adequate annual earnings.

The relatively small (in terms of employment) Saskatchewan field illustrates by the high proportion of men working less than 100 shifts even during the war years the highly seasonal nature of operations in that field. The Saskatchewan operation is probably the best adjusted of all the seasonal operations in that respect, since many of the extra men the industry employs in the busy season are farmers for whom coal mining is a supplementary source of income; but a substantial proportion of the men are primarily dependent upon the coal mines and have in the past experienced seasonal unemployment. The increasing productivity and success in securing an industrial market in recent years appear to make employment prospects for this field more favourable than in the past.

In the Alberta "domestic" coal fields, the seasonal variation of employment, although not as extreme as in the Saskatchewan field, is of prime importance. This seasonal variation, plus a high rate of turnover, explains the very high proportion of men in the Alberta "domestic" coal fields shown to work less than 100 shifts in all the years covered in the sample. Conversely, in none of the years covered did more than half of the men reported by the Alberta "domestic" coal operators work more than 200 shifts. This seasonal factor in the Alberta "domestic" fields is a long-standing problem to which no adequate solution has yet been found. Some of the men turn to farming in the slack season, either on their own account or as employees, but many of the men have over the past years been unable to count on securing other employment to supplement their work in the coal mines. From the point of view of the men, this situation produces

highly unsatisfactory annual earnings. Until some method can be devised for maintaining activity in the slack period in these coal fields, each individual coal mine worker will have to make his own adjustment.

On Vancouver Island a comparatively high proportion of the men employed worked 200 or more shifts in all the years covered by the sample. As in Nova Scotia, there has been a great deal of partial employment in this field.

Annual Earnings

No adequate statistics of earnings in the coal industry are kept on a national basis. However, from payroll and employment figures collected by the Dominion Bureau of Statistics, it was possible to work out approximate average annual earnings. These figures appear to contain a margin of error, but this difficulty does not seriously affect the comparison of these annual average earnings figures from year to year and from district to district. It does mean that they can not be taken as an exact statement. It should also be remembered that averages do not adequately show the possibilities of the industry as a source of income to the individual: as demonstrated later, there is a wide range in earnings above and below the average. For these reasons the average earnings figures are not here tabulated, but are compared in general terms as between periods of time and among the various Canadian coal mining areas.

Since 1922, the first year for which such information is available, the average for Canada of annual earnings of coal mine workers from coal mining first exceeded $1,400 in 1941, while in the five years 1931 to 1935 the average ran below $1,000 in each year, being just over $800 in 1933. In 14 of the 24 years covered the average was $1,200 or over.

As between coal mining areas there are wide variations in the annual average. In New Brunswick the average exceeded $1,000 only in 1923, 1927 and 1942 to 1945 inclusive, and in nine of the 24 years it was below $800. Even in 1944 and 1945 the New Brunswick average was about $500 below the national average. Similarly in Saskatchewan average earnings exceeded $1,000 in 1923 and then not again until 1941, and still in the recent years have lagged behind the national average: they have been below $800 in 8 of the 24 years on record. In both these Provinces the primary reason for the discrepancy from the earnings for the principal coal producing areas is a lower wage scale which reflects in both Provinces a relatively low grade of coal, in New Brunswick low productivity, and in Saskatchewan a short mining season.

The Alberta "domestic" coal fields have shown the next lowest level of earnings, with the exception of a few years in which earnings in Nova Scotia were lower (1924, 1925, 1932, 1933) and the most recent years when earnings on Vancouver Island have been lower. Here again the reasons for the relatively low level of average earnings would appear to have been the lesser value of the coal produced, a correspondingly low wage scale, and seasonal inactivity.

Vancouver Island, where for many years average earnings were higher than in any other principal coal field in the country, has in recent years fallen behind the level of earnings in the western "steam" coal fields and in Nova Scotia. The daily wage schedule since 1938 has been similar to that in the Crowsnest and other "steam" coal fields, but problems of markets and difficult physical working conditions have reduced activity on the Island below the level of those fields.

The highest rate of earnings has been enjoyed in the western "steam" coal fields and in Nova Scotia, with the western fields holding an edge over Nova Scotia in 16 of the 22 years in which comparison is possible. Even in these fields the average annual earnings have dropped below $1,000 in several years, in the western "steam" coal fields in 1933 and 1936, and in Nova Scotia in 1924,

1932, 1933 and 1935. It will be remembered that the wage rate in Nova Scotia has historically been lower than that in the western "steam" coal fields: the reason that earnings in Nova Scotia have from time to time exceeded those in the western "steam" coal fields is that the mines in Nova Scotia have worked more steadily.

To get a clearer picture of the earnings received by coal mine workers than that afforded by these approximate averages, the Commission through the co-operation of the industry secured records of the distribution of earnings among a substantial sample of the mine workers in the country, similar to the sample of distribution of work previously mentioned. A summary of the earnings distribution indicated by this sample, with a weighted distribution for Canada, is shown below.

DISTRIBUTION OF EARNINGS
SAMPLE MINES, SELECTED YEARS, 1931-1944

(Canada by Regions, Weighted According to Regional Coal Mining Employment)

Region	Year	Percentage of Men Earning				
		Less than $1,000	$1,000–$1,499	$1,500–$1,999	$2,000–$2,999	$3,000 and Over
Nova Scotia	1931	81	17	2	[5]	.....
	1936	60	36	4	[5]	.....
	1939	49	40	10	1	.....
	1942	37	33	23	7	[5]
	1944	16	22	30	30	2
Saskatchewan[1]	1940	79	11	5	5	.....
	1942	74	8	12	5	..... 1....
	1944	55	13	22	9	[5]
Alberta Domestic Coal Fields[2]	1931	86	12	2	.....	.....
	1936	78	19	3	.....	.....
	1939	78	16	5	1	.....
	1942	47	19	20	14	[5]
	1944	35	11	22	30	2
Western Steam Coal Fields[3]	1931	66	24	7	3	[5]
	1936	46	42	10	2	.....
	1939	30	42	23	5	.....
	1942	23	15	34	26	2
	1944	14	11	32	39	4
Vancouver Island	1931	65	27	7	1	.....
	1936	39	45	15	1	.....
	1939	39	49	11	1	.....
	1942	44	26	24	6	.....
	1944	19	18	39	24	[5]
Canada[4]	1931	78	18	3	1	[5]
	1936	60	34	5	1	.....
	1939	52	36	11	1	.....
	1942	37	26	24	12	1
	1944	20	17	30	31	2

[1] No data available before 1940.
[2] By "domestic coal" is meant high volatile "B" bituminous and lower rank coals.
[3] By "steam coal" is meant high volatile bituminous "A" and higher rank coals.
[4] In the Canada figures, the Nova Scotia weight is increased to allow for coal mining employment in New Brunswick.
[5] Less than 0.5 per cent.

In 1931, 78 per cent of the coal mine workers in Canada were earning less than $1,000; in the Alberta "domestic" coal fields the proportion was 86 per cent. At the same time men earning $1,500 and over numbered only 2 per cent of the Nova Scotia total and of the Alberta "domestic" coal fields total, and ranged up to 10 per cent in the western "steam" coal fields.

By 1944 the picture had changed radically: 55 per cent of the men in Saskatchewan and 35 per cent of the men in the Alberta "domestic" coal fields were still earning less than $1,000 per year, but the detailed records indicate that most of these were men who worked only seasonally in the coal mines, and in some cases moved about from one mine to another even during the busy season. In Nova Scotia and the western "steam" coal fields, where employment is more stable, the proportion of men earning less than $1,000 was 16 per cent and 14 per cent respectively, while in Vancouver Island it was 19 per cent and in Canada as a whole 20 per cent. In these fields the group earning less than $1,000 was apparently made up largely of men who left the coal mines during the year, or commenced employment at the mines well on in the year, or who for various reasons worked only part time. By 1944 a third of the mine workers in Canada were earning over $2,000; in the western "steam" coal fields the proportion was 43 per cent.

In the western "steam" coal fields 1941 was the first year in which 50 per cent of the men earned $1,500 or more, while in Nova Scotia, the Alberta "domestic" coal fields, and Vancouver Island, this point was not reached until 1944. It had not then been reached in Saskatchewan. Until 1942 not 1 per cent of the coal mine workers in Canada earned $3,000 and over; in 1944 the proportion was 4 per cent in the western "steam" coal fields, 2 per cent for Canada.

In evaluating earnings data it is important to remember that the recent years represent an all-time peak in the earnings of coal miners. Up until 1939 more than half of the mine workers in Canada were earning less than $1,000 per year from coal mining, and until 1944 over half of them were earning less than $1,500. The proportion of one-third earning over $2,000 in 1944 is an event which has not previously occurred. High wage rates were fundamental to it, but even if high wage rates are maintained, the coal mines in general must work nearly full time in order to maintain this level of annual earnings. The real problem, once again, is regularity of work.

On the other hand, the earnings pattern during the war years did not reflect the maximum available earnings. As discussed in the section on productivity, there was an increase in absenteeism and labour turnover during the war, for a number of reasons. Had the men worked every available day, as they did during the 1930's, a larger proportion of them would have appeared in the higher earnings brackets. This point is illustrated by comparison, for a large eastern operator and two representative western bituminous operators, of the earnings pattern in 1944, first of those employees who worked less than 260 shifts, and second of those employees who worked 260 shifts or more, i.e., five days or more per week over the year.

	Eastern Operator		Two Western Operators	
	Men Working less than 260 Shifts	Men Working 260 Shifts or More	Men Working less than 260 Shifts	Men Working 260 Shifts or More
	5,562	4,576	657	254
	Per Cent	Per Cent	Per Cent	Per Cent
Proportion Earning—				
Less than $1,500	63	1	41	x
$1,500–$1,999	22	40	27	26
$2,000–$2,999	15	54	28	65
$3,000+	x	5	4	9

x Less than 0.5 per cent.

A large proportion of the men who worked less than 260 shifts and earned less than $1,500 in both East and West, was apparently men who were in the employ of the operators concerned for only part of the year, but this does not detract

from the primary point, that of the men who worked steadily, 59 per cent at this eastern operation and 74 per cent at these western operations earned over $2,000.

For a comparison of average earnings in coal mining with average earnings in some other industries of a more or less comparable nature (heavy work, large-scale industries), there were available only approximate figures on average annual earnings. Such averages appear below for selected years for gold mining; copper and gold mining together; silver, lead and zinc mining where carried on together; and primary iron and steel. They indicate that average earnings in coal mining in Canada were lower than in these other industries in all the sample years before 1944. In 1933 average annual earnings in gold mining were almost twice those in coal mining, and in 1936 and 1939 they were about 50 per cent higher.

—	Coal Mining	Gold Mining	Copper and Gold Mining	Silver, Lead and Zinc Mining	Primary Iron and Steel
	$	$	$	$	$
1933	802	1,541	1,354	1,269	1,049
1936	1,029	1,547	1,386	1,482	1,144
1939	1,118	1,675	1,567	1,699	1,374
1942	1,573	2,016	1,904	2,141	1,797
1944	1,990	2,041	1,965	2,042	1,930

Note—Non-ferrous metal mining data above excludes smelting and refining.
SOURCE: Research and Statistics Branch, Department of Labour.

Annual earnings and wage rates must be considered in relation to the cost of living to gain some idea of the real level of wages and earnings. For this purpose indices of wages and earnings in coal mining in comparison with the index of the general cost of living are shown below for selected years. Through the 1920's, when the coal mining wage rate index was lagging substantially below the cost of living index, the index of average annual earnings in coal mining compared favourably with the cost of living. Conversely, during the depression when the wage rate index ran at a level closely comparable with the index of the cost of living, annual earnings fell off sharply. During the recent war and up to 1945, while the official cost of living index increased only 20 per cent above the 1935-1939 average and the wage rate increased 50 per cent above that level, the annual earnings index increased 93 per cent above that level. To the extent that the general cost of living index is applicable to single occupational groups, this indicates that, as compared with the 1935-1939 average, real wages in coal mining by 1945 were up 25 per cent and real earnings 62 per cent. This comparison illustrates once again that the miners' standard of living is quite as dependent upon the steadiness of employment as upon the level of wage rates.

—	Index of Wage Rates in Coal Mining	Index of Average Annual Earnings in Coal Mining	Index of Cost of Living (General)
1923	116.7	133.2	120.7
1929	99.6	132.0	121.7
1933	95.5	76.5	94.4
1939	102.9	106.6	101.5
1942	116.4	150.0	117.0
1945	149.6*	192.9*	119.5

1935–1939 Average = 100 for all three indices.
* Preliminary.

Productivity

Productivity, measured by the average number of tons of coal produced per day per man employed, or tons per man-day, is the common yardstick of the efficiency of coal mining operations, because production per man-day at any given wage level determines labour cost per ton; labour cost is in Canadian mines from 50 to 65 per cent of total cost per ton; and cost per ton in relation to price levels determines whether the operation prospers or collapses. For the same reasons, it is a principal determinant of the wage rates and regularity of employment of the mine workers.

Productivity is affected directly by the physical characteristics of the coal field, by the equipment employed, by the efficiency of management and of engineering methods: these factors are dealt with in the chapters on Mining Methods and the Financial Aspects of Production. Productivity is also directly affected by the efficiency and attitude of the miners; it is to this aspect of productivity only that this section is devoted. It deals with the ways in which the mine workers affect productivity, and with the importance of productivity to the mine workers. Productivity in net tons per man-day in Canadian coal fields for selected years is shown below:

	1939	*1945*
Nova Scotia	2.34	1.58
New Brunswick	1.42	1.72
Saskatchewan	5.85	12.07
Alberta "Steam" Coal Fields	3.75	3.91
Alberta "Domestic" Coal Fields	3.46	3.93
Vancouver Island	1.84	1.89

In the United States bituminous coal fields, where productivity is generally higher than in Canadian fields, principally because of more advantageous physical conditions and a higher degree of mechanization, overall productivity from underground and stripping operations was 5.25 tons per man-day in 1939 and 5.67 in 1944. More than half of the United States coal which competes in the central Canadian market comes from States averaging 5.08 to 6.77 tons per man-day in 1944. Productivity in the United States anthracite fields was 2.79 tons per man-day in both 1939 and 1944. In the United Kingdom productivity is lower than in Canada, 1.27 net tons per man-day in 1939 and 1.13 in the second quarter of 1944.

The principal factors affecting productivity in which the mine workers are closely involved are the composition and balance of the labour force, methods of training and recruitment, absenteeism, and the state of labour-management relations. Labour-management relations is the subject of a separate section of the chapter.

Composition and Balance of the Labour Force

Reference was made in the first section of this chapter to the increasing proportion of older men in the mining labour force: whereas in 1931 the proportion of mine workers over 45 was 29 per cent in Nova Scotia and 28 per cent in Alberta, in 1941 it was 37 per cent in Nova Scotia and 46 per cent in Alberta. There is reason to believe that the increase in the proportion of older men has continued since 1941, and indeed was accelerated during the war years. Heavy enlistments drained off in the earlier war years the most physically fit miners. Physically fit young men did not come into coal mining at a normal pace, partly because of enlistments and partly because of other employment opportunities. Men who would normally have retired stayed on during the war years. It seems reasonable to infer that with this increase in average age and withdrawal of a large proportion of men eligible for military service, the physical capacity of the mine labour force was lower than before the war.

During the war there developed a shortage of certificated miners and a consequent imbalance in the labour force. The shortage of mine workers for all classes of work was not of critical dimensions but the shortage of face workers did seriously impair the efficiency of the whole force. This shortage resulted in a reduction in the volume of coal produced at the working faces, even though production per face worker was reasonably well maintained in most mines. The result was that the force of datal workers necessary to operate the mines, which for technical reasons could not be contracted proportionately to the shrinkage in the face worker force, did not have made available to it the volume of coal which it could have handled. In consequence there was a decrease in overall productivity in areas where this imbalance was marked.

It was most striking in Nova Scotia, where productivity declined by a third between 1939 and 1945. In other major areas productivity had by 1945 been restored to the 1939 or a higher level. In Nova Scotia, the proportion of face workers to total workers was 31 per cent in 1939, fell to 23 per cent in 1943, and 22 per cent in 1944. The Dominion Coal Company's overall productivity fell from 2.7 tons per man-day in 1939 to 1.6 in 1945, or 41 per cent, while the productivity of face workers fell from 7.6 to 5.7 tons per man-day, or 25 per cent. In 1945 the Company's total labour force was 95 per cent of the 1939 number, while the face workers were only 75 per cent of the 1939 number. By October, 1946, the non-producer force was 10 per cent larger than in 1939, while the face worker force was still only 86 per cent of the 1939 force.

The reasons for this imbalance and its continuation after the war are not entirely clear. The principal Nova Scotia operators report that enlistments were particularly heavy among face workers. It is easier to replace surface workers and underground haulage and maintenance men than to replace face workers. In Nova Scotia qualification for a miner's Certificate of Competency now requires either six months intensive apprenticeship training or eighteen months practical experience underground: in a shortage such as arose during the war, this time factor puts a limit on the speed of replacement. A second reason suggested for the failure to keep face workers in balance with the rest of the labour force is that work at the face is sufficiently arduous to require physically fit men, i.e., the same group from which the Armed Forces were recruiting during the war. A further explanation given is that a full maintenance staff is required to operate a mine whether there is a full crew at every working face or not, and that while it was possible to recruit enough men for maintenance, the new men assigned to the mines were so inefficient that more than the normal complement were required to do the work.

Several expedients were used during the war in attempts to improve the balance, by government agencies as well as by the operators. Miners were frozen in their jobs by Order in Council; provision was made for compulsory transfer of miners working in other employment, and for return of miners in the Armed Forces to the mines on special leave; the qualifications for work at the face were simplified, and special training schemes for apprentices instituted. The best that can be said of these schemes is that they slowed up the decline of the face worker force.

The question is naturally asked: was it not possible to restore the balance by up-grading men already working in the mines but not at the face? National Selective Service in 1944 shed some light on this question by a survey covering over 6,000 datal workers in the employ of the five principal Nova Scotia operators. While 53 per cent of these men held certificates which would permit them to work at the face, most of them were disqualified for one reason or another. Of the total surveyed, 36 per cent were reported medically unfit for face work, 29 per cent were declared by their employers to be essential in their present datal jobs, 10 per cent were over age for face work, 3 per cent under age, and 4 per cent

had not enough experience to qualify. Ten per cent declared themselves unwilling to work at the face, for reasons which varied from working conditions to the rate of income tax which would apply to their higher earnings. There remained only 8 per cent, 516 men, who were able and declared themselves willing to work at the face.

These 516 men were apparently available at a time when the shortage of face workers among these operators was 612 men. However, only 169 of the 516 potential face workers were at collieries where there was a need for face workers: even in as small an area as the Nova Scotia coal fields it is difficult to shift mine workers about from one colliery to another as needed, for the same reasons which make people anywhere reluctant to change their place of residence or to commute long distances. Further, the willingness of the 169 men to move to the face was never put to the test, for National Selective Service had bound itself in obtaining the information from the men not to release their names. The Companies therefore could not approach them directly, and National Selective Service did not attempt any compulsory direction of these men to face work. From previous canvasses of their employees, the operators believed that they had found all the men who were actually willing, as well as able, to move to the face.

Explanation is still required for the special reluctance of Nova Scotia mine workers to move to the face, because in the other coal mining areas, while this difficulty in maintaining the balance of the labour force arose, it was found possible to maintain overall productivity: indeed in Alberta the number of face workers fell below the 1939 level only slightly, and in British Columbia, while there was a decline in their number in 1941 and 1942, the 1939 level was reached again in 1943 and exceeded in 1944.

The primary reason for the reluctance of the Nova Scotia mine workers to go to the face appears to have been the lack of sufficient money incentive. This in turn arose from several factors. The first was that the differential between the pay of datal workers and that of contract miners had been narrowed during the war period, the datal wages having increased more than contract rates. The second factor was the practice of paying "extra shifts" which had arisen many years before in the employment practices of the Nova Scotia operators but became important only during the war years. This extra shift system is an outgrowth of the task system, by which a man is assigned a certain amount of work which is considered a full day's work, but which may in fact be completed in less than eight hours. It has become increasingly common in Nova Scotia under the stress of wartime manpower shortages and absenteeism to offer men who completed such tasks in less than eight hours another task which is also paid for as a whole day's work. Thus, for a few hours more than the normal eight (occasionally for no more than the normal eight) a man may earn two days' pay. Figures from the above mentioned National Selective Service survey indicate that in 1944 the number of extra shifts being paid for amounted to 16 or 17 per cent of the total shifts. The possibility of extra earnings through this method naturally diminished the financial incentive for taking a job at the face. A third factor of importance in the reluctance of men to move to the face was income tax. This had a more important bearing on absenteeism, but some men considered the net increase in their earnings after taxation, which would result from their transfer to face work, not worth the extra effort, responsibility, and danger involved. This factor was operative in all coal mining areas, but may have been particularly marked in Nova Scotia because of the decreased differential between datal and contract pay.

Training and Recruitment

In the past, the labour force in Canadian coal mines has been built up and maintained by immigration and by young men of the locality going into mining as a life work. Immigration has virtually stopped in the last two decades,

and young men appear reluctant to enter coal mining so long as alternative employment is available. The results of this situation are reflected in the wartime imbalance of the labour force and in the increasing proportion of older men within the force. In Nova Scotia, the fact that the population of the mining areas is increasing while employment opportunities remain fairly stable may mean that adequate numbers of recruits will be available to the mines, but even there young men are reluctant to enter the mines; in the western mining areas the same reluctance is observed and alternative work is more feasible.

Training in the past has largely been given by experience, as the men passed through successive work classifications. Some evening classes and correspondence courses have been available for men seeking certification as officials, and a few scholarships have been made available to bright young miners for short technical courses to fit them for work as officials. During the war an apprenticeship scheme was commenced in Nova Scotia, with government assistance to meet the shortage of face workers.

From the point of view of productivity, it is important that in the composition of the labour force a normal proportion of young men be maintained. This can only be done if work in the mines is made sufficiently attractive to compete with alternative employment. The growing trend to mechanization requires the skill and the adaptability of young men; and an increase in mechanization will make coal mining more attractive to them. Both recruitment and training are problems best dealt with by the industry itself, by management and the miners' unions together. The Commission commends the recent commencement in western Canada of a joint management-union investigation into means of increasing productivity in that area.

Absenteeism

A third major factor affecting productivity is absenteeism. Although accurate and comparable statistics on absenteeism on a national basis are not available, it is generally agreed that absenteeism is a problem in coal mining, and became a very serious one during the war years. This is not peculiar to Canada, but is shared also by the coal mines of western Europe and the United Kingdom, the United States and Australia. It is not solely a wartime problem: an estimate commonly given for "normal" absences for all reasons in coal mining is 5 to 10 per cent, as against 3 to 5 per cent for all industry. During the war, this proportion increased substantially. At the Dominion Coal Company, which commenced detailed records in 1943, absenteeism for the whole labour force increased from 19 per cent in 1943 to 28 per cent in the first nine months of 1946.

There were a number of reasons for this wartime increase. Perhaps the most important was that the earning power of the miners increased beyond their money demands. Before the war, because of intermittent unemployment and relatively low wage rates, the miners became accustomed to a low standard of expenditure. During the war, increased earnings combined with scarcity of consumer goods appear to have produced, at least in some cases, a belief that enough money could be earned during three or four days to supply all the miners' needs for a week. The miners were buying leisure. This attitude was easier to adopt because the men knew that they ran little risk of discharge for absenteeism during the acute shortage of mine workers.

A related factor was the increasingly high rates of income tax during the war years. This is a point which is difficult to establish, but some specific examples made available to the Commission support the statement generally made by reliable observers that the individual miner gauges very closely the proportion of each dollar which is taken in tax, and stops work at the point where

he feels the additional income retained is not worth the additional work required to earn it. Considerations of patriotism in many cases and desire to earn additional money even at reduced net rates in other cases have of course modified this attitude.

In Nova Scotia absenteeism had more serious effects than elsewhere, because of the prevalence of longwall mining, in which the absence of a few key man may disrupt the work of a whole shift, all the haulage and other supporting staff as well as the face crews. In the room and pillar mining prevalent elsewhere in Canada, a number of rooms may be idle through absenteeism, but the balance of the men can produce, although the supporting crew may not be working at full capacity.

Intra-Union Affairs

Productivity in Nova Scotia suffered during the war years from dissension within the union. A deliberate slowdown, which commenced at the end of April, 1941, and was formally abandoned in September of that year, resulted from dissatisfaction of some of the membership of District 26, U.M.W.A., with the District Executive, and was in particular a protest against the Executive's signature of a new contract with the operators without the customary prior referendum vote of all union members. The slowdown, which was conducted against the express advice of the International Executive of the U.M.W.A., caused a drastic decline in productivity. At the Dominion Coal Company, the operation most affected, net tons per man-day in 1941 were as follows:

January	2.48
February	2.49
March	2.51
April	2.42
May	1.97
June	1.85
July	2.04
August	1.84
September	1.84
October	2.45
November	2.46
December	2.42
Calendar Year Average	2.24

For Nova Scotia as a whole, productivity fell from 2.16 in April, 1941, to 1.81 in September. After the slowdown was called off, productivity for a few months returned to levels slightly above 2 tons per man-day; then a steady decline to the 1945 level of 1.58 tons set in.

Employer-Employee Relations

Employer-employee relations are a matter of emotion as much as a matter of fact: they vary from time to time and from place to place, depending upon factors of human personality as much as upon logic and factual circumstances. In one sense the other two main problems, living standards and productivity, are aspects of the problem of achieving co-operation, for there are no more important determinants of the nature of relations between men and management than the trend of earnings of the men and the trend of productivity of the industry. Also important in determining the state of relations at any given time are the history of past relationships and what the men and management each believe to be the present attitude and degree of efficiency of the other in the mutual enterprise.

Relations in the past have been frequently marked by strikes and work stoppages. According to the Federal Department of Labour, there have been since 1921 761 strikes and other work stoppages in the Canadian coal mining industry, involving a total loss of over 4.75 million potential man-days of work. Four hundred and seventy-one of these strikes and stoppages, resulting in a time loss of 2.5 million man-days, have been in Eastern Canada, 90 per cent of them in Nova Scotia, and 247 have occurred in Alberta, or Alberta and British Columbia together, with a time loss of 2.1 million man-days. If a "serious" strike be arbitrarily defined as one involving a time loss of 100,000 days or more, there have been no serious strikes in Nova Scotia since 1925, the last of four consecutive years in which serious strikes occurred. There have been no District-wide strikes called by the union in Nova Scotia since 1925, but enough work stoppages to cause losses of 60,000 or more man-days occurred in 1934, 1939, 1940, 1941 and 1943. The most serious strike in New Brunswick was one involving 60,000 days time loss in 1937. In Saskatchewan the most costly strike recorded in terms of man-day loss was in 1939, when the time loss was 14,000 days. Serious strikes involving mine workers in both British Columbia and Alberta occurred in 1922, 1924, and 1945, and in 1943, 94,000 man-days were lost in a strike for higher wages. The 1945 incident was a widespread work stoppage unsanctioned by the District Executive, not a formal strike. In the Province of Alberta itself there were serious strikes in 1925 and 1932. In British Columbia the most important strike in terms of time lost was in 1935, when the total time lost was 22,000 man-days.

Causes of the strikes, as recorded by the Department of Labour, were wages, hours, working conditions and related questions in 499 of the total of 761 strikes. Strikes over questions of union recognition, security and related matters numbered 262, and time loss involved in them amounted to only 19 per cent of the total time loss in the industry. This reflects the fact that the general principles of union recognition and collective bargaining have been accepted in most coal mining fields in Canada for many years, and that coal mining labour organization has been relatively free of jurisdictional disputes. Strikes in this industry have been mainly of two kinds; District-wide strikes arising from breakdown of contract negotiations, and local stoppages in breach of existing agreements. Since the 1920's the former variety of strike has become less frequent and the latter more frequent. Strikes during the early 1920's were usually undertaken to prevent wage reductions and were in both eastern and western Canada of a District-wide nature. In recent years most work stoppages have been caused by local grievances arising out of existing agreements, rather than by failure to reach agreement with the employers on District-wide questions concerning the wage schedules and similar fundamental matters. This applies particularly to Nova Scotia.

Many of these small local stoppages have been the result of the impatience of the men with the normal procedures for settling grievances. In both District 26 and District 18 the contracts between the miners' union and the operators set forth elaborate machinery by which a grievance may be negotiated at succeeding levels of authority and finally submitted to arbitration. Often the men in the locals affected by the grievance in question walk off the job for a few days without waiting for the grievance machinery to operate. Local stoppages sometimes occur for reasons which to the bystander seem frivolous, or even irrelevant to collective bargaining within the industry.

As to strikes arising in the course of negotiation for a new contract, the Industrial Disputes Investigation Act, in some cases provincial legislation, and the Wartime Labour Relations Regulations, preserved the legal right to strike but postponed its exercise until an attempt had been made to reach an agreement with the aid of Conciliation Officers and Boards. These measures did not always prevent such strikes. There is much to suggest that, so far as they rely chiefly on mere delay and the influence of public opinion, such measures are inadequate deterrents, particularly where the financial reserves of both parties are considerable. Since such legislation does not apply to coal mining alone, and since it is presently the subject of Dominion-Provincial negotiations, the Commission does not think it appropriate to comment further.

Compulsory arbitration is sometimes suggested as a method for eliminating or dealing with strikes. Wartime experience in coal mining indicates the difficulty of enforcing arbitration of general disputes even in times of national emergency. A case in point is the acceptance by the Dominion Government of the recommendations of the O'Connor Commission permitting a wage increase in District 18 arising out of strike action in 1943 without fulfilling the legal requirements of the Regional and National War Labour Boards. The success of this strike action is only one illustration of the difficulty of attempting to apply compulsory arbitration.

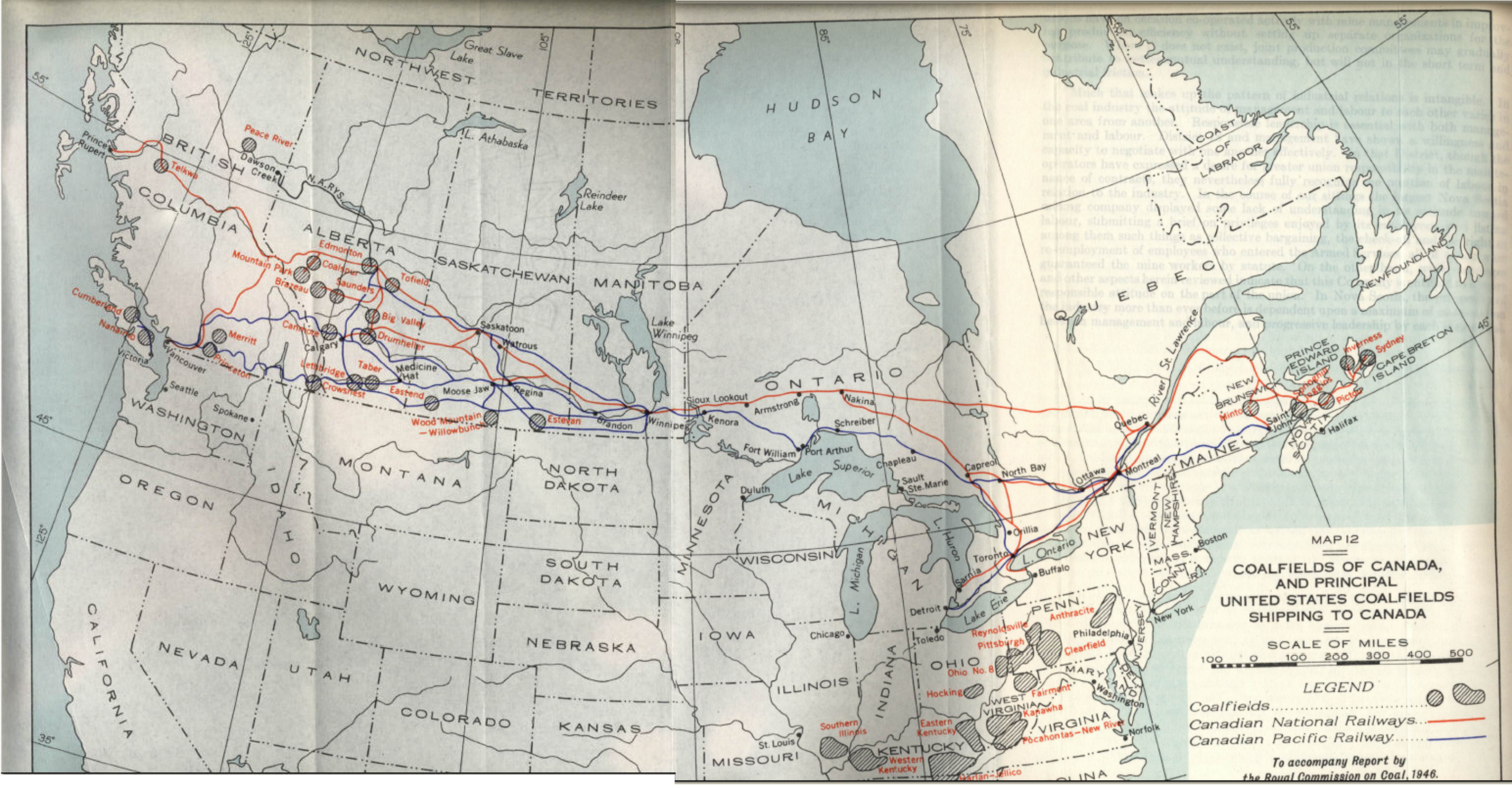
It has also been suggested that strikes can be done away with by legislation prohibiting them and providing sufficiently stiff penalties to make the prohibition effective. The House of Commons Standing Committee on Industrial Relations, in its recent report on industrial unrest in Canada, did not endorse this suggestion.

An approach to the problem of unauthorized local stoppages in breach of contract which is also frequently suggested is that the union in its own interests take whatever steps are necessary to strengthen its internal discipline sufficiently to minimize unauthorized stoppages. District 26 argues that this can not be done until the union can, by expelling an offender from the union, deprive him of his job. This is a principal reason advanced by District 26 for an agreement by which all employees of operators having contracts with the U.M.W.A. who were eligible for membership in the U.M.W.A. would be required to join that union. The operators oppose this request on the grounds that such a provision is an unjustifiable infringement of the liberty of the individual, and also point out that the union does not use all means now at its disposal for maintenance of discipline among its members. In District 18 such a provision is in effect but local stoppages in breach of contract still occur.

The attention of the Commission on several occasions was directed to joint production committees representative of men and management. Such joint committees, under various plans of organization and frequently under government sponsorship, have from time to time operated in many industries and in many countries. There was a considerable development of them, with varying degrees of success, in Canada during the war years; a number of coal mine operators in both eastern and western Canada participated in this form of industrial co-operation with their employees. The success of such committees is dependent upon the personalities of the men involved, and the good faith of men and management alike. It is too much to expect that joint production committees will function satisfactorily unless the atmosphere is such that collective bargaining functions smoothly. Where such an atmosphere does exist,

unions have on occasion co-operated actively with mine managements in improving production efficiency without setting up separate organizations for the purpose. Where it does not exist, joint production committees may gradually contribute to better mutual understanding, but will not in the short term end industrial friction.

Much that makes up the pattern of industrial relations is intangible. In the coal industry the attitude of management and labour to each other varies in one area from another. Responsible leadership is essential with both management and labour. District 18 and management have shown a willingness and capacity to negotiate with one another effectively. In that District, though the operators have expressed a desire for greater union responsibility in the maintenance of contracts, they nevertheless fully recognize the position of labour in relation to the industry. In the course of our sittings the largest Nova Scotia mining company displayed some lack of understanding in its attitude toward labour, submitting a brief on privileges enjoyed by its employees, and listing among them such things as collective bargaining, the check-off and the right of re-employment of employees who entered the Armed Services, all of which were guaranteed the mine workers by statute. On the other hand, work stoppages and other aspects herein reviewed indicate that this Company is entitled to a more responsible attitude on the part of the union. In Nova Scotia, the prosperity of the industry more than ever before is dependent upon a maximum of co-operation between management and labour, and progressive leadership by each is essential.


MAP 12
COALFIELDS OF CANADA, AND PRINCIPAL UNITED STATES COALFIELDS SHIPPING TO CANADA
SCALE OF MILES
100 0 100 200 300 400 500
LEGEND
Coalfields
Canadian National Railways
Canadian Pacific Railway
To accompany Report by the Royal Commission on Coal, 1946.
NORTHWEST TERRITORIES
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
HUDSON BAY
COAST OF LABRADOR
NEWFOUNDLAND
PRINCE EDWARD ISLAND
CAPE BRETON ISLAND
NOVA SCOTIA
NEW BRUNSWICK
MAINE
VERMONT
NEW HAMPSHIRE
MASS.
CONN.
R.I.
NEW YORK
PENN.
NEW JERSEY
MARYLAND
DELAWARE
VIRGINIA
WEST VIRGINIA
OHIO
KENTUCKY
INDIANA
ILLINOIS
MICHIGAN
WISCONSIN
MINNESOTA
IOWA
MISSOURI
KANSAS
NEBRASKA
SOUTH DAKOTA
NORTH DAKOTA
MONTANA
WYOMING
COLORADO
UTAH
NEVADA
CALIFORNIA
OREGON
WASHINGTON
Great Slave Lake
L. Athabaska
Reindeer Lake
Lake Winnipeg
Lake Superior
L. Michigan
L. Huron
L. Erie
L. Ontario
Peace River
Dawson Creek
N.A.R.Y.S.
Prince Rupert
Telkwa
Edmonton
Coalspur
Mountain Park
Brazeau
Saunders
Tofield
Cumberland
Nanaimo
Victoria
Vancouver
Merritt
Princeton
Seattle
Spokane
Calgary
Canmore
Big Valley
Drumheller
Lethbridge
Taber
Medicine Hat
Crowsnest
Eastend
Wood Mountain – Willowbunch
Saskatoon
Watrous
Moose Jaw
Regina
Estevan
Brandon
Winnipeg
Sioux Lookout
Armstrong
Nakina
Kenora
Schreiber
Fort William
Port Arthur
Duluth
Chapleau
Sault Ste. Marie
Capreol
North Bay
Ottawa
Montreal
Quebec
St. Lawrence River
Inverness
Sydney
Pictou
Minto
Saint John
Halifax
Orillia
Toronto
Sarnia
Buffalo
Detroit
Toledo
Chicago
New York
Boston
Philadelphia
Reynoldsville
Pittsburgh
Anthracite
Clearfield
Ohio No. 8
Hocking
Fairmont
Kanawha
Pocahontas – New River
Washington
Norfolk
Southern Illinois
Eastern Kentucky
Western Kentucky
Harlan – Jellico
St. Louis

CHAPTER VI

TRANSPORTATION

This chapter treats with the transportation of coal and coke, both by rail and water. In Canada transportation costs constitute a substantial proportion of the total cost of coal and coke to most consumers. Particulars relating to some important rates have been collected, and comparisons are made between coal rates in Canada and the United States, and between coal rates and rates applicable to other commodities in Canada. This study has been made to assist us to decide whether subventions could be abandoned and Canadian coal enabled to find a market solely by a reduction in transportation charges. While this report is being written the Canadian railways have applied for a general increase in freight rates*. The Commission has attempted to deal factually with present freight rates, but has restricted itself to a limited comparison within the present structure. No attempt has been made to analyse completely the Canadian railway rate structure.

THE FLOW OF COAL TRAFFIC IN CANADA

The channels by which coal used in Canada moves in normal times will be briefly described, using the movement in 1939, a year when the flow of coal was not materially affected by wartime disruptions of trade and transportation. Some of the changes brought about by the war which seem likely to persist into the postwar period for several years, at least, are also mentioned. In this connection attention is directed to an accompanying map.

As a general background for a description of the traffic flow, the production and volume of coal available for consumption are shown below for the years 1939 and 1944, by provinces. The figures of coal available given for certain provinces are not exact, mainly because locomotive fuel delivered to railways by mines in any province is shown as available in that province rather than at the point where the coal is actually used. The chief effect of this is to inflate the figures for coal available in Alberta while showing less than the actual coal available in Saskatchewan and Manitoba.

	1939				1944			
	Production		Available for Consumption		Production		Available for Consumption	
	Million Net Tons	Per cent of Total	Million Net Tons	Per cent of Total	Million Net Tons	Per cent of Total	Million Net Tons	Per cent of Total
Prince Edward Island	0.0	0.0	0.1	0.4	0.0	0·0	0.2	0.4
Nova Scotia	7.0	23.8	2.9	9.8	5.8	12.5	3.7	8.3
New Brunswick	0.5	1.6	1.0	3.4	0.3	0.7	1.5	3.4
Quebec	0.0	0.0	5.1	17.6	0.0	0.0	8.0	17.9
Ontario	0.0	0.0	11.5	38.9	0.0	0.0	21.0	46.8
Manitoba	0.0	0.0	1.7	6.0	0.0	0.0	1.4	3.1
Saskatchewan	1.0	3.3	1.5	5.3	1.4	2.9	1.9	4.1
Alberta	5.5	18.7	3.7	12.8	7.4	16.2	5.0	11.2
British Columbia	1.7	5.7	1.7	5.8	2.1	4.7	2.2	4.8
Total	15.7	53.1	29.2	100.0	17.0	37.0	44.9	100.0
Imported from Great Britain	1.1	3.7	.....	.....	0.2	0.5	.....	.....
Imported from U.S.A.	12.5	42.1	.....	.....	28.7	62.5	.....	.....
Imported from other countries	0.3	1.1	.....	.....	0.0	0.0	.....	.....
Total imports	13.9	46.9			28.9	63.0		
GRAND TOTAL (including exports)	29.6	100.0			45.9	100.0		
Exports	0.4	.....	.....	.....	1.0	.....	.....	.....

*In the case of coal and coke the increases proposed are 20 cents per ton for rates $1.00 per ton and less, 30 cents for rates from $1.01 to $1.50, and 40 cents for rates over $1.50 per ton.

74634—22

While these statistics do not illustrate the entire movement of coal since interprovincial movements of coal are not clearly shown, they indicate the dependency of Canada on transportation for the provision of coal-generated heat and power. The most significant wartime shifts are, of course, the very large increases in consumption, especially in Ontario and Quebec, increased production in the western provinces, reduced output in the Maritimes, the great reduction in overseas imports and the large increase in imports from the United States.

There follows a description of the transportation methods and routes, dealing individually with the movements from the various producing provinces, and from the different sources of imported coal.

From Nova Scotia

Nova Scotia's output in 1939 was 7,051,000 tons, of which 6,364,000 tons was available for shipment. The channels by which this coal reached its markets are the most varied of any producing fields in Canada.

All the fields are reached by railways. Some mines are served by lines owned by the coal producers, notably the Sydney & Louisburg Railway, a subsidiary of Dominion Coal Company, which connects with the Canadian National Railways at Sydney. Coal is shipped by rail in normal times to destinations throughout Nova Scotia and New Brunswick, to Prince Edward Island over the car-ferry and, to a limited extent, to points in Quebec and Eastern Ontario, the latter movements being assisted by subventions. The westward movement of Nova Scotia coal by rail is limited slightly by competition of New Brunswick coal, partly by competition from United States sources, and partly by the lower cost of moving Nova Scotia coals by water-and-rail to many destinations in Quebec.

Water transportation enables Nova Scotia producers to market their coal beyond the Maritimes, and also to some extent in the Maritime Provinces themselves. All of the coal production of the province is within a short distance of tidewater, with railway connections from the mines to leading piers at the ports, the most important being at Sydney and North Sydney on Cape Breton Island and Pictou on the mainland. More than half the province's coal shipments normally move by water. A substantial tonnage is shipped to Halifax, Liverpool and other Nova Scotia ports and to New Brunswick ports, especially Saint John. In some years Nova Scotia producers have exported as much as 350,000 tons to Newfoundland.

The St. Lawrence River is the artery which permits Nova Scotia coal to reach the large consuming areas of Quebec and Ontario. Up this river in 1939 moved nearly three million tons of Nova Scotia coal, about 45 per cent of the total Nova Scotia output. Montreal, Quebec and Three Rivers are the principal destinations for the large colliers used in the trade, but other ports also receive some tonnage. A considerable part of the tonnage received at the river ports is consumed in the port areas or distributed for relatively short distances by truck. Some coal is transferred to barges for delivery in the harbour area of Montreal.

The Lachine Rapids just west of Montreal, and the Lachine Canal accommodating only vessels of draft not exceeding 14 feet, form a boundary beyond which the large colliers cannot move. Some tonnage is moved from Nova Scotia in small vessels which can use the canal. Transfer of lading from the large vessels to canalers, either direct or more generally by loading to the docks and thence reloading from the docks to the canal-size ships, is required. More than a half million tons was so handled in 1939, assisted by subvention payments. The bulk of the tonnage moved to ports on Lake Ontario and on the Upper

St. Lawrence River, but there were movements to destinations such as Port Colborne on Lake Erie, Windsor on the Detroit River, and Midland and Little Current on Georgian Bay. Less than half of the coal so moved was consumed at the lake ports themselves. About 300,000 tons was shipped inland by rail to such destinations as Kitchener, Peterborough and Clarabelle.

In addition to the water movement west from Montreal, there is a substantial movement by rail inland from St. Lawrence River ports, not only from Montreal but also from Quebec and Three Rivers, tonnage from the latter port being shipped principally to destinations on the Murray Bay line and to Donnacona and Shawinigan Falls. Rail movement from Montreal in 1939 amounted to over 400,000 tons, the destinations including Thetford Mines, Noranda and Sherbrooke in Quebec and points in Ontario such as Ottawa, Cochrane and Clarabelle.

These combinations of water and railway transportation enabled Nova Scotia coals, with subvention assistance, to move to Ontario destinations more than 1,100 airline miles west of Sydney, the distances by the actual routes of movement being very considerably greater.

From New Brunswick

From a transportation standpoint, the distribution of New Brunswick coal is relatively simple. The total production in 1939 was 468,000 tons, of which 462,000 tons was available for shipment from the mines. Approximately 179,000 tons was sold to the railways and consumed principally in the province itself. The New Brunswick industrial market received about 45 per cent of the shipments, the principal destinations being Dalhousie, Bathurst, Edmunston and the power plant at Grand Lake. About 25,000 tons was shipped by rail to points in the adjoining State of Maine, slightly under 50,000 tons by rail to destinations in Quebec, principally in the Eastern Townships, and very small quantities to Prince Edward Island, Nova Scotia and Ontario. The Minto field has no convenient access to water transportation and the movement by truck is limited.

From Saskatchewan

Saskatchewan's coal shipments move to market wholly by railway, except for some tonnage moved by truck to points in proximity to the mines. Of 960,000 tons produced in 1939, approximately 904,000 tons was marketed, of which one-half was shipped to Manitoba points, 48 per cent to Saskatchewan destinations and the balance of about 16,000 tons to Ontario. The distribution is limited to points east of Moose Jaw. Winnipeg is an important market, the coal being used largely for industrial purposes. The Province's coal is not used for locomotive fuel, but substantial quantities are used by the railways in stationary heating plants. During the war, shipments of Saskatchewan coal increased to about 1,600,000 tons in 1943 and 1,300,000 tons in 1944, but there was no significant change in the distribution pattern.

From Alberta

The Province of Alberta presents many variations in the flow of coal traffic. The coals are technically classified as bituminous and sub-bituminous, and are popularly known as "steam" and "domestic". Some sub-bituminous coal, especially in the smaller sizes, is marketed for steam purposes, but generally speaking, the "steam" coal is bituminous, while the most of the "domestic" coal is sub-bituminous. Dealing first with bituminous coal, the production of which

amounted to about 3.4 million tons in 1939, the market is largely the railways, nearly 70 per cent of the production being sold for locomotive use throughout the Prairies and in Ontario. The balance is marketed for industrial and domestic purposes in British Columbia, the Prairie Provinces and the westernmost part of Ontario, with a small tonnage exported to the northwestern United States. Shipments of sub-bituminous coal in 1939 were about 2 million tons. Most of this coal was marketed in the Prairie Provinces for domestic use, while the movement to Ontario, aided by subventions, amounted to about 90,000 tons. The latter movement was somewhat larger during 1941 and 1942, due in part to conditions of short supply in the central provinces. In addition to the large domestic market on the Prairies, "domestic" coals move in sizeable volume to British Columbia points as far west as Vancouver, principally from the Drumheller, Lethbridge and Coalspur districts. The transportation of Alberta coals is largely by the railways, with trucks a factor in some localities.

From British Columbia

Coal is produced in British Columbia from three widely separated groups of mines. From a tonnage standpoint the Crowsnest Pass district is now the most important. Its production almost doubled between 1939 and 1944, while that of the Inland and Island districts declined. The latter coals are limited to markets in and west of the Rocky Mountains, where they encounter strong competition from competitive fuels, whereas the Crowsnest coal moves not only to British Columbia points as far west as Vancouver, but also to destinations as far east as northern Ontario. A substantial share of the Crowsnest coal is used by the railways as locomotive fuel. Crowsnest coal has had a market in the Spokane area and northern Idaho for many years, this outlet absorbing about 170,000 tons of coal in 1944. The entire distribution of Crowsnest and Inland District coals is by rail. The Vancouver Island coals have access to both rail transport for distribution on the island, and also to water transportation for delivery on the mainland of British Columbia and in the Puget Sound area in the United States.

From Great Britain

Of the 1,100,000 tons of British coal made available for consumption in Canada in 1939, about 94 per cent was anthracite. Almost three-quarters of the anthracite was received at Montreal, with substantial quantities also being unloaded at Halifax, Saint John, Quebec and Toronto. Comparatively little British coal was handled inland by rail, the bulk of the imports being consumed in the port areas, or shipped inland by truck. In addition to the tonnage received direct at Toronto, about 340,000 tons was transhipped from Montreal to Ontario points. Bituminous coal, totalling only about 67,000 tons, was received at Halifax, Saint John and Montreal.

From the United States

In the 35 years, 1910–1944, the smallest tonnage imported from the United States in any one year was just under 9,000,000 tons. Prior to World War II, the largest years for imports across the border were 1918 with about 21.7 million tons and 1923 with 20.4 million. In 1939, imports from the United States amounted to about 12.5 million, and in 1944 to about 28.7 million tons.

Anthracite imports grew from 2.6 million tons in 1939 to 4.2 million tons in 1944. The distribution of Pennsylvania anthracite by receiving areas in 1939 and 1944 was as follows:

	1939		1944	
	Thousand Net Tons	Per cent of Total	Thousand Net Tons	Per cent of Total
Maritime Provinces	51.4	2.0	86.2	2.1
Quebec	596.6	22.9	1,573.4	37.5
Ontario	1,953.1	75.0	2,518.3	60.0
Manitoba	4.7	0.1	16.8	0.4
Prairie Provinces and British Columbia	.....	.....	.....	.....
Total	2,605.8	100.0	4,194.7	100.0

As shown, the consumption of United States anthracite is largely concentrated in Ontario and Quebec. The bulk of this tonnage reaches Canada by all-rail routes, principally through Buffalo, the car ferries across Lake Ontario to Cobourg, Ont., and across the St. Lawrence River to Prescott, Ont., and through the Adirondack Gateways, such as Rouses Point, Huntingdon and Massena, N.Y. This is a rather steady year-round movement, since the coal stocks well. In addition, in 1939 there was a movement by rail-and-lake through the ports of Sodus Point and Oswego, N.Y., on Lake Ontario, amounting to 290,000 tons, and through ports on Lake Erie amounting to 31,000 tons. About 85 per cent of the anthracite imported from the United States is in the larger sizes for use in hand-fired furnaces, and as size degradation is an important factor, all-rail movement is the preferred transportation method.

Bituminous coal imported from the United States was as follows:

	1939		1944	
	Thousand Net Tons	Per cent of Total	Thousand Net Tons	Per cent of Total
Nova Scotia and Prince Edward Island	2.9	.....	89.6	0.4
New Brunswick	13.9	0.1	40.5	0.2
Quebec	1,105.6	11.2	5,878.5	24.0
Central Ontario	8,035.2	81.7	15,654.6	63.8
Manitoba and Head of Lakes	674.8	6.9	2,847.6	11.6
Prairie Provinces and British Columbia	3.7	0.1	2.7	.....
Total	9,836.1	100.0	24,513.5	100.0

The transportation of this tonnage employs a variety of agencies and facilities which together form a co-ordinated transportation and distribution system. All this tonnage is moved initially from the mines by railroad, either to the Great Lakes ports, to the junctions between Canadian and United States rail carriers, or in the case of a relatively small tonnage, to trans-shipping ports on the Atlantic seaboard. The lakes are closed for navigation during the winter months, so the lake movement must be concentrated into a part of the year, and facilities provided for storage on the docks or at the final destination. Railroads serving a number of the ports on Lake Ontario and Lake Erie operate dumpers for transferring coal from cars to vessels and track storage facilities for assembling cargoes at the ports. The same railroad facilities are, of course, used for coal moving to both Canadian and United States ports; of the coal moved by lake, about 20 per cent in 1939 and 28 per cent in 1944 was for Canada. There is a

rail-to-vessel coal transfer facility at Chicago, which is not railroad-owned, and which since 1941 has handled a substantial tonnage of lake coal originating in Illinois, Indiana and western Kentucky and moving to upper lake ports in Canada.

Lake coal moving to Canada originates principally in Pennsylvania, Ohio, West Virginia and Kentucky. The distance by railroad from the several districts to the lake ports varies from about 100 miles to over 400 miles. The major part of the lake coal for Canada is shipped from the adjacent fields of Pennsylvania, Ohio and northern West Virginia. Vessels used for the water-movement include large bulk-cargo steamers which handle most of the tonnage moving to destinations north of Sarnia, as well as to some of the lower-lake ports, self-unloaders equipped with conveyers and booms for unloading coal onto the docks, and canalers for movement through the St. Lawrence River canals. The bulk-cargo steamships handle coal up the lakes and ore and grain in the reverse direction. There is also some reverse movement in the canal-size steamers, including coal moving from Nova Scotia or overseas origins to ports on the Great Lakes.

The principal receiving ports for lake cargo coal in 1939 were Toronto and Hamilton with over one million tons each, Sault Ste. Marie, Fort William, Montreal, Kingston, Prescott and ports on Georgian Bay and Lake Erie. During the war years there have been substantial increases in the tonnage moved to Lake Ontario and St. Lawrence River ports, partly to replace Nova Scotia coals and partly as a result of increased consumption. There have also been increases in the movement to Upper Lake ports as a result of increased consumption and the withdrawal of western Canadian coals from that territory after 1942.

The port cities themselves consume most of the coal received by lake, but there are also important movements of coal inland. Coal is trucked in quite substantial volume from some docks to destinations close to the ports, and in some cases the truck movement may be for distances as great as 60 miles or more. The railways handle an appreciable volume of coal from the ports for varying distances.

The movement of imported bituminous coal via all-rail routes is smaller than that via the lakes, but it is still of importance. This coal originates in the same general areas as the lake coal, and moves through the gateways at Windsor, the Niagara Frontier, and the Adirondack junctions, as well as over the car ferries to Cobourg, Port Burwell and Prescott, forming one of the major commodities interchanged from United States railroads to Canadian railways at these junctions. The all-rail movement is less seasonal in its flow, and to a considerable extent the coal so moved is in prepared sizes which are subject to degradation when handled by boat. Coal shipped by all-rail routes at one time formed the larger percentage of Canadian imports from the United States, and the volume increased considerably during the recent war, but the lake routes will continue in the future to be the principal channel for bituminous coal received from the United States.

MECHANICS OF TRANSPORTATION BY RAIL

Canadian railways span the continent with two, and in some sections, three main lines. Unlike the truck, or the aeroplane or the steamship, the railway is not basically arranged as a point-to-point agency of transportation, even though it will receive a car of coal at a given mine and transport it to a given consumer many miles away. The distinguishing feature of railway operation as contrasted with other forms of transportation is that the car of coal is joined with many other cars of various commodities at receiving or marshalling yards so as to constitute a tonnage train[1] for the distance through which the car moves.

[1] This is a train which includes the maximum number of gross tons (lading plus equipment) which a given locomotive can pull over the ruling grade of the route to the next terminal. A ruling grade is a sustained uniform slope whose gradient or degree of steepness determines the tonnage or number of cars a locomotive can handle over a given portion of a railway.

The combining of all such single cars or groups of cars originating at many points into a full train for movement over the main lines requires the use of engines and crews to collect the cars from loading points and move them into yards. At the yards the cars are sorted into blocks or groups according to general destination areas. These blocks of cars are then built up into trains scheduled for movement into various districts or terminal areas. For example, a train may be assembled at Winnipeg with cars destined for Toronto, London and Windsor, and perhaps points intermediate between Winnipeg and the Toronto-Windsor area. Another group of cars may be assembled on an adjoining track at Winnipeg to make up another train for destinations between Ottawa and Quebec. The essential feature in the development of these two trains is that they shall have sufficient gross tonnage to utilize fully the power and speed of the locomotive which are to haul them. The tonnage that a locomotive can handle over a given route depends upon the capacity of the locomotive, the grade of the track, the sharpness of curves, the number of cars in the train, weather conditions, and finally, the operating practices used to assist the train over steep grades.

The mechanics of transporting freight by railway divide roughly into "yard operation" and "road operation". The criterion of efficient yard operation is the rapid assembly and weighing of cars and dispatching of trains. Any delay in these operations, such as waiting for the receipt of sufficient loaded cars to make up a tonnage train for a given general destination, has the effect of delaying all cars thus far received for that train, with a consequent reduction of car utilization, that is, ton-miles per car per day. The measure of efficiency in road operation is the ton-miles accumulated per locomotive-day. If a locomotive does not have a full train, it is not being fully utilized. Any inefficiency in yard and road operations has the effect of requiring more trains to move the same volume of freight. In congested parts of the railway, this is a vital factor as the main tracks have a capacity for handling just so many trains per unit of time.

Frequently it is necessary, for lack of sufficient tonnage in a given direction, to dispatch a train with less than its full capacity. The inefficiency inherent in such procedure is minimized in actual practice by adding a block of cars to that train at the first opportunity. This may be, and frequently is, accomplished without "yarding" the train at the intermediate terminal or pick-up point. The train involved pulls in on a designated track, the pre-assembled block of additional cars is attached, and the train proceeds with a minimum loss of time.

In mountainous country, maximum utilization of locomotives is effected where feasible by temporarily adding power (locomotive) to the head or rear of the train, when a succession of long steep grades is encountered. The alternative is to reduce the tonnage in the train by setting off a number of cars. Thus, by dispatching cars in full tonnage trains from a terminal, adding or subtracting blocks of cars, adding or subtracting power, and sometimes by doubling on hills, a maximum weight of lading and cars is moved at the highest practicable speeds, and with the minimum use of equipment. This is the essence of efficient railway operation. Any temporary condition, or special transportation necessity, which involves deviating from these practices is attended with additional costs.

Train-Load Operation

The above description of basic railway operating practices has been given in some detail in order that the reader may understand the factors that would be involved in the handling of "train-lot" movements of a given commodity. Suggestions have been made to this Commission that the railways might be able to transport coal from the Alberta mines to points in Ontario in solid trains at substantially lower costs to the railways, who could then offer to the shipper train-lot rates lower than the prevailing car load rates.

Trainload movements are to be found everywhere on this continent. In Canada a familiar example is the movement of grain. In the United States perhaps the most outstanding examples of train load movements are those of coal and iron ore, which will be shortly discussed. Train load rates as such are limited to a few exceptional cases in the United States, the most notable being the movement of molasses from New Orleans to Peoria, and the movement of coal from Arkansas and Oklahoma to St. Louis, but even these exceptional examples are, strictly speaking, not rates for trains carrying the designated commodity exclusively.

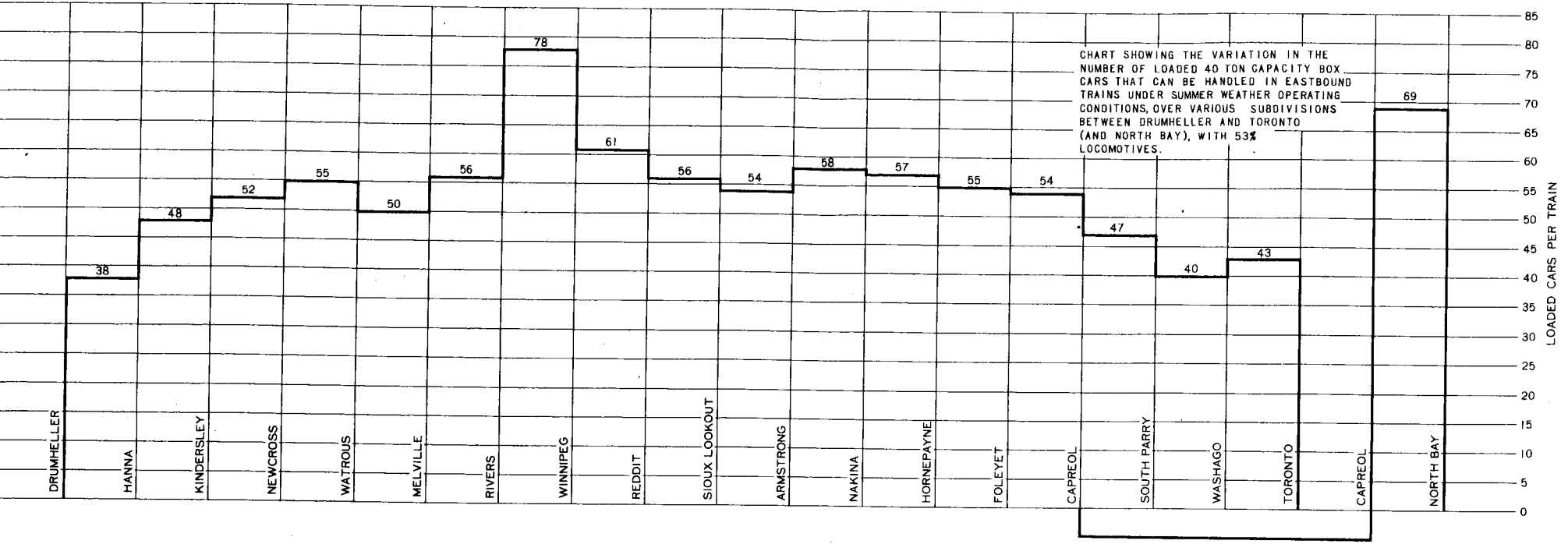
Many examples might be cited in which coal and iron ore are moved in solid trainloads in the United States. Practically all of the ore movements are from one point of origin (an ore-mine or lake dock) to a single destination (a lake port or a steel mill), and many of the solid coal trains originate at one or a very few mines and terminate at a single lake dock or perhaps at a coke plant. The volume of tonnage in some cases is so large that one day's shipments may make up not one but several trainloads per day. None of these examples constitutes trainloads moving on train-lot rates as such. The movement is handled in solid trainloads, because a full tonnage train is the efficient method of transporting freight by rail. To the extent that the volume of traffic provides such transportation advantages, the cost per ton-mile of performing this service is lower than for handling small or scattered shipments. Many coal rates in the United States are at a low level because the total movements for which they apply are so large as to provide one or more trainloads a day. These rates are not published as trainload rates as such, and the small shipper moving only one or two cars gets the benefit.

There are a number of factors that must be given consideration when determining the feasibility of solid-train movements at a solid-train rate from Alberta mines to destinations in Ontario. In the first place it would be necessary at any mining point to build up a train-lot which would involve holding cars in an assembly yard, generally for several days. At the same time coal destined to points in Saskatchewan and Manitoba would have to be shipped in the ordinary way. It would be necessary to separate cars for these points from the cars grouped in the train-lot movement; this in itself would delay dispatch of cars and increase switching costs. Furthermore, segregation of a solid train would probably result in more other trains operating without a full load, or would result in delay while cars for full trains were accumulated. There is a further vital factor; through the relatively level parts of the prairie long heavy trains can be handled, but in other divisions the conditions are such that the trains must be shorter. The accompanying charts show the maximum number of loaded cars that can be handled as a train over the various sub-divisions of the Canadian National and Canadian Pacific Railways between Drumheller and North Bay. By reference to these charts it will be observed that the capacity varies considerably in the different sub-divisions and, taking the Canadian Pacific as an example, it would appear that a train of 47 cars could be handled for the first sub-division out of Drumheller, but by the time the train reached the Fort William-Schreiber sub-division it would have to be reduced to 26 cars, while intervening sub-divisions can take trains of 70 cars or more. It is not necessary to review the situation for the Canadian National Railways. In short, under efficient railway operation, no solid train leaving Drumheller would maintain its identity en route to North Bay in Ontario.

COST OF TRANSPORTATION BY RAIL

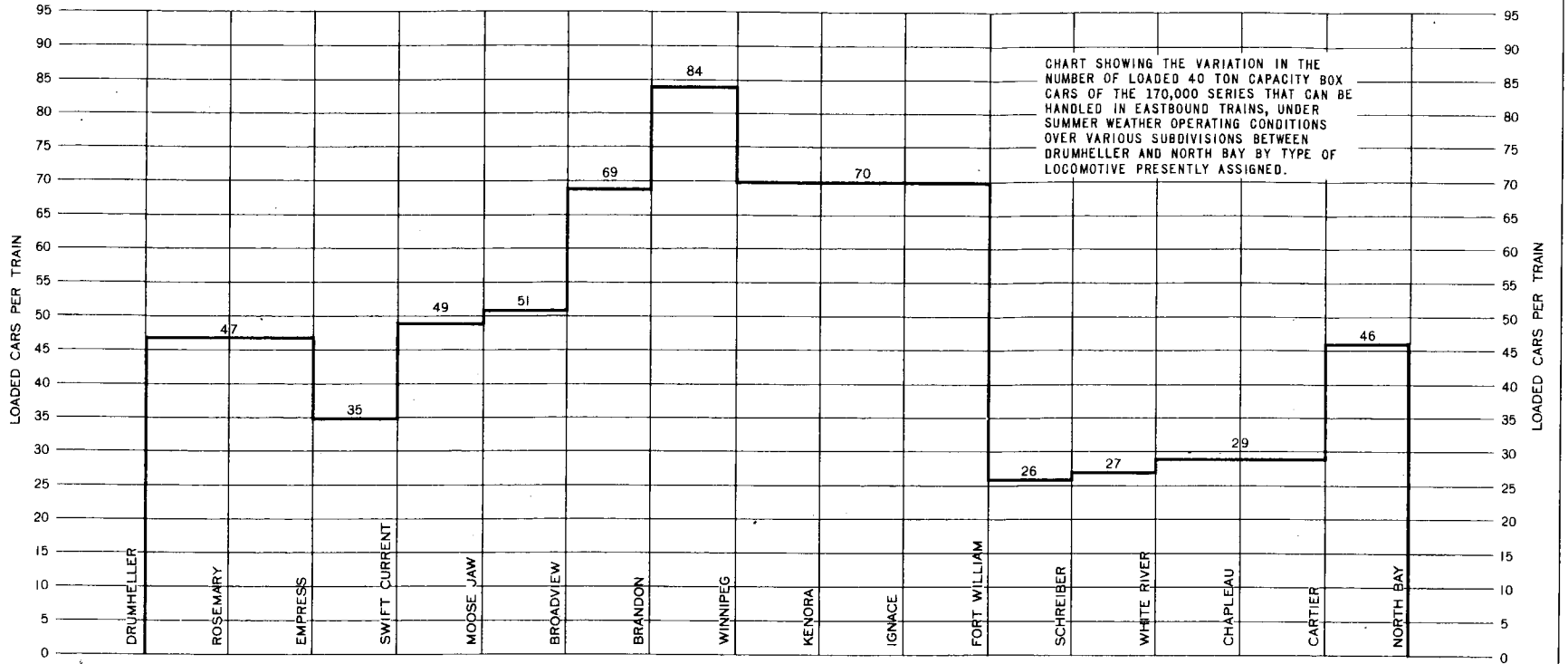
The cost of transporting a given commodity by rail is not susceptible of more than an approximate determination under ordinary railway operating conditions. Only in the case of a railway which handles nothing but coal can the costs per ton-mile for that commodity be ascertained. The first difficulty in

CANADIAN NATIONAL RAILWAYS
MAXIMUM EASTWARD TRAIN-LOAD



To accompany Report by the Royal Commission on Coal, 1946.

CANADIAN PACIFIC RAILWAY
MAXIMUM EASTWARD TRAIN-LOAD



To accompany Report by the Royal Commission on Coal, 1946.

estimating the cost of transporting coal is in separating the expenses applicable to all the other commodities transported. It is obvious that expenses involved in collecting a carload of less than carload freight, moving it to a destination and delivering its lading to a number of receivers, are much greater than in receiving, transporting and delivering a car of coal. But both loaded cars move over the same tracks, may be billed by the same agent, and must share general administrative expenses. It is evident that the separation or allocation of expenses as between cars of various commodities is not subject to determination by any mathematical formula. More difficult problems arise in any attempt to ascertain costs of handling the same commodity under the variable conditions that obtain on different railways, and on different portions of the same railways, and on the same portions at different seasons. If there is a movement of coal involving 100 cars per day over a 200-mile route between two points, the cost of handling this traffic per ton-mile is obviously much less than on some other railroad, of comparable physical layout, where only 20 or 30 cars are handled per day.

Where a railway is located in a highly industrialized area, or where there is a steady and heavy flow of traffic, it will generally prosper. These conditions enable the carrier to purchase modern cars and locomotives, to improve its right-of-way, and to provide effective automatic signalling systems, thereby making possible heavy tonnage trains and high speed operation. The cost of transporting the average ton of freight one mile on such railways is at a minimum. Other railways, less fortunately situated, are obliged to survive on a smaller volume of traffic thinly spread over longer distances. The cost per ton-mile on such lines is likely to be greater than on railways more favourably situated. It is therefore evident that the ton-mile costs on a given railway cannot necessarily be used to determine the ton-mile costs on another railway.

A substantial part of Canada's coal is produced in part of the grain-growing area of western Canada. The consequence of this geographic relationship is that the eastward movement of loaded cars greatly exceeds the westward movement throughout the Prairie Provinces and the northwestern part of Ontario. The westward movement of manufactured products and other items consumed in the western provinces is small compared with the tonnage of coal, agricultural and forest products moving eastward. It is evident that such an unbalanced movement, with its inevitably high empty car mileage, is more costly than if the number of loaded cars was more nearly equal in both directions.

East of Winnipeg there are many miles in the Province of Ontario where, aside from trans-lake business, railway traffic is neither produced nor delivered in any appreciable volume. This is virtually barren land from the railroad traffic viewpoint. While such areas exist in the United States, they are not so extensive, and represent a lower percentage of the total territory served by the United States railroads.

RAILWAY FREIGHT RATES—GENERAL

The cost of coal to the consumer is made up of the price paid to the mines for producing it, the price paid to the transportation agencies for moving it to him, and the price paid for marketing or distribution. This section of the report deals with the price of transportation, that is, the freight rates. Particular attention will be directed to the railway rates, because virtually all of the coal consumed in Canada requires rail transportation during part or all of its journey to market. Water transportation enters into the movement of a substantial portion of the coal consumed, and separate attention will, therefore, be given to boat rates.

The general term freight rate embraces the various tolls or charges assessed by carriers for the transportation of freight, and for the miscellaneous services incidental to such movement. Class rates apply generally, in the absence of

any lower basis of rates, on freight of all kinds and between any two points in a wide area. In Canada, all freight is classified into one of ten groups or classes (coal being in the tenth or lowest class) according to certain transportation characteristics, and tariffs provide for rates between any two points in Canada on each of the ten classes, decreasing in level from first class down to tenth class. Among the factors determining the particular classification to which a commodity is assigned are the quantity shipped, the size, weight, fragility, value, shipping characteristics and so on. Only a very small percentage of the railway traffic of North America moves on class rates. Commodity rates are published on specific commodities either from specified origins to specified destinations, or for hauls of various lengths, are on a lower level than the classification rate on the same commodity, and supersede the class rate which would otherwise apply. Specific rates are published by the railways to cover every normal movement of coal and coke in Canada and the United States, and since these rates are substantially lower than the class rates, the classification basis has no real application on coal and coke traffic on this continent.

Class or commodity rates may be local rates between two stations on the line of a single railway, joint rates applicable over the lines of two or more carriers, or proportional rates applicable over the line of one or more railways to or from a junction point or port when the traffic does not either terminate or originate at the junction or port. Specific examples of proportional rates on coal include tidewater and lake cargo rates, applying on coal shipped from inland mines to coal dumping piers at seaboard and lake ports respectively for movement beyond the pier by water, which are lower than rates for delivery on tracks at the same ports; and ex-lake and ex-water rates which apply for rail transportation of freight beyond a port, the coal having had previous water transportation by lake or ocean. The existence of lower proportional rates side-by-side with normal rates between the same two points is based on the conception of such rates as constituting only one factor of the transportation charges covering a through movement, and the regulatory commissions have ruled that such rates may be on a lower level than the normal rate which covers the entire transportation service.

The rate from one point to another may be a through rate, applying as a single factor from origin to destination, or it may be a combination rate, that is, composed of two or more factors, applying to and from a junction point, which, when added together, make up the total freight charge. In some cases, rates are not published specifically, but in the form of mileage rates, where a table of distances is published with varying rates according to the length of the railway haul.

It is necessary for railways to transport a considerable volume of commodities, including coal, for their own use, and this transportation on company service is often designated an "O.C.S." movement. The determination of the appropriate O.C.S. rate has been necessary by the Dominion Fuel Board in the administration of transportation subventions. The Board has used an O.C.S. rate of five mills per ton-mile.

Principles of Rate Making

Railway freight rates are printed and published in freight tariffs, which are in effect the price lists of freight service. To a layman, the huge number of tariffs published by the railways, ranging in size from single sheets to large books, is bewildering. The railways of North America must provide rates to

move practically anything from anywhere to anywhere on the continent, and it is not strange that there are literally millions of freight rates published by the railways of Canada and the United States, and that the railway catalogues, or tariffs, are voluminous and complex.

Some of the basic principles or considerations which appear to influence the determination of freight rates are:

(1) Conformity to the existing rate structure,
(2) Cost of the service to the carrier,
(3) Value of the service to the shipper,
(4) Value of the article,
(5) Nature and quantity of the article,
(6) Competition between carriers, and between producing centres or markets.

(1) Conformity to the Existing Rate Structure

There now exists a structure or pattern of railway freight rates which has evolved over a period of time, modified by the constantly changing forces of commercial needs, competitive conditions and the orders of regulatory bodies. When a railway is called on to establish a new rate, or to change the level of an existing one, such changes have to be made in relation to the existing pattern. Fitting the new rate into the present structure is an important consideration weighed by the railways, because the interests of other shippers may be adversely affected by a drastic departure from the prevailing rate levels and relationships. For example, if a new factory should be established in a particular town, the needs of such a factory might require the creation of special rates to handle the inbound raw materials for the plant and the outbound shipments of the product. If such rates were established without consideration being given to the inbound and outbound rates available to similar factories at other points, the result might well be rates so high as to prevent the new factory from competing with the other plants, or on the other hand so low as to put the other factories out of business. Changes are constantly being made in rates, and the structure itself modified to meet new conditions, but the influence of existing rates on proposed new rates is very strong.

(2) Cost of the Service to the Carrier

While the impracticability of measuring the exact cost of moving a particular article from one place to another by railway has already been discussed, cost of service does enter into the making of rates. Unless the total revenue derived from the transportation services as a whole covers the total cost of performing such services over a number of years railways go bankrupt. This condition affects the general level of rates.

Recognition of the cost-of-service element also determines other features of the freight rate structure. The practice of publishing lower rates for shorter hauls than for longer hauls is, of course, a reflection of differences in the cost of performing the services. The provision of lower rates, per hundred pounds of weight, for carload movement than for less-car-load (L.C.L.) movement of the same commodity between the same points is another. The necessity of providing special types of cars, or special services such as heating or refrigeration for handling certain commodities results in higher rates on these commodities than on others not requiring such services. The prospects of cars being returned empty or loaded may influence the level of the rate published for the loaded movement, and this is a cost element.

While it is not possible to determine accurately all the costs of moving a particular piece of traffic, certain parts of such costs can be measured, and railways do not establish rates below a level which will pay at least these costs. The average earnings of the railroads of North America on their freight traffic as a whole vary from year to year and from railroad to railroad, but are in the neighbourhood of one cent per ton per mile. This is an average, and, of course, some traffic pays more than this amount and some pays less, but in establishing or reducing a freight rate, the railways feel that traffic moved on a rate which yields very much less than this amount may be a drain on their revenues and a burden on other traffic.

Distance as an element in rate-making was touched on above, but requires some elaboration. As one of the simplest rough-and-ready measures of the cost element, it is the principal basis for many rates established by the railways or prescribed by the regulatory commissions. Such rates do not reflect a constant relationship to mileage. There are certain so-called terminal costs of starting traffic and of delivering it at destinations which do not vary greatly whether the road-haul is 10, 100 or 1,000 miles. Many general costs of railway operation do not vary with the length of haul. Since the rate charged by the railway must cover all the costs, terminal, general and line-haul, and the terminal and general costs are a larger proportion of the total costs for short hauls than for long hauls, the rate per ton-mile is invariably higher for the shorter distances than it is as the length of the haul increases. This "tapering" of rates per ton-mile becomes more gradual as the distance increases, and approaches a point where the rate increases in exact proportion to the distance.

This relationship between rates and distances makes it necessary to use caution in making comparisons between rates per ton-mile for different hauls. To draw the conclusion that one rate is on a higher level than another because it reflects greater ton-mile earnings may be erroneous if the lengths of the railway haul are different, and this error is one that is frequently made. Before leaving the subject of rates related to mileage, it is noticeable that many rates on coal on this continent, originally based on mileage, have subsequently been modified to the point where the original structure can hardly be identified. Generally speaking, however, coal rates in Canada show a closer adherence to distance than those within the United States where the multiplicity of railroad routes, competition between producers and between consumers at different points, have subordinated distance as the controlling factor in rate relationships.

(3) Value of the Service to the Shipper

In the adjustment of the relative levels of rates as between different commodities, and also to some extent in determining the actual level of rates on a particular commodity, railways have been largely influenced by the principle of value of the service to the shipper. It costs no more for a railway to move a carload of shoes from one point to another than to move a carload of hay. Based on the cost-of-service theory only, the freight rate on both should be the same. It developed early in transportation history that to provide equal rates for the two commodities did not encourage trade and commerce. The value of the service is considerably greater in the case of shoes than in the case of hay, and the freight rates applied can be and are higher. The value-of-the-service principle has worked out very well in practice and has been repeatedly recognized and approved by government regulatory bodies.

(4) Value of the Commodity

The value of the commodity, as a factor affecting the level of freight rates, is closely allied to the value of the service since, generally speaking, the higher the market value of an article, the greater the value of the transportation service. Market value can be determined much more readily than the value of the

service, and is, therefore, a convenient yardstick to use in setting the relative level of rates on different commodities. As a justification for differences in rates, it has been sanctioned by regulatory authorities.

(5) NATURE AND QUANTITY OF THE COMMODITY

Under this heading come a number of considerations, some of which involve one or more of the principles already referred to, but which have come to be generally recognized as distinct factors determining relative freight rates. For example, rates are usually lower on heavy materials than on light ones, lower on solid commodities than on liquids, lower on crude materials than on finished products, lower on commodities which do not require protection from extremes of heat or cold than on those which do, lower on shipments which are packaged so as to afford full protection from damage than on those which are not so adequately packed.

Variations in the quantities shipped are also determining factors. Rates per unit of weight are lower when commodities are shipped in carloads than when shipped in less than carload lots, as has already been mentioned. The amount of a commodity which can be loaded in a car frequently influences the rate. The volume of traffic available is a very important consideration, since railways will frequently make lower rates where a large movement is involved than where only a small tonnage is available. There are definite limitations to this practice, however, in that the regulatory laws do not permit discrimination in favour of the large shipper over the small shipper; in fact, it was this practice, carried to excess, which to a large extent led to the creation of regulatory commissions.

(6) COMPETITION

It has been said that freight rates are built on "comparison, competition and compromise". The influence of competition on the freight rate structure has been very strong, and has produced many rate relationships which seem illogical.

While government regulation has put an end to the competitive rate-cutting between railway carriers and secret rebates to shippers, there is still competition in rates between rail-carriers to the extent that between any two points one railway must maintain rates as low as another railway does if it is to participate in handling traffic between the two points. Since not all railways run parallel to each other, this frequently results in the publication of the same rate by two different routes of quite different length. There are a number of complications in adjusting rates of various railways to permit competition between them and it is not necessary to describe these more fully, except to point out that many rates via circuitous routes are lower on a ton-mile basis than they would be if not reduced to meet short-line competition; that the Board of Transport Commissioners permits the railways to meet competition by reducing rates to common points without requiring similar reductions at points served by only one railway; and that the regulatory bodies have generally ruled that it lies within the discretion of a railway whether it will or will not meet competition of other railways for any particular traffic. The existence of competition in one case and not in another, or of differences in the degree of competition in different cases, frequently results in differences in rate levels.

Competition between railways and water-carriers has affected many railway rates, and there are a great number of instances where the railways have departed from the distance principle to secure business at points where water transportation was available. Competition between railways and trucks has in recent years resulted in the reduction of many rail rates below their normal level, particularly in the case of rates for the shorter hauls.

All these competitive forces have had an influence on the general railway rate structure and the level of particular rates. Many apparently illogical rates are the result of competitive pressures, and some freight rates on coal are among them.

Government Regulation of Freight Rates

The regulatory body having jurisdiction over railways in this country is the Board of Transport Commissioners for Canada. The law which the Board administers comprised principally the Railway Act, Revised Statutes of Canada, 1927, the Transport Act of 1938, and the Maritime Freight Rates Act of 1927. Effective regulation of railways in Canada began with the passing of the Railway Act of 1903 by Parliament, creating a Board of Railway Commissioners and prescribing certain rules and standards to which railway rates and practices must conform. By the Transport Act of 1938 the name of the Board was changed to Board of Transport Commissioners. The equivalent regulatory body in the United States is the Interstate Commerce Commission, established by the Interstate Commerce Act of 1887. The railway regulatory laws of both countries were founded on laws in effect in Great Britain, and have been amended on a number of occasions as the need for changes became evident.

The primary purpose of regulation was to protect the public against unreasonable rates and practices, unjust discrimination as between shippers, between different localities, and between different commodities or types of traffic; to provide for adequate railroad service; and to ensure that all changes in rates and rules were given proper publicity and advance notice. Prior to the creation of the regulatory commissions, many abuses had developed to railroad practices which not only resulted in injustices as between different shippers but produced a chaotic situation in commerce, since rates fluctuated from day to day and no shipper knew what his rates would be at any time or what those of his competitor were or would be.

The Board of Transport Commissioners is composed of six members appointed by the Governor in Council, each for a term of ten years and eligible for reappointment. The Board is a court of record and has all the powers of a superior court as regards the attendance and examining of witnesses, the production and inspection of documents, and the enforcement of its orders. Its decisions and orders are public documents, are published in the Board's Judgments, Orders, Regulations and Rulings, and many of them are published in a series of reports cited as Canadian Railway and Transport Cases, formerly Canadian Railway Cases. The Governor in Council may either on petition or of his own motion amend or rescind any order of the Board, and any order of the Governor in Council is binding on the Board and on all parties. The right to appeal to the Governor in Council has been exercised in only a very few cases. Except for intervention by the Governor in Council, the Board's findings or determinations as to matters of fact within its jurisdiction are final. Its decisions and orders may, however, be appealed to the Supreme Court of Canada on any question of law or jurisdiction. The Board's jurisdiction extends in general over all steam railways in Canada with the exception of a few provincially-owned lines, chiefly the Ontario Northland and Pacific Great Eastern Railways. The Transport Act of 1938 gave the Board authority over water-transport agencies operating between Canadian ports on the Great Lakes and the St. Lawrence River west of the Island of Orleans. The jurisdiction does not, however, apply to bulk commodities handled by water carriers and therefore excludes the movement of coal, grain and ores which move as bulk cargoes. Insofar as railways are concerned, the Railway Act vests in the Board a number of powers over construction of lines, location of stations, building of bridges, highway crossings, type of equipment, and the like.

From the standpoint of this report, the Board's control over rates is its most important function. The Railway Act provides that rates shall not be unreasonable, unjustly discriminatory, unduly preferential or prejudicial; empowers the Board to determine whether particular rates violate these provisions and to disallow rates which it considers to be unjust or unreasonable. The Board does

not initiate rates—that lies with the railways—but once rates are filed the Commissioners can examine them, either on complaint or of their own motion, and can order them changed if found to be unlawful. The Board cannot, however, order changes in freight rates unless they infringe the provisions of the law.

Complaints may take the simple form of a letter from a shipper, and a large proportion of rate complaints are settled through exchange of correspondence between the Board, the complainant and the railways. On the other hand, formal complaints may be made, hearings held at which testimony is received from any interested party, and formal decisions rendered by the Board. Such hearings may be, and actually are, held in any part of Canada. The more important cases affecting coal rates are described in the next section.

BASIS AND EVOLUTION OF COAL AND COKE RATES

Within Canada

At the risk of repeating what has been said elsewhere in this chapter, it might be emphasized here that special commodity rates are published by the railways to apply on all railway movements of coal and coke in Canada. These rates are considerably lower than the lowest class rates. They are published with regard to the particular conditions affecting the marketing of coal and coke in different parts of the country, and do not in general reflect a definite or fixed relationship either with mileage or with rates on other commodities. Some of the rates have been fixed by the regulatory authority, and others have been voluntarily established by the railways.

The filing in 1904 of the railway freight rate schedules with the then Board of Railway Commissioners subjected these schedules or freight tariffs to complaint and investigation, and in due course of time to the fixing of rates by the Board. The two investigations of the Board, which initially fixed the level of freight rates (including coal and coke) in eastern Canada and western Canada, are the Western Rates Case decided in 1914 and the Eastern Rates Case in 1916. About ten years later the Dominion Government, by Order in Council P.C. 886 of June 5, 1925, directed the Board of Railway Commissioners to make a country-wide investigation of railway freight rates, and after two years of hearings the Board, in 1927, issued its judgment and order in this general freight rate investigation. A brief digest of the reasons for and the results of these investigations is given herein for the purpose of an understanding of the present freight rates on coal and coke.

Western Rates Case

The first step leading up to the enquiry into western freight rates was a resolution of the Winnipeg Board of Trade passed on November 14, 1911, which held that the rates charged for the carriage of freight from Winnipeg and throughout the whole western territory were based on a much higher scale than those charged for similar service in the Provinces of Ontario and Quebec. The resolution was adopted by other Boards of Trade in the western provinces and was forwarded to the Minister of Railways and Canals, who referred the question to the then Board of Railway Commissioners.

As a result of the representations made, the Board on January 8, 1912, ordered that a general enquiry be undertaken by the Board into all freight rates in effect in the Provinces of Manitoba, Saskatchewan and Alberta and in Ontario west of Port Arthur, and subsequently extended the enquiry to cover rates in British Columbia. In its decision, the Board concluded that the western rates were not unjustly discriminatory, but that many of them were unreasonable as

measured by the traffic necessities of western Canada, and a fair rate of return to the railway carriers as a whole. A number of important changes in the rate structure were ordered.

Dealing with coal, the Board found that some of the rates were too high and should be reduced to a basis as low as could be consistently directed, having regard to the character of the commodity and the general practice of the carriers in establishing low rates on low-grade commodities, particularly coal. Accordingly, reduced rates were prescribed from Lethbridge and Cardiff in Alberta, and from Bienfait and Estevan in Saskatchewan, to a number of specified destinations. The rates specifically ordered were to serve as a guide for revising coal rates to other destinations and from other origins, and while the Board did not state the basis for the reductions or for the rates set forth in their order, they were actually about 55 per cent of the tenth class rates in the case of the Alberta mines and 50 per cent of the tenth class rates from the Saskatchewan origins.

The Board approved the principle of grouping mines within a reasonable distance of each other and applying a common rate from all mines in the group to destinations more than 100 miles distant, the rate to be based on the distance from the mine nearest to the destination. Where joint through rates over the lines of two carriers were published, it was ordered that such rates should not exceed by more than 20 cents per ton the rate which would have been applicable if the through mileage had been that of a single railway.

Eastern Rates Case

The Eastern Rates Case was initiated in 1916 by the Canadian Freight Association on behalf of all railway companies in eastern Canada under the jurisdiction of the then Board of Railway Commissioners for a general increase in freight rates. A number of shippers, Boards of Trade and other organizations intervened in opposition to this application on various grounds, and the Board broadened the case to include a study of the existing rate structure, as well as the merits of the application for a general increase in the rates.

Without going into detail as to the Board's findings, it may be said that in general the Board approved the proposed rate increases with certain modifications. As to coal rates, on which an increase of 10 cents per ton had been sought, they authorized increases of 10 per cent in the rates, with a maximum increase of 10 cents per ton. At the same time, as a result of their general study of the prevailing rates, they ordered a substantial revision of the rates published on coal from the Niagara Frontier and Detroit to destinations in Ontario and Quebec, primarily to correct relationships between the rates to different destination groups so as to form "a more symmetrical blocking". The effect of these changes was, first, that in many cases the rates were increased by less than ten cents and in some cases actually reduced; second, the destination groupings and relationships were fixed by regulatory order; and finally, that the rates specified became prescribed maximum rates, not subject to increase by initiative of the carriers. In the case of rates on coke, the railways applied for a blanket increase of 10 cents per ton in the existing rates, and this was granted by the Board. They required, however, the same regrouping of destinations as in the case of coal, which resulted in some rates receiving less increase than the 10 cents authorized generally.

General Freight Rates Investigation

During 1925-1927, the then Board of Railway Commissioners, by direction of the Dominion Government, conducted a general freight rate investigation with a view to the establishment of a fair and reasonable rate structure which would, in the language of Order in Council P.C. 886, dated June 5, 1925, "under sub-

stantially similar circumstances and conditions, be equal in its application to all persons and localities, so as to permit of the freest possible interchange of commodities between the various provinces and territories of the Dominion, and the expansion of its trade, both foreign and domestic". Notice of the investigation to be undertaken was given to the provinces, industrial organizations and to the public generally, and all parties were invited to appear before the Board and make such submissions and representations as to them seemed expedient with respect to any and all rates with which they were dissatisfied. Reference to the Board's judgment, reported in 17 J.O.R. and R. at pages 131-422, indicates that three complaints relating to coal were received.

The judgment left the basis of coal and coke rates generally as prescribed by the Board in the Western Rates Case and the Eastern Rates Case, but subject to general increases and reductions in all freight rates authorized by Orders of the Board in 1918, 1920, 1921 and 1922.

Present Rates

The general level of Canadian freight rates has not been changed since 1922. In 1941 all freight rates, including those on coal and coke, were "frozen" by Order 92 of the Wartime Prices and Trade Board.

Before undertaking a description of the present Canadian coal and coke rate basis, it must first be explained that originally the railways made their rates on coal, as on other commodities, on purely a distance basis by means of so-called mileage scales which specified the distance between stations on the railways, and the rate charged for each distance was set forth against the mileage. The mileage rates progressed in regular steps, usually 10 cents per ton for each succeeding distance, and in 5, 10 or 25 mile blocks. These mileage scales are still in existence, but as the country developed, such simple scales were too rigid in many cases, especially for the longer hauls, and it was necessary to depart from the scale to make individual or specific rates between various points to meet vessel competition and market or commercial competition, or to place groups of mines on one rate basis not especially related to distance so that several mines in one geographical location might compete with each other at the same rate in a common market. Thus, there are now within Canada, or from the international boundary to Canadian points, literally thousands of coal rates, each of which has been established for one of the particular reasons just outlined.

Obviously these rates cannot be described individually in the scope of this chapter, but an effort will be made to state in brief form the general character of the various coal rate schedules. This must be done in a regional manner, due to the well-separated geographical location of the coal deposits in Nova Scotia and New Brunswick in the east, the Saskatchewan, Alberta and British Columbia deposits in the west, and the United States deposits adjacent to the Central Provinces.

Maritimes

The Intercolonial Railway, extending from the Maritime Provinces to Montreal, was operated until 1923 under the authority of the Minister of Railways and was free until 1923 to fix rates in accordance with the economic situation of the Maritime Provinces without any regulatory control by the then Board of Railway Commissioners. Freight rates in the earlier days of the Intercolonial were influenced by Government policies with respect to Confederation obligations, and so continued until 1912, when the Dominion Government instituted a different form of administration on the Intercolonial, which endeavored to adjust the rates to a self-sustaining basis. This resulted in dissatisfaction on the part of

shippers, and the appointment of the Royal Commission on Maritime Claims to investigate, amongst other things, the situation with respect to freight rates. Following the report of this Commission, legislative action restored the rate schedules which the Maritime Provinces had formerly enjoyed by requiring on July 1, 1927, a reduction of approximately 20 per cent in the freight rates within the Maritime Provinces and for that portion of the rate accruing in those provinces on traffic destined beyond Levis. The reductions in rates so made do not decrease railway revenue since the Dominion Government pays the difference between the statutory rates and the normal rates to the railways. Two examples of the present rates are: from Sydney to Halifax the rate on coal is $1.60 per net ton for 290 miles; to Saint John $1.90 on coal and $1.85 on slack for 432 miles.

There are also through rail rates from the Maritimes to Quebec and Ontario which are low for the distance involved; for example, from Sydney to Quebec $3.20 for 817 miles; to Montreal $3.80 for 956 miles; and to Ottawa $4.60 for 1,063 miles. These rates, despite their low level relative to distance, are not important, as the cost of water transportation from Sydney to Quebec or Montreal, added to the rail rates beyond, makes a much lower combination than the all-rail rate. The water rates fluctuate considerably and much coal is not carried at quoted rates but is transported in company vessels, for which the costs are not specified. However, assuming a water rate of 61 cents per ton from Sydney to Montreal, with handling charges at the ports amounting to 41 cents and adding the rail rate from Montreal to Ottawa of $1.10, the total is $2.12 per ton compared with the rail rate of $4.60 per ton.

Quebec and Ontario

The western portion of the Province of Quebec and much of Ontario are in relatively close proximity to the coal fields of the United States, and a great part of this area secures its supplies from United States points. So far as bituminous coal is concerned, the coal is largely delivered by vessel via cross-lake routes or down the St. Lawrence River to the Canadian lake and river ports. To some extent, however, the coal moves all-rail from United States coal fields to the Canadian destinations. These circumstances have resulted in the Canadian railways making proportional rates on coal from the St. Lawrence River ports, from the Canadian lake ports and from the junctions with the United States railways along the boundary. The rates from Quebec and Montreal also apply generally on coal produced in Nova Scotia and New Brunswick. For example, the rate from Montreal to Sherbrooke is $1.30 for 101 miles; to Ottawa $1.10 for 117 miles; to North Bay $2.60 for 340 miles; to Copper Cliff $2.80 for 445 miles, and to Noranda $3.20 for 543 miles. From Buffalo to Hamilton the rate is 90 cents per net ton on bituminous coal and $1.05 per gross ton on anthracite coal for a distance of 61 miles; to Toronto the rate is $1.00 per net ton on bituminous and $1.15 per net ton on anthracite for a distance of 101 miles; to London the rate is $1.40 per net ton on bituminous and $1.65 per gross ton on anthracite for a distance of 132 miles; to Sudbury the rate on bituminous is $2.80 per net ton and on anthracite $3.00 per net ton for a distance of 356 miles. From Detroit to London the rate on bituminous coal is $1.10 per net ton for a distance of 112 miles; to Hamilton $1.40 per net ton for 192 miles; to Toronto $1.40 per net ton for 227 miles, and to Sudbury $3.10 per net ton for 476 miles.

Head-of-the-Lakes

Rates on ex-lake coal from Port Arthur and Fort William, when originally established, were influenced by competitive shipments of coal to Prairie points from Duluth, a shorter distance than from Port Arthur or Fort William. At the present time the prevailing rate from the Head-of-the-Lakes to Winnipeg is $3.30 per net ton on both anthracite and bituminous for a distance of 424 miles.

Prairie Territory

Comment has already been made on the order of the Board of Railway Commissioners in 1914, prescribing a reduced basis of rates on coal on the Prairies equal to 50 per cent of the tenth class rates from Saskatchewan mines and 55 per cent from Alberta mines, and on the fact that these mines were grouped in well-defined areas based on their geographical location and the type of coal produced. The general increases permitted by the Board based on increased railway costs in 1918-1920, were lower on coal than on the tenth class rates, so that the present rates on the Prairies are on a relatively lower percentage of tenth class rates than originally prescribed by the Board. From Estevan to Winnipeg the rate now is $2.30 per net ton for a distance of 291 miles; from Drumheller to Saskatoon the rate is $2.80 for a distance via Canadian National of 315 miles and via Canadian Pacific 576 miles; to Winnipeg $4.70 for a distance of 783 miles; and to Port Arthur $6.50 for 1,220 miles.

Agreed charges have been put into effect in Saskatchewan from the Estevan and Bienfait fields to points relatively close to the mines in order to assist the railways in meeting truck competition. The rates are especially low but are only available to shippers upon an undertaking to use railways exclusively. In Alberta, to meet truck competition, the railways have had recourse to special truck-competitive rates on a level considerably lower than the generally prevailing rates.

British Columbia

The general basis for coal rates in British Columbia was laid down by the Board of Railway Commissioners in the Western Rates Case previously described. There have been some modifications of this basis—for example, rates have been established from Alberta mines on the Coalspur Branch of the Canadian National Railways to Vancouver, B.C. which reflect the application of 6 mills per ton-mile to the through distance, and it appears that this rate was made to assist in the marketing of Alberta steam coal in competition with coal shipped from Vancouver Island by boat. As an example, the rate from Coalspur to Vancouver is $3.90 per ton for 663 miles, this rate being applicable for Canadian National Railways delivery. This coal is principally delivered on C.P.R. tracks, and there is an additional switching charge of 20 cents per ton; the total rate for Canadian Pacific Railway delivery is $4.10 per ton. The rate to Vancouver from Drumheller is $5.00 per ton for 741 miles via the Canadian Pacific and 943 miles via the Canadian National; from Lethbridge the rate to Vancouver is $5.00 per ton for 769 miles.

Alberta to Ontario

Rates from mines in Saskatchewan, Alberta and British Columbia to points in Ontario as far east as Port Arthur and Fort William have been in effect for many years, on a basis reflecting the Board's order in the Western Rates Case. As example, the rates to Port Arthur are $4.30 per ton from Estevan, Sask., for 715 miles via C.P.R., 741 miles via C.N.R., $6.30 from Lethbridge, Alta., for 1,181 miles, $6.50 from Drumheller, Alta., for 1,220 miles, $6.80 from Michel, B.C., for 1,295 miles, and $7.20 from Coalspur, Alta., for 1,403 miles.

In 1923, rates were extended to destinations east of Port Arthur, the rates from Drumheller, for example, being $10.90 per ton to North Bay for 1,797 miles; to Toronto, Hamilton, Ottawa and Windsor the rate is $12.70 for distances of 1,990, 2,028, 2,023 and 2,197 miles respectively. Rates from other points of origin vary, depending on their location, as in the case of rates to Port Arthur. In 1933, the railways established what might be called a "subvention rate", which will be specially dealt with later in the chapter. This rate is $8.00

per ton, applies to a large group of Ontario destinations extending as far east as Ottawa and Cornwall, and is carried as a uniform rate from substantially all mines in Alberta and the Crowsnest Pass District of British Columbia.

Anthracite Rates

Most of the foregoing matter relates to bituminous coal rates, with only incidental reference to rates on anthracite. United States anthracite for Canada is mined in only one locality, eastern Pennsylvania, and a different transportation situation exists with respect to that coal. Generally speaking, there are joint through rates via the routes through and east of Cobourg, Ontario, but via the Buffalo and Detroit gateways the rates are published separately south and north of the boundary. Rates are also published where necessary to handle shipments from the lake ports to inland destinations. Some examples of rates on anthracite coal within Canada have already been given, and further detail with respect to these rates is considered unnecessary. The subject of through rates from the United States to Canadian destinations is dealt with more fully in another section of this chapter. Anthracite rates in both Canada and the United States are generally slightly higher than those applying on bituminous coal, reflecting the higher value of anthracite.

Coke Rates

While the major part of the coke produced in Canada is consumed at the point of production or is distributed locally without the use of railway transportation, the rail movement of coke both from Canadian producing points and from across the United States border is of sufficient importance to warrant mention of the rates provided on such movements. The principal plants shipping by rail are at Sydney, Montreal, Hamilton, Sault Ste. Marie, Coleman, Michel and Vancouver. The railways maintain specific commodity rates on coke from these points to destinations in their normal market areas. Rates are also published from the Detroit, Niagara Frontier and Adirondack junctions with the United States lines to destinations in eastern Canada, and from Port Arthur, Fort William and Duluth to points in western Ontario, Manitoba and Saskatchewan.

Generally speaking, rates on coke are somewhat higher than rates on coal, since coke is more bulky, the average load per car is less, and the value of coke is usually higher than that of coal. This difference was accentuated in Canada by General Order No. 308 of the then Board of Railway Commissioners in 1920, which, in granting increases in rates limited the increases in the case of coal rates but permitted the general increase of 35 per cent to be applied on coke.

From the United States to Canada

Section I of this chapter has described the channels through which coal produced in the United States reaches Canada. In dealing with the rates applying on the movement via these routes, it may be observed that with insignificant exceptions they are an integral part of the structure of rates applied on the movement of coal within the United States and are not specially designed for the shipment of coal to Canada, that they reflect the existence of competition between a number of United States railroads and between thousands of coal producers, and that most of them have been either prescribed or specifically approved by the governmental authority having jurisdiction over railroad rates in the United States.

To avoid confusion, the rates stated herein are those in effect immediately prior to July 1, 1946. In response to a petition by the United States railroads for an immediate increase in freight rates, the Interstate Commerce Commission granted temporary increases taking effect July 1, 1946, and hearings on the request for a permanent increase are pending at the time of writing.

Lake-Cargo Rates

On the south shore of Lake Erie there are elaborate facilities maintained by the railroads for the assembling and transfer of coal from cars to boats at a number of ports from Buffalo, N.Y., in the east, to Toledo, Ohio, in the west. These ports handled 6.7 million tons of coal destined to Canada in 1939 and 12.2 million tons in 1944. The two most westerly ports, Sandusky and Toledo, handle the largest tonnage, most of which originates in the so-called southern fields—that is, in Virginia, southern West Virginia, eastern Kentucky and Tennessee. The freight rates for this movement are $1.91 per net ton from one group of origin districts which ship high volatile coal and $2.06 per net ton from another and more distant group of mines shipping principally low volatile coal.

The principal district in Ohio, so far as the lake trade is concerned, is in the eastern part of the State, being generally known as the Ohio No. 8 District, and the rate from this district to various Lake Erie ports is $1.53 per net ton. The Pittsburgh district of southwestern Pennsylvania has a rate of $1.56, and the Fairmont district of northern West Virginia a rate of $1.76 to most of the ports from Erie, Pennsylvania, to Sandusky, Ohio, inclusive. The Reynoldsville district of western Pennsylvania carries a rate of $1.56 from certain mines to Buffalo, N.Y., and Fairport, Ohio. There is a dumping charge of 9 cents per ton for transferring the coal to boats at all the Lake Erie ports, which is in addition to the rates shown. This is not a complete list of all the lake-cargo rates to the Lake Erie ports, but it covers the principal movements so far as coal reaching Canada is concerned.

On Lake Ontario there are railroad-owned coal dumping piers at Charlotte, Sodus Point, and Oswego, N.Y. These docks handled in 1939 about one million tons and in 1944 about two and three-quarter million tons of bituminous coal destined to Canada, and slightly less than 300,000 tons of anthracite in both years. Canada is the principal market for coal handled over these piers, and the coal originates in central and western Pennsylvania and in northern West Virginia. Rates from some districts to the Lake Ontario ports are published on a gross ton basis, but for purpose of comparison we have shown the rate per net ton to which the gross ton rates are equivalent. The principal rates are: from the Clearfield and Reynoldsville districts of central Pennsylvania $1.68 per net ton; from the Westmoreland district, which includes the Pittsburgh district of western Pennsylvania and the Fairmont district of northern West Virginia $1.90 per net ton; both rates being subject to a dumping charge of 9 cents per net ton.

The lake-cargo rates described are on a lower level than local rates. For example, while the Pittsburgh district rate to Cleveland, Ohio, for lake-cargo movement is $1.56, the rate for delivery to industries or dealers at Cleveland is $1.94. In part, this difference represents a proportional rate as compared with a local rate, since the lake-cargo rate only becomes applicable when there is a further movement beyond the port by water. A further contributing factor is the competition between the different fields and between the different railways.

A new development in the flow of lake-cargo coal was the publication in 1941 of lake-cargo rates from mines in Illinois, Indiana and western Kentucky to Chicago, and the construction of facilities for transferring coal from cars to boats at that point. These rates were established to permit coal produced in the midwestern fields to compete with eastern coal at the ports on the upper lakes, and are lower than the rates for delivery to consumers at Chicago by varying amounts. The rate from the southern Illinois district is $1.65 per ton for lake movement, compared with $2.05 for track delivery. From western Kentucky the lake-cargo rate is $1.90 and the track delivery rate $2.30. Chicago is a highly competitive market and the rail rates for track delivery reflect this competition.

All-Rail Rates

Detroit—Windsor Gateway

Bituminous coal shipped to Canada through Windsor moves on a combination of rates published from the mines to Detroit plus the rates published from Detroit by the Canadian railways. The coal originates mainly at mines in Ohio, West Virginia and Kentucky, and includes both high and low volatile coals. Some of the rates to Detroit are: $2.20 per ton from the principal Ohio fields, $2.70 per ton from the southern high volatile fields, and $2.95 per ton from the southern low volatile districts. The same rates apply on coal shipped to Detroit for use in that city.

Niagara Frontier Gateway

Generally, the rates on coal moving via the Niagara Frontier are based on combination of rates to and from the border points. The principal bituminous coal origin districts and the applicable rates to the Niagara border junctions are: Reynoldsville district $2.19 per net ton, Pittsburgh district $2.34 per net ton, Connellsville $2.49 per net ton, and Clearfield $2.34 per net ton, all these districts being in Pennsylvania; and the Fairmont district in northern West Virginia $2.49 per net ton. These are the same as the rates to Buffalo for local delivery.

Car-Ferry Routes

Through rates are published on coal from mines on certain railways in the United States to destinations in Ontario and Quebec via the car-ferry routes but, with minor exceptions, the through rates are the same as the combination rates via the border gateways and were published as single-factor through rates partly as a convenience and partly to avoid technical difficulties in equalizing rates via the ferry routes with those in effect via the all-rail routes.

Adirondack Junctions

There is a general arrangement of through rates now published by various United States railroads on coal from the Pennsylvania and northern West Virginia fields to destinations in eastern Ontario, Quebec, and a number of points in the Maritimes applying via several gateways, principally junctions between Canadian and United States lines between Prescott, Ontario, and Ogdensburg, N.Y., on the west, and such points as Vanceboro, Maine, on the east. Originally, rates on United States coal to this territory were based on combinations made up of proportional rates to the gateway plus rates of the Canadian lines beyond. These rates to and from many of the gateways are still in effect. Since these gateways are not all close together, it was found difficult to maintain combinations which would provide equal rates via all the routes involved, and in order to have such equality through rates were published applying via various junctions to a wide destination territory. A few examples of the through rates on bituminous coal are:

Origin District	Destination	Published Rate per Gross Ton	Equivalent Rate per Net Ton
		$	$
Clearfield (Central Pennsylvania)	Ottawa, Ont.	4.50	4.02
Clearfield	Sherbrooke, P.Q.	5.20	4.64
Clearfield	Montreal, P.Q.	4.60	4.11
Westmoreland (Western Pennsylvania, Northern West Virginia)	Ottawa, Ont.	4.75	4.24
Westmoreland	Sherbrooke, P.Q.	5.45	4.87
Westmoreland	Montreal, P.Q.	4.85	4.33

Tidewater Rates

Special trans-shipment rates are published on coal from mines in Pennsylvania, Maryland, and northern West Virginia to New York, Philadelphia and Baltimore, and from mines in Virginia, southern West Virginia and eastern Kentucky to the Hampton Roads piers. The movement to Canada through these piers does not appear to be substantial enough to warrant a discussion of the rates.

Rates on Anthracite

The entire production of anthracite is limited to a small area in eastern Pennsylvania and, while it is shipped to Canada in considerable volume, the channels through which it moves are much more restricted than for bituminous coal. Some anthracite is shipped over the lakes, principally through the Lake Ontario ports of Oswego, Sodus Point and Charlotte, while a smaller tonnage moves through Lake Erie ports. The all-rail rates handle considerably more tonnage to Canada than do the lake-cargo rates. As in the case of bituminous coal, the basic framework of the rates is the combination to and from the border points, but a number of through rates have been published in order to permit the traffic to move by several different routes. In addition to this, special reductions were made in the rates to Toronto, Montreal and Quebec in 1933, to meet the competition of water-carriers. A few representative examples of the through charges on prepared anthracite are shown below:

—	Per Gross Ton	Per Net Ton
	$	$
To Quebec	4.61	4.12
To Montreal	4.11	3.67
To Toronto	3.91	3.49
To Hamilton	3.76	3.36
To Peterboro	5.31	4.74
To North Bay	5.98	5.34

Rates on Coke

Normally, a large part of the United States coke imported into Canada originates at by-product coke plants at the border cities, Detroit and Buffalo. During World War II and at times during the fuel shortage since the war there have been movements of coke in some volume from various United States sources. Most of this coke moves on combination rates made to and from the border junctions, but there are a limited number of through rates published, particularly from the beehive coke districts of southwestern Pennsylvania via the Adirondack gateways. The movement is not of such importance as to warrant an extended consideration of the rates. Shipment of coke by lake has not attained any great volume, and there is no special basis of rates published from United States coke-producing points to the lake ports for movement by water. Water competition has, however, affected some railway rates from the border cities to Canadian destinations.

From Canada to the United States

From a tonnage standpoint, the movement of coal from Canadian mines to markets in the United States is not important. However, the existence of consuming areas across the border and reasonably close to certain coal fields of Canada has led to some speculation as to the possibility of increasing exports to the United States. The subject is dealt with in the chapter on Markets, and we are here concerned only with the railway rates provided for such movements.

The present market for Maritime coal in the United States is limited to a few points in Maine, adjacent to the international boundary. There are through rates from the Minto field to a few Maine destinations, but in general, the available rates are made up of combinations of proportional rates from the New Brunswick and Nova Scotia mines to border junctions, plus rates of the United States railroads from the junctions.

There is a sizeable movement to the States of Washington and Idaho from mines in the Crowsnest Pass district. The Canadian Pacific Railway, with the co-operation of the Spokane International Railroad, publish through rates from mines in the Crowsnest Pass to a number of points in Idaho, Oregon and Washington.

Vessel Rates

We have pointed out the importance of water transportation in the movement of coal in and to Canada. The economy of large-scale vessel transportation for bulk commodities of relatively low value such as coal is well known and is reflected in the freight rates for vessel transportation of coal.

Vessel rates for movement of a commodity from one port to another are very strongly influenced by the volume of traffic moving in the reverse direction. The substantial tonnage of coal brought to Canada from the United Kingdom prior to the war was handled very cheaply because the amount of traffic moving eastward across the Atlantic greatly exceeded the westbound movement and vessel owners made low rates for the carriage of coal, in preference to returning to North America in ballast. A similar situation exists in connection with the movement of coal from ports on the lower lakes to points on the upper lakes, since there is a heavy movement of grain and iron ore from the Lake Superior ports to Georgian Bay and Lake Erie ports.

The charges assessed by vessel carriers are not ordinarily published in tariffs or paid by all shippers alike. For shipment on the Great Lakes there is a certain uniformity and stability in the rates, but even for this movement there may be differences in the terms arranged between the vessel owners and various individual shippers or receivers, or between the charges during different parts of the shipping season. Shipments by water from Sydney prior to the war were partly in colliers owned by the coal company and partly in chartered vessels. Coal shipments from overseas are in chartered vessels.

During the war there was a complete disruption of ocean-going transport, and the effects were felt on the Great Lakes. Rates charged by Canadian vessels operating on the Lakes were set by the Wartime Prices and Trade Board, at a level slightly higher than those applying in 1939. Much of the lake coal tonnage moved in vessels of United States registry which were not subject to control of the Wartime Prices and Trade Board, and there were moderate increases in their rates. There has been an increase in the number and aggregate capacity of the bulk cargo fleet on the lakes. The number of canal-size freighters has been materially reduced. The sea-going cargo fleet owned by United States interests has increased enormously, while there has been a marked reduction in the number of vessels of other registry. Costs of construction, of uel and supplies, and the wages of crews have gone up very considerably. In view of these and other circumstances, we are unable to foresee at what levels the boat rates will finally stabilize, although it seems altogether likely that they will be generally somewhat higher than before the war.

From Sydney, the pre-war cost of shipping to Montreal was about 61 cents per net ton. To Quebec the cost was approximately 50 cents, and to Three Rivers about 55 cents. Rates from Pictou were about 5 cents lower than

from Sydney to Montreal, while to other St. Lawrence River destinations they were in some cases a few cents lower and in others a few cents higher than the Sydney rates. Rates for movement from Montreal in "canalers" were about 55 to 60 cents to Toronto and Hamilton, approximately 70 cents to Welland and Windsor and about 75 cents to Georgian Bay ports. The speed at which the boats can be unloaded at different ports affects the rates. For instance, coal to Belleville, Ont., was carried at a rate of $1.00, although lower rates were applied on coal moving to ports further west.

Rates from ports in the United Kingdom to Montreal were in the neighbourhood of $2.00 per net ton, and the rates for furtherance from Montreal approximately the same as in the case of coal originating in Nova Scotia. Some coal moved from Mariupol in Russia at rates of about $4.80 per net ton.

From the ports on Lake Ontario, rates ranged at about 30-40 cents to Toronto, 35 cents to Prescott, 70 cents to Montreal and 80 cents to Quebec. Rates in self-unloaders, including the dumping of coal on the dock, were generally slightly higher than those shown. Rates to Montreal were about 85 cents from the western ports on Lake Erie and 75-80 cents from the eastern ports. Rates to Toronto and Hamilton were from about 40-60 cents, depending on the port through which the coal was shipped, and also whether it moved in bulk carriers or self-unloaders. To ports on the Ontario shore of Lake Erie rates ran from 28 to 45 cents, and to Windsor between 25 and 35 cents. Rates to Georgian Bay were about 40 cents, to Sault Ste. Marie approximately 35 cents and to Fort William about 40 cents per ton.

The pre-war rates on scow movements from Vancouver Island to Puget Sound points were as follows:

Nanaimo to Seattle	$0.60
Nanaimo to Bremerton	1.00

Union Bay to the above points about 10 cents higher.

By comparison with railway rates for comparable distances, the vessel rates described are low. They do not, however, cover the total transportation charges applicable to the movement of coal by vessel in Canada. Virtually all the waterborne coal requires rail transportation from the mines to the docks where it is loaded in steamers. In the case of Nova Scotia coals, the initial railway movements are quite short and the charges range from 12 to 25 cents per ton. Most of the coal shipped from Great Britain moves relatively short distances to the ports. Coal imported by lake from the United States requires rail hauls of varying lengths, usually several hundred miles, and the freight rates charged have already been discussed. The rates applied for the railway portions of the haul must, of course, be added to the vessel rates to determine the transportation charges to the ports of destination. There are also charges for dumping coal from cars to vessels, additional charges or costs for unloading from vessels to docks (except in the case of self-unloaders whose rates usually include discharge to the docks), and costs for reloading to trucks or railway cars. At some ports wharfage charges are assessed. Since waterborne coal can only move during the season of open navigation while much of the consumption is during the winter months, coal must be stored on the docks or at the point of consumption, which involves storage costs, insurance, interest on inventory, and so on. In the case of coal which must be marketed in the larger sizes, the additional physical handling incidental to the movement of waterborne coal results in degradation or breakage and the necessity of rescreening the coal on the docks, and disposing of the screenings at a lower price than the screened coal, often at a loss. This factor is of special importance in the case of anthracite and helps to explain why the bulk of this coal imported from the United States is shipped all-rail.

There are shown in the following table, a few examples of approximate transportation and handling costs to representative destinations, also the corresponding all-rail rates prevailing in 1939, exclusive of transportation subventions:

EXAMPLES OF APPROXIMATE TRANSPORTATION AND HANDLING COSTS IN 1939

(Rates per net ton)

	To			
From Glace Bay, N.S.	Montreal	Ottawa	Toronto	Kitchener
	$	$	$	$
Rail rate to port	0.25	0.25	0.25	0.25
Dumping to vessel	0.10	0.10	0.10	0.10
Vessel rate	0.61	0.61	0.61	0.61
Handling at Montreal	0.31	0.31	0.25	0.25
Rail from Montreal	.....	1.10	.....	.....
Boat from Montreal	.....	.....	0.55	0.55
Handling at Toronto	.....	.....	0.47	0.47
Rail from Toronto	.....	.....	.....	1.20
Total	1.27	2.37	2.23	3.43
Rail rate to Sydney	0.25	0.25	0.25	0.25
Rail rate from Sydney	3.80	4.60	5.20	5.70
Total rate, all-rail	4.05	4.85	5.45	5.95

	To			
From Pittsburgh District	Montreal[1]	Ottawa[2]	Toronto[3]	Kitchener[4]
	$	$	$	$
Rail rate to port	1.90	1.90	1.56	1.56
Dumping to vessel	0.09	0.09	0.09	0.09
Vessel rate	0.65	0.35	0.42	0.24
Discharge and Handling	0.47	0.10	0.30	0.25
Rail rate from port	.....	1.08	.....	1.40
Total	3.11	3.52	2.37	3.54
All-rail rate	4.33	4.24	3.34	3.74

[1] Via Sodus Point [2] Via Sodus Point and Prescott [3] Via Cleveland
Via Cleveland and Pt. Burwell

The vessel rates have all advanced since 1939, and the increase in the case of the movement from Nova Scotia is considerably greater than for the shipment from lake ports. In 1939, the total cost of vessel movement from Glace Bay to Montreal, including rail rate to port, dumping, wharfage and handling charges, amounted to $1.27. In the Fall of 1946, as this report is being written, the transportation cost for the same movement is $2.43 per ton. The full implications of this sharp increase in transportation costs are further discussed in the chapter on Markets.

COMPARISON OF LEVELS OF FREIGHT RATES

Because the freight rates applied by the railways are so important an element in the marketing of coal in Canada, it appears appropriate to examine the level of existing rates in relation to rates on other commodities in Canada, and also in comparison with rates on coal in the United States.

Coal Rates Compared with Other Commodities in Canada

Rates on coal in Canada, as in the United States, are among the lowest of those charged on any commodity. In the light of rate-making principles already described, it is obvious that this should be the case. Comparing coal rates with rates on other commodities, the following examples are representative of the situation, all rates being shown per net ton:

Sydney, N.S. to Bathurst, N.B.	Coal $2.00, cordwood $2.50, pig iron $2.95, lumber $3.60.
Maccan, N.S. to Moncton, N.B.	Coal 80 cents, cordwood $1.00, lumber $1.70.
Port Arthur, Ont. to Winnipeg, Man.	Coal $3.30, crude petroleum oil $4.60, cement $5.40, soda ash $7.20.
Drumheller, Alta. to Winnipeg, Man.	Coal $4.70, lumber $8.60.
Drumheller, Alta. to Port Arthur, Ont.	Coal $6.50, lumber $11.30.

Rates on coal from the Nova Scotia and New Brunswick fields are substantially lower than rates on fuel oil from Halifax, N.S., for comparable distances. The subvention rate of $8.00 per ton (of which the shipper pays only $5.50 per ton) on coal from Alberta mines to destinations in Ontario may be contrasted with rates of $15.60 per ton on eastbound lumber for similar distances, $11.00 per ton on crude or ground clay from Saskatchewan producing points to Eastern Canada and with rates applying in the reverse direction from Ontario to Alberta of $18.60 per ton on salt and $17.70 per ton on pig iron.

A particularly significant comparison is that between rates on coal and rates on grain. This comparison indicates that the rates on coal are lower than the grain rates throughout Canada, with the exception of certain statutory rates on grain determined by the Crowsnest Pass Agreement. Comparing first rates on coal in western Canada with grain rates not governed by the Crowsnest Pass Agreement, the following examples will illustrate the point, rates being shown per net ton. From Drumheller, Alta., to Prince Albert, Sask., the rate on coal is $3.20 and on grain $5.90; from Drumheller to Weyburn, Sask., $3.80 on coal and $6.40 on grain; from Lethbridge, Alta., to Prince Albert, $4.20 on coal and $7.30 on grain; and from Lethbridge to Lanigan, $3.80 on coal and $6.60 on grain.

The Crowsnest Pass Act, assented to by Parliament on June 29, 1897, confirmed an agreement between the Dominion Government and the Canadian Pacific Railway Company, whereby the Government granted aid to the railway for the construction of a line through the Crowsnest Pass in British Columbia, extending from Lethbridge to Nelson, in consideration of materially lower rates being given on grain and flour from the Prairie Provinces to Fort William and all points east, and on certain staple commodities from the east destined to points west of Fort William.

Except for some reduction made in grain rates in 1903, of which it is not necessary to give the details, the Agreement continued to determine grain rates until 1917 when it was suspended by Order in Council. However, in 1922, following a vigorous debate in the House of Commons, a statute was enacted restoring the Crowsnest Pass Agreement with respect to the eastbound movement of grain and flour, Parliament taking the view that in the interests of the Canadian economy the rates imposed by the Agreement upon the Canadian Pacific Railway should be restored and extended to all other railways in western Canada, with the result that the present rates on grain in this territory are on the same level as was made effective in 1898. To appreciate the extent to which this policy has affected grain rates to the Head-of-the-Lakes, we may make a comparison between such rates and the charges for comparable move-

ments in the United States. As an example, the grain rate from Calgary to Port Arthur is 26 cents per 100 pounds and from a point of equal distance in Montana to Duluth the rate is 55 cents per 100 pounds. Rates on coal from Alberta to Port Arthur and Fort William are somewhat higher than the grain rates, as shown below: from Drumheller, Alta., coal $6.50 and grain $5.20 per net ton; from Edmonton, Alta., coal $6.50 and grain $5.20 per net ton; from Lethbridge, Alta., coal $6.30 and grain $5.00 per net ton.

Coal Rates in Canada Compared with Coal Rates in the United States

When comparing levels of rates applying on coal in Canada with those applicable in the United States, one should try to compare like with like, so far as is possible. The comparisons should be for hauls of approximately equal length, rates applying in eastern Canada should be matched with those in the eastern United States, and similarly for the west. Nor should proportional rates be compared with rates covering the entire transportation service.

From what has been said earlier, it will be apparent that to find rates in the two countries covering railway services performed under identical circumstances is all but impossible. Generally speaking, coal rates in Canada are not higher than comparable rates in the United States and in some instances are actually lower. In the Eastern Rates case, the then Board of Railway Commissioners compared the rates established by the railways in Ontario with certain rates prescribed by the Interstate Commerce Commission for moving coal similar distances in the United States, and found that the Canadian rates were lower. Since that time, the rate increases permitted by the Board in Canada have been less than those allowed in the United States, with the result that the differences have been accentuated.

The Commission had compiled for it some comparisons of rates in Canada and the United States, which follow. It believes that due regard was paid to the need of selecting rates which were properly comparable.

FREIGHT RATES, PER NET TON, ON BITUMINOUS COAL, AS OF JUNE 30, 1946

—	Distance	Rate Paid by Shipper	Rate Received by Railway
		$	$
Sydney, N.S. to Truro, N.S.	226	1.50	1.88
Pocahontas District (Va.–W. Va.) to Lynchburg, Va.	199	2.15	2.15
Clearfield Dist., (Pa.) to Elmira, N.Y.	223	2.41	2.41
Sydney, N.S. to Moncton, N.B.	342	2.00	2.50
Clearfield Dist. (Pa.) to Syracuse, N.Y.	293	2.64	2.64
Clearfield Dist. (Pa.) to Oswego, N.Y.	350	2.76	2.76
Hardwood Ridge, N.B. to Edmundston, N.B.	166	1.10	1.38
Clearfield Dist. (Pa.) to Harrisburg, Pa.	154	2.18	2.18
Pittsburgh Dist. (Pa.) to Cleveland, O.	162	1.94	1.94
Maccan, N.S. to Drummondville, Que.	606	2.60	3.25
Clearfield Dist. (Pa.) to Standish, N. Y.	604	3.98	3.98
Stellarton, N.S. to Quebec, Que.	633	2.60	3.25
Clearfield Dist. (Pa.) to Boston, Mass. (Water Compet.)	627	3.87	3.87
Montreal, Que. to Ottawa, Ont. (Ex Water)	117	1.10	1.10
Conway, Pa. to Cleveland, O. (Ex Water)	115	1.55	1.55
Portland, Me. to Groveton, N.H. (Ex Water)	122	1.45	1.45
Detroit, Mich. to Toronto, Ont.	227	1.40	1.40
Ohio No. 8 District to Toledo, Ohio	213	1.99	1.99
Reynoldsville Dist. (Pa.) to Buffalo, N.Y.	200	2.19	2.19

FREIGHT RATES, PER NET TON, ON BITUMINOUS COAL, AS OF JUNE 30, 1946—*concluded*

—	Distance	Rate Paid by Shipper	Rate Received by Railway
		$	$
Estevan, Sask. to Winnipeg, Man.	291	2.30	2.30
Republic, N.D. to Fargo, N.D.	279	1.99	1.99
Roundup, Mont. to Marmarth, N.D.	270	3.09	3.09
Truax, N.D. to Barnesville, Minn.	296	2.35	2.35
Lethbridge, Alta. to Regina, Sask.	401	3.10	3.10
Kirby, Wyo. to Helena, Montana	391	3.23	3.23
Pittsburgh, Kan. to Superior, Neb.	390	3.00	3.00
Lethbridge, Alta. to Saskatoon, Sask.	573	4.00	4.00
Roundup, Montana to Aberdeen, S.D.	569	4.11	4.11
Sheridan, Wyo. to Bismarck, N.D.	566	4.41	4.41
Drumheller, Alta. to Brandon, Man.	657	4.40	4.40
Southern Illinois Dist. to Hutchinson, Kan.	652	5.60	5.60
Walsenburg, Colo. to Omaha, Neb.	665	5.15	5.15
Drumheller, Alta. to Winnipeg, Man.	783	4.70	4.70
Somerset, Colo. to Hastings, Neb.	754	4.90	4.90
Walsenburg, Colo. to Sioux City, Ia.	786	5.40	5.40
Coalspur, Alta. to Vancouver, B.C. (Compet.)	663	3.90	3.90
Roundup, Montana to Coeur d'Alene, Idaho	633	4.13	4.13
Bear Creek, Mont. to Spokane, Wash.	649	4.13	4.13

(N.B.—Applications for permanent increases in rates were pending before the regulatory Commissions of both Canada and the United States in October, 1946.)

In the absence of actual rates applied in the United States for movements comparable with that from Alberta to Ontario, only a rough comparison may be made between rates per ton-mile and per car-mile in the case of the Alberta movement and some low rates published in the United States. The distance from Drumheller to Toronto is 1,990 miles, and coal from this field is ordinarily shipped in box cars containing about 40 tons. The normal rate of $12.70 per ton is equivalent to 6.4 mills per ton-mile and 25.6 cents per car-mile; the subvention rate of $8.00 per ton is equal to 4.0 mills per ton-mile or 16.0 cents per car-mile. In the United States, the rates from Illinois mines to Chicago are highly competitive. Several million tons of coal move annually from the southern Illinois district to the Chicago area, an average distance of 358 miles in open top cars averaging about 55 tons per car. The rate for this movement, $2.05 per ton, was prescribed by the I.C.C. as a minimum rate, and is equal to 5.7 mills per ton-mile or 31.4 cents per car-mile.

The very heavy movement of coal to the Lake Erie ports for trans-shipment has already been mentioned in this chapter. The tonnage handled in 1945 was over 50,000,000 tons and the average load per car was about 60 tons. The movement is largely in trainloads. There are great quantities of iron ore shipped inland from the lake ports which provide return loads for many of the cars used to handle coal to the lake ports and the service is performed during the summer when operating conditions are most favourable. The rates applied on this movement are proportionals covering part of a through movement, and are affected

by competitive influences. The level of rates varies, but the following will illustrate the general range:

From	To Lake Erie Ports, Lake-Cargo			
	Average Distance	Rate per Net Ton	Rate per Ton-Mile	Rate per Car-Mile
		$	Mills	Cents
Pittsburgh District, Pa.	172	1.56	9.1	54.6
Fairmont District, W. Va.	269	1.76	6.5	39.0
Kanawha District, W. Va.	370	1.91	5.2	31.2
Pocahontas District, Va., W. Va.	436	2.06	4.7	28.2

The examples cited in this section are an indication that the level of freight rates on coal in Canada is not dissimilar to that in the United States. We wish to emphasize again, however, that a strict comparison cannot be made, for conditions in the two countries differ considerably; this is particularly true of the movement of western coals into the Provinces of Ontario and Quebec.

TEST MOVEMENTS, COST DETERMINATIONS AND TRAINLOAD RATES

The Dominion Government's assistance to Canadian coal producers in their attempt to secure a larger share of the markets in Ontario and Quebec has been linked with efforts to determine the cost of transporting coal by rail from Alberta to Ontario and from the Maritimes to Ontario and Quebec. While the cost determinations in the case of the movement from the Maritimes were undertaken somewhat later than the Alberta tests, they have been much less extensive and significant and we can, therefore, deal with them before proceeding to a discussion of the test movements of western coal.

Test Movements in Eastern Canada

With a view to expanding the markets for Nova Scotia and New Brunswick coal, the then Board of Railway Commissioners was directed by Order in Council P.C. 226 dated February 13, 1926, to ascertain the rail cost of transporting coal mined in eastern Canada to consuming points in Quebec and Ontario during closed navigation on the St. Lawrence River. Supplementing this direction, Order in Council P.C. 539 of March 30, 1928, was issued, requiring the railways to publish a nominal rate of $3.00 per ton on all-rail shipments of coal from Nova Scotia and $2.10 per ton on coal from New Brunswick to points in the Province of Quebec for a three-year test period, and the Board of Railway Commissioners was authorized to enquire into the cost of the movement to determine a rate per ton and also the payments which might be due the railways above the nominal rate. In its report to the Government dated February 13, 1931, the Board found that the additional cost, including the factor of operating profit, for the all-rail movement from Nova Scotia was $1.95 per ton in excess of the nominal rate, or a total of $4.95 per ton. From Minto, N.B., the difference over the nominal rate was $1.36 per ton, or a total of $3.46 per ton. Further tests conducted during the winter seasons of 1929-30 and 1930-31 in the transportation of coal from the Maritimes to the Province of Quebec led to the conclusion that the costs did not vary from the figures above mentioned.

Test Movements, Alberta to Ontario

For many years the question of freight rates on coal from Alberta to Ontario has been the subject of extended consideration and investigation by the railways, the Board of Railway Commissioners for Canada, the Dominion Govern-

ment, and the Provincial Governments of Alberta and Ontario. The consideration of the rates falls into three periods, i.e., from 1923 to 1926 when the Canadian National Railways made its own experiments in moving coal from Alberta to Ontario, from 1926 to 1933 when the Dominion Government directed that further test movements be made to establish the cost of transportation of the coal, and the period since 1933 with the adoption of a policy of transportation subventions.

Following the anthracite strike in the United States in 1922 and the consolidation of the Canadian National Railways and the Grand Trunk Railway System in the early part of 1923, interest in the possibility of moving Alberta coal to Ontario grew, and from July 1923 to the early part of 1926 the Canadian National Railways instituted special rates at various times of $7.00 and $9.00 per ton. Five experimental lots of coal (consisting of 1,250 tons, 4,961 tons, 10,000 tons, 25,000 tons, and 50,000 tons) were shipped during this period. The traffic was carried as an experiment by the Canadian National Railways without subvention in an effort to ascertain whether a substantial movement could be developed at a low rate basis in competition with United States anthracite.

These experiments of the Canadian National Railways did not, however, produce the results expected, and the Dominion Government issued Order in Council P.C. 225 on February 13, 1926, which in part set forth:

> "That on account of the distance to be traversed in the coal mining areas of Western Canada and the large consuming areas in Ontario, the element of the cost of transportation of coal mined in Western Canada is of paramount importance, and, there appearing good reason to believe the cost of the same would be very considerably reduced if this movement takes place at a time when the rolling stock of the railways is not mobilized for the transportation of the grain crop of Western Canada, therefore, the Board of Railway Commissioners for Canada be requested to enquire and report to the Government upon the question of the cost of transportation of coal per ton in full capacity trainload quantities for such seasonal movements, such enquiry and report to show as nearly as practicable what rate or rates per ton would be the actual cost of the movement, both exclusive and inclusive of overhead, superintendence, and allowance for operative profit; (*a*) from an operating standpoint and eliminating the costs which would have to be incurred in any event, (*b*) inclusive of the same."

Following this direction, the Board instituted an enquiry and required the railways to submit extensive data, which the Board analysed with the assistance of cost experts of the railways and a cost expert for the Provincial Governments of Alberta and Ontario. In order to provide additional specific information on which to base costs, Order in Council P.C. 1446 of September 24, 1926, was issued. The Order in Council in part set forth that:

> "It was expedient in the public interest that measures should be taken to obtain the cost per ton of moving coal by rail in solid trainloads from the coalfields in the Province of Alberta to the Province of Ontario, it being stated that no solid train of coal had been moved by rail from Alberta to Ontario and therefore no complete cost records were available; and that arrangements had been made with the Canadian National Railways to transport a solid train of cars from Drumheller to Toronto and that suitable records were to be made of the movement of the train;
>
> The railway company would charge a rate of $9.00 per ton, of which the Dominion Government would pay $2.00 per ton;
>
> The coal would be consigned to the Fuel Controller of Ontario and sold by him."

After an experimental shipment was made, the enquiry instituted by the Board under direction of Order in Council P.C. 225 was continued. The findings of the Board in this connection and the dissenting opinion of Commissioner

Oliver are published in Volume XVII of the Board's judgments, pages 439-467, of September 22, 1927. While Order in Council 225 directed that the cost of transportation of coal per ton "in full capacity trainload quantities" be investigated, it became evident in the early part of the investigation that such "solid-train" loads were impracticable. The Board commented upon that fact at page 442 of its judgment.

In the report with respect to P.C. 225, the Board set out its understanding of the direction in that Order as follows:

"In summary, what is asked for, as we understand it, is:

(1) The out-of-pocket cost,

(2) The out-of-pocket cost plus the coal traffic's share of the cost incurred in any event, the latter cost being diluted by the added ton mileage resulting from the coal movement, and

(3) Also item (2) plus the element of profit".

The necessity for such information in relation to the coal movement was unique in railway experience, and it is apparent that a sincere effort was made to develop the data on which conclusions could be based. The Board summarized its findings as follows:

	Per Ton
(1) Out-of-pocket cost	$ 7.22
(2) "Inclusive" cost	10.07
(3) "Inclusive" cost, plus the element of profit	12.20

On the basis of these findings that as of the year 1927, the bare out-of-pocket cost for transporting Alberta coal to Ontario for an average distance of approximately 2,000 miles was 3.6 mills per ton-mile; inclusive cost of operation was 5 mills per ton mile; and the inclusive cost plus profit 6.1 mills per ton mile. Commissioner Oliver, in his separate judgment, arrived at an out-of-pocket cost of $6.50 per ton after eliminating certain elements of cost which he thought were inapplicable, and refrained from making any findings as to inclusive cost, and inclusive cost plus profit.

Following this exhaustive enquiry, the Dominion Government, by Order in Council P.C. 439 of March 16, 1928, required the railways to institute test movements of Alberta coal for a period of three years and to publish a nominal rate of $6.75 per ton. The Order further directed that the Board of Railway Commissioners make continuing studies during this period of the cost of moving Alberta coal to Ontario, and the difference between such cost and the nominal rate of $6.75 per ton was directed to be paid out of the Dominion Treasury. In accordance with this direction the Board required the railways to submit the costs of movement of the coal actually transported under the nominal rate of $6.75 per ton for each year and detailed cost studies were submitted to the Board. After carefully reviewing these cost studies the Board found that the cost was $8.23 per ton.

The Board was then directed by Order in Council P.C. 1179 of May 18, 1932, to ascertain what may be described as the bare out-of-pocket costs, and this was done for the year 1931. After investigation, the Board reported on February 1, 1933, that the bare out-of-pocket cost from Drumheller to North Bay was $6.06 per ton, and to Toronto $6.88 per ton, but it qualified its findings by this statement:

> "The railroad adopted a program of retrenchments, extraordinary economies and deferred maintenance resulting in a substantial decrease in operating expenses. These out-of-pocket costs reflect subnormal conditions in operations and should not be considered as applicable to any period other than the year ended December 31, 1931."

During all these investigations the railways contended that their published rates were reasonable, and this contention seems to be supported by a report by the Board to the Dominion Government dated March 16, 1933, wherein it was stated:

> "The only rates under review in the present case are those applicable to the coal movement.
>
> We have determined that the tariff rates are only slightly in excess of the operating expense cost of transporting the coal.
>
> Giving consideration to the relation of coal rates to rates on other commodities and without disturbing the parity but keeping in mind the factors which in the national interest may properly be taken into consideration, it is our judgment the reasonable rates on coal from Alberta points to points in Ontario are the rates published in Canadian National Railways Tariff C.R.C. No. W 354 and Canadian Pacific Railway Company Tariff C.R.C. No. W 2727."

Following this conclusion the Dominion Government, in respect of test movements directed, paid the difference between the rate of $6.75 and the normal tariff rates. It was obvious, however, that coal would not move from Alberta to Ontario on published rates. It then became a question as to what could be done to develop the movement. Consideration resulted in an offer by the railways to carry the coal at a rate of $8.00 per net ton provided the Dominion Government would contribute $2.50 per ton to reduce the cost to the shipper to $5.50, and this rate was established.

Trainload Rate Proposal

It was suggested to the Commission that by moving coal in solid trains the cost could be so reduced that a rate of $5.00 per ton could be maintained by the railways and that such a rate would earn a profit for the carriers. The proposal contemplates the accumulation of trainlots of 50 cars of 40 tons each at any of five assembling points in Alberta, moving them in unbroken trains to Orillia, Ontario, and distributing the cars individually from that point, the $5.00 rate to include delivery to all stations within 100 miles of Orillia, and be subject to additional charges of 0.5 cent per ton for each additional mile of haul outside the 100-mile radius.

At two sittings of the Commission there was considerable reference to trainload rates in the United States, and it is therefore desirable to treat briefly with two existing trainload rates in that country, which were cited to us in support of a trainlot rate to Ontario. One of these, a rate of $2.00 per ton on coal in lots of 2,000 tons from mines in Arkansas and Oklahoma to St. Louis, Mo., compared with a rate of $2.75 per ton in single-car lots. This rate was published only by the St. Louis-San Francisco Railroad, and applies only to dealers served by that line. Where delivery is taken on the lines of other railroads in the St. Louis area, there are additional switching charges ranging from 20 cents to 70 cents per ton, whereas these switching charges are included in the $2.75 rate applicable on single-car lots.

Another example cited was a rate of 15 cents per 100 pounds for the movement of molasses from New Orleans, Louisiana to Peoria, Illinois, in lots of 38 cars, compared with a rate of 17.5 cents when in single-car lots. An examination of the report (235 ICC 485) of the Interstate Commerce Commission approving this rate indicates that the circumstances under which it applies are special and unusual in a number of respects. The rate was established to meet barge competition, no competing shippers were involved, the minimum quantity of 38 carloads was to be available for shipment on a single day, and the 38-car block could be included in a train hauling as many as 71 cars.

Bearing in mind that a movement in solid trains of 50 cars from Alberta to Ontario is not physically possible even during the summer months over the railways involved and that the accumulation of the required minimum tonnage and the departure from the practice of handling full tonnage trains up to the maximum capacity of each railway subdivision might entail additional expense as compared with existing practices, the trainload rate proposal offers small hope of reducing the cost of transporting Alberta coal to Ontario. The movement of grain from the western provinces to the Head-of-the-Lakes is in trainload quantities. As we have seen, the rates for this movement are controlled by the Crowsnest Pass Agreement and are now on the same level as in 1898. With a rate of $5.20 per ton applying on grain from Drumheller to Port Arthur, the proposition that the railways could transport coal from Drumheller (an additional 700 miles or more) to reach the markets of Central Ontario at a rate of $5.00 does not appear to be a reasonable one.

SPECIFIC TRANSPORTATION PROBLEMS

Railway Rates from New Brunswick Mines

The New Brunswick Coal Producers' Association, representing seven coal producers whose output constitutes over 90 per cent of the Province's production, submitted a brief to the Commission which dealt in part with the railway rates applying from the mines in the Minto-Chipman field to various destinations, principally in New Brunswick. The brief calls attention to—(1) charges assessed for moving coal from the collieries over spur tracks to the main lines of the railways, (2) inequalities in these charges as between different mines, and (3) differences in rates from New Brunswick mines as compared with rates from Nova Scotia mines to certain destinations.

Insofar as this rate adjustment may constitute unreasonable and unduly prejudicial treatment of certain operators in the Minto field as compared with other operators in the district, or as compared with Nova Scotia producers, it appears that these are matters which should be presented to the railways and if necessary to the Board of Transport Commissioners. The Producers' Association does not, however, suggest that the freight rate structure be changed, but rather that the inequalities be eliminated by the payment of subventions. The same proposal has been made on previous occasions to the Dominion Government. There are a great many differences in freight rates as between coal producers in various parts of Canada, and for the Government to undertake by subvention payments to counterbalance all such differences would involve many difficulties. It is the view of this Commission that a recommendation of subvention payments for this purpose is not warranted and that the producers, if they feel that the present situation is a hardship on them, should pursue the matter further with the railways and the Board.

Alberta Coal Via Rail-and-Lake to Great Lakes Ports

The suggestion has been made that the marketing of Alberta coals in eastern Canada might be expanded if they were moved by rail to Port Arthur or Fort William and down the lakes by boat to ports on the lakes, more specifically to Georgian Bay ports. While attractive in theory, the proposed transportation does not appear to be either practical or economical. The physical structure of most western "domestic" coals is such that degradation resulting from the handling from cars to vessels and vessels to docks, and from storage on the docks, would create serious marketing problems. The present facilities at Port Arthur and Fort William are not well adapted to a transfer of coal from rail to water-carriers. A movement of coal down the lakes would have to compete with the other commodities for vessel space, and it could not be expected that the rates offered

would be on anything like the same low level as for movement of coal to the Head-of-the-Lakes. The rate on coal from Drumheller, Alberta to Port Arthur and Fort William is $6.50 per ton. Adding to this the cost of transfer to vessels and a vessel rate to Georgian Bay or lower lake ports, it is clear that such a movement could not compete with the all-rail transportation for which the present charge is $8.00 per ton.

The Canso Causeway

Cape Breton Island is separated from the mainland of Nova Scotia by the Strait of Canso, a body of water about 16 miles long and 4,000 feet wide, with depths ranging from 100 to 160 feet. Transportation across the strait is provided principally by two car ferries operating between Mulgrave on the mainland and Point Tupper on the island, and carrying both freight and passenger cars. The railway lines from Sydney to Point Tupper, Mulgrave to Stellarton, and Truro to Moncton, N.B., have heavy grades and curvatures which limit the load that locomotives can handle over these sections. It has been proposed that the ferries over the strait be replaced by a causeway or a bridge, and that the three sections of railway line be re-aligned or rebuilt.

There is no doubt about the desirability of these changes from the standpoint of general convenience but we have given consideration only to the effect of the present arrangements on the transportation of coal, and what results could be expected from construction of a causeway and revision of the railway line. The large proportion of the output of coal on Cape Breton which is consumed by steel plants on the island or shipped by water from Sydney in normal times has already been noted. The physical limitations of the existing rail route have not apparently restricted the distribution of Cape Breton coal to market by railway. During the war, because of the shortage of vessels there were heavier shipments of coal by rail across the strait which coupled with heavy wartime movements of other commodities resulted occasionally in congestion and delay to shipments. The increase in vessel capacity now taking place will apparently reduce the movement of coal across the strait to approximately its pre-war volume, so that from the standpoint of transportation capacity of existing facilities, it cannot be seen that the marketing of coal would be materially assisted by the proposed construction.

It was suggested to the Commission that the proposed causeway and revision of line would so reduce the cost of railway operation as to warrant substantial reduction in freight rates from the mines and expand shipments by rail to markets in Quebec and Ontario during the winter months—for example, a reduction of $1.23 per ton in rates to Montreal was proposed. The construction would make comparatively small reductions in the length of the rail hauls. In this connection it might be pointed out that the present rail rates paid by the shippers to Montreal are $3.80 per ton from Sydney and $3.30 per ton from Stellarton on the mainland, a difference of only 50 cents per ton. Even with the proposed construction, the distance from Sydney would still be more than 125 miles greater than from Stellarton, so that the expectation of any such substantial reduction in rates is illusory. Further, the difference between the water cost and even greatly reduced rail rates is so large that there is no reason to expect a diversion of traffic to the railway route if the rates from Stellarton to Montreal should be extended to apply from Sydney.

The St. Lawrence Deep Waterways

The Great Lakes and the St. Lawrence River have provided an artery of transportation for many years, the canals at Sault Ste. Marie and Welland making the lakes navigable by large steamships from the Head-of-the-Lakes to

Lake Ontario. On the St. Lawrence River the Lachine Canal, built many years ago, makes navigation between the Great Lakes and Montreal possible for small sized boats, generally termed canalers.

About 1905 the deepening of the St. Lawrence River to accommodate ships of much deeper draft was first projected and, following much examination in the intervening years, resulted in 1932 in the signing of the St. Lawrence Deep Waterways Treaty between the Governments of Canada and the United States, which provided for a channel of 27 feet. However, all treaties are required to be ratified by a two-thirds majority of the Senate of the United States, and the project collapsed when the Treaty failed to secure the necessary majority in the United States Senate. In March of 1941, a new agreement entitled "The Great Lakes-St. Lawrence Basin Development", which also calls for a 27-foot channel, was concluded between the two countries. This agreement has since been under consideration by the Senate of the United States but has not yet been ratified by that body.

Over the years, the project has become as important from its hydro-electric aspects as from the deep-sea waterways standpoint. Both countries, under the agreement, would share in the power generated. The development of the International Rapids section proposes two powerhouses, one on the Canadian side and the other on the United States side, each powerhouse to have an installed capacity of 1,100,000 horsepower. The total cost of the whole project has been variously estimated, but as Canada has already contributed to the project by the construction of the Welland Canal, which merely has to be deepened, her additional contribution will not be as large as that of the United States.

The project has been generally, although not unanimously, regarded with approval in Canada; but in the United States amongst the interests opposing it are the coal mining industry, the railways and shipping companies, the organizations of labour employed in such industries, and certain communities which feel they may be adversely affected.

Assuming, however, that the project is eventually proceeded with, this is an appropriate place for some speculation as to its effects on the Canadian economy, with particular reference to coal. The waterpower development will result in further large supplies of power, which will have the effect of displacing some coal as a source of energy. At the same time it will make for an intensely industrial area in the St. Lawrence basin and, to that extent, coal may derive some benefit. With the completion of the project, many seagoing boats would be able to proceed to upper lake ports without trans-shipping cargo, and as a sizeable amount of coal was imported prior to World War II to the ports on the St. Lawrence River from Great Britain and Europe, including Russia, resumption of that movement may be possible and the canal would permit a further extension to ports on the lakes. At the present time most Nova Scotia coal waterborne to Montreal has to be trans-shipped, either by rail or by smaller sized ships, for westward furtherance. The development of the waterways would make it physically possible for much larger boats to move directly from Sydney to any port on the Great Lakes. On the other hand, there is also the strong probability that United States coal, which now moves in some volume down the St. Lawrence in canalers, would move through the enlarged canal in the more economical bulk steamers and be more competitive in the Montreal area that at the present time. Furthermore, the waterways would probably encourage the inflow to Canadian points of foreign petroleum and fuel oil, thereby increasing the competition with

coal. The canal would not, of course, be a year-round operation, since ice will prevent navigation during the winter months; therefore the project offers no solution to Nova Scotia's problem of seasonal coal movement.

CONCLUSIONS

The foregoing review of transportation of coal in Canada makes it evident that the distribution is not handicapped by any lack of adequate facilities for movement by rail or water or for the physical transfer of coal from one means of transportation to another. Even with the necessity of concentrating the vessel movement into the months of open navigation on the rivers and lakes, the capacity and co-ordination of the transport facilities is such that in normal years inadequacies of transportation are virtually unknown. During the war there was, of course, an interruption in the vessel movements up the St. Lawrence River, and this situation is not yet fully corrected.

The review of freight rates indicates that in relationship to other commodities the rates maintained on coal are among the lowest, and that railway rates on coal in Canada are generally comparable to those in the United States.

Nova Scotia coals, because of relatively high production costs, must rely on water transportation to reach markets outside the Maritimes, and before the war only the low cost of transporting coal by vessel enabled Cape Breton coal to compete with imported coals as far west as Montreal. Beyond Montreal, subventions were required to permit the marketing of Maritime coals in the face of competition from United States sources. The marked increase that has occurred since 1939 in vessel rates raises doubt as to the ability of Nova Scotia coal to maintain its competitive position.

Broadly speaking, western "steam" and "domestic" coal is competitive with imported coal under existing railway rates about as far east as Winnipeg. The principal market for the "steam" coals is for railway use, and for this purpose the published freight rates are not a factor. In the case of the "domestic" coals it seems clear that it is not possible to have unassisted rates low enough to permit movement of this coal to the densely populated areas of Ontario so that if "domestic" coals are to be marketed in this area there must be assistance through subventions. This is also true of marketing western coals for industrial use east of Winnipeg.

CHAPTER VII

DISTRIBUTION

The price of coal to the consumer is the mine cost, plus duty in the case of imported coal, plus transportation and plus the cost of services provided by the distributive trade. Excessive costs in any of these fields must work to the disadvantage of either the producer or the consumer, or both. Production and transportation costs have been discussed in other chapters, and this chapter will only examine the services provided by the distributor and the price he charges for those services.

The chapter on Markets gives full information as to the types of coal used in the various areas, where it originates, and the approximate tonnages. The Maritimes use principally Maritime coal, Western Canada uses coal produced in that area, and Central Canada uses chiefly imported coal. Prior to the war substantial quantities of United States and United Kingdom coal were used for domestic heating in the Montreal and Lower St. Lawrence regions, and Maritime coal was an important fuel for industrial and railway purposes in Central Canada east of Lake Ontario. The entire Central Canada area is now, however, almost entirely dependent on United States coal for all purposes.

The terms used in describing those engaged in the distribution of coal are importer, wholesaler and retailer. Wholesalers are those engaged in buying and selling coal, the sales being generally to the retail trade or to large consumers. They may physically handle some coal, although in most cases coal sold by them is shipped direct from the mine to the customer without going through the wholesaler's hands; and some wholesalers never actually take possession of any coal. Retailers are those who take delivery of coal and sell it to the ultimate consumer. In areas where water-borne coal is imported, the importation is usually handled by a wholesaler who takes delivery of coal in large quantities and maintains coal stocks on hand. In such cases he is commonly termed an importer. Where most of the coal used is shipped by rail and possession is not taken by the wholesaler, the term importer is not often used, although the coal originates in a foreign country. It is not possible, however, to adhere strictly to any classification when dealing with the subject of distribution. Frequently a retailer imports his own coal and may act as a wholesaler with respect to some isolated transactions; in some cases a distributing concern owns the mines which are its principal source of supply; and sometimes the producer operates his own selling agency, occasionally to the extent of handling his own retail sales.

As by far the greater part of Canada's coal consumption occurs in the Provinces of Ontario and Quebec, herein designated as Central Canada, it is proposed to deal with that area first, turning then to the Maritimes and to the West.

CENTRAL CANADA

Mechanics of Coal Importation

United States coal enters Central Canada both by rail and by water. The rail movement of coal requires no special comment. The coal is loaded on cars at the mine and is routed, as a rule, direct to the premises of the larger consumer or to the distributing yard of the retail dealer, at which point it is unloaded and trucked to the consumer's premises after being screened, oil treated and bagged, if such services are necessary for the purposes of the particular consumer.

Due to the proximity of Central Canada to the anthracite fields of Pennsylvania, and the fact that it is a domestic fuel conveniently handled in carload lots direct to the retailer's yard, most of the anthracite consumed in Central Canada is still brought in by rail, although a considerable tonnage also moves by water.

In recent years bituminous coal has been principally water-borne. The present water movement of coal, at least to the areas of greatest industrial activity on Lake Ontario, is a comparatively new development. While there has been considerable movement of coal on the Great Lakes for about a century, the opening of the Welland Ship Canal in 1931 permitted the passage of large-sized ships from Lake Erie to Lake Ontario and accelerated the development of large self-unloading vessels which could discharge their cargoes at any point having sufficient depth of water to accommodate them. While this did not greatly affect the importation of coal into the Upper Great Lakes region, where bulk freighters are still used extensively and many docks have facilities for unloading them efficiently, and did not influence to any great extent the movement of American coal from United States ports on Lake Ontario into the area east of Cornwall where small canalers are still required, it did lead to a great expansion in the water movement of United States coal to such large centres of industry and population as Toronto, Hamilton and the Niagara peninsula, and by shortening the expensive rail haul to the trans-shipment point brought about a shift from some of the sources of supply in Pennsylvania to southern coal fields.

Efficient discharge of coal delivered in bulk freighters requires the use of either a coal bridge, which moves coal directly from the boat into storage, or coal towers, which unload coal from vessels into small cars holding from five to twenty tons which are moved on elevated tracks to the storage area where the coal is dropped. The development of the self-unloading collier, discharging its cargo at rates in excess of 1,000 tons an hour, made it possible to deliver cargoes economically at many ports where tonnage would not justify the heavy expense of installing unloading equipment. The development of shallow-draft small self-unloaders of approximately 1,000-ton capacity led to the establishment of many small docks to look after local consumption at lower cost. The opening of the Welland Canal and the development of the self-unloader altered the mechanics of coal importation from Quebec City to the Head-of-the-Lakes. In this section there are, in all, over sixty points where United States water-borne coal is unloaded. These points, with the type of vessel handled, the principal method of trans-shipment and the approximate tonnages received are shown in Appendix B of this report.

Coal docks vary considerably in the type of equipment used. Docks on the Upper Lakes or the Lower St. Lawrence, such as those at Fort William or Quebec, accustomed to receiving coal by bulk freighter, still use the towers or coal bridge for unloading; docks built for the use of large self-unloaders and handling considerable tonnages do not have the towers or bridge but have elaborate facilities for moving, screening and treating coal; and small docks served by the smaller self-unloaders may have as little equipment as one or two small portable conveyers.

The docks at Toronto are a good example of the recent development of the dock business, as a comparitively small amount of United States coal came into that city by water prior to the opening of the Welland Canal. There are sixteen dock operations in Toronto, handling a total of some 1.5 to 2 million tons a year. These vary in size from smaller docks handling as little as 50,000 tons to larger ones handling approximately 300,000 tons. They are all designed to receive coal by self-unloading vessel. The dock area in this city practically

all belongs to the Harbour Commission, which has reclaimed the land and built the dock frontage, and leases dock areas to coal importers or private dock operators. There is sufficient depth of water to accommodate any vessel. The dock areas run as much as 800 feet in depth from the waterfront, and as the coal is deposited by the self-unloader vessels at approximately 200 feet from the water most of the coal must be moved to storage areas at the rear. Some of the docks have installed belt conveyers equipped with stackers to move this coal into piles or storage hoppers, but most of the docks move the coal back either by casting with cranes or by trucking and ramping.

From storage the coal is reloaded into trucks for delivery to the retailer or consumer, either directly by cranes or a portable conveyer, or is handled by these means through hoppers having a capacity of forty to fifty tons each. Most of the domestic coal is handled through the hoppers, which are generally equipped with screens, with apparatus for oil treatment, and with bagging platforms. At a point like Toronto, most water-borne coal for domestic consumption is trucked direct from the docks to the householder.

The docks are also equipped with railway facilities which can be used for both incoming and outgoing shipments, although in the case of Toronto they are used almost entirely for incoming coal, as practically all deliveries to retailers and consumers are made by truck. Railway cars on these docks are generally unloaded by crawler cranes with clam-shell buckets, although sometimes railway cars are dumped into shallow underground pockets from which the coal is brought to the surface by a conveyer belt system or portable conveyer.

In order to supply the varied consumer requirements, many different kinds and sizes of coal are handled on the dock. Typical of these are northern coals from Pennsylvania and Ohio in egg, nut, stoker and nut slack sizes; West Virginia and Kentucky high volatile coals in the same sizes; Pocahontas coal from southern West Virginia in stove, nut, pea and stoker sizes, and, in addition to these bituminous coals, three or four sizes of anthracite and two or three sizes of coke.

The docks handling considerable tonnages of domestic coals are equipped with machinery for treating the coal with oil, this applying particularly to stoker coals, which although often so treated at the mine have to be treated again at the dock to ensure dustless delivery. Practically all coals, except industrial and stoker sizes, are re-screened, and the resultant screenings constitute a considerable operating problem. An example of this is Pocahontas stove size where, the coal being very friable, only about 65 per cent is recovered for sale as domestic coal, the remaining 35 per cent being sold as screenings for industrial and commercial uses.

While the Toronto docks have been dealt with as representing the new development in coal handling resulting from the use of the self-unloader, dock operations on the St. Lawrence, such as those at Quebec, Three Rivers and Montreal, are equally efficient, differing principally in that most of the coal arrives in bulk freighter and requires unloading equipment.

These docks are usually operated by persons or firms engaged in the wholesale distribution of coal, although in some cases dock operations are carried on as an independent business by persons who are not themselves engaged in the buying or selling of coal, and in others by persons engaged principally in the retail trade.

Having dealt in brief with the mechanics of the importation of coal, it is now proposed to deal with the individuals who engage in this trade and who deal with the coal following its importation.

Wholesale Distribution

United States Bituminous

United States bituminous coal, in normal times principally water-borne, is handled largely by a relatively small group of companies. This is natural having regard to the cost of equipping a modern dock, which might run to upwards of one-half million dollars, and to the capital required to meet operating expenses and maintain large stocks of coal on hand for considerable periods. A number of the larger producers of this coal in the United States have established importing and wholesale subsidiaries in Canada, and in other cases have given exclusive contracts for the Canadian distribution of their coal to a single Canadian company.

In addition to operating their own docks, coal importers place substantial tonnages of coal on docks owned by others. In such cases they may pay a dock-handling charge of so much per ton to the dock operator, the charge varying depending on the way the coal is handled, the tonnage involved, and the amount of treatment required to be given the coal on the dock. In some cases the dock is operated by the railway company and the charge is absorbed in the outgoing freight from the dock. In other cases the dock company may own, in addition to the dock, the vessels bringing coal in from the United States exporting port, and the boat and dock charges are combined in one handling charge. Frequently coal is sold direct to a dock company which re-sells to the trade. In the case of railway coal, the contract may merely oblige the importer to deliver a specified amount of coal at an f.o.b. mine price and ship it to a United States lake port, after which full responsibility in connection with the payment of freight, the dumping charges, and the delivery, is that of the railway. In some instances the purchaser may provide a ship but desire to have it loaded, in which case the importer will ship the coal to the United States lake port and pay the railway freight and dumping charges, which will in turn be billed to the customer. In other cases the vessel will be arranged for and the duty will be paid by the importer.

The importer, if a wholesaler, usually makes direct or off-dock shipments in the case of bituminous coal to large consumers and to retailers, and does not seek direct sales to small consumers because the credit risk of the customers and a variety of other circumstances make it easier for the individual dealer rather than the wholesale firm to satisfy the ultimate consumer; although at points where the wholesaler maintains a dock, he will often sell to smaller industrial or commercial consumers in the immediate locality, the coal being delivered direct from the dock to the consumer in dump trucks. Some wholesalers sell even to householders, and some retailers, even those without dock facilities, have large industrial accounts. It is estimated, however, that in general the dividing line is in the neighbourhood of 200 tons annual consumption, those consuming more than that amount purchasing from wholesalers, and retailers supplying consumers with smaller annual requirements.

The importer-wholesaler is obliged to maintain close contact with the United States producing fields, to enable him to locate and supply the coal most adaptable to the consumer's needs. He must also promote the use of coal produced by the United States supplier with whom he has a contract and try to persuade the consumer to use burning equipment suited to the coal which he supplies. He often employs a combustion engineer to advise customers and potential customers. He supervises the movement of coal from the mines to the lake front, and the co-ordination of the rail movement to the United States loading dock with the lake vessel movement to the Canadian destination. Careful planning is required to accomplish this. Some coals break down in storage more than others and must be shipped as late as possible in the navigation

season. He must find market outlets to prevent an unbalanced position at the mines between sizes. He must make all the necessary arrangements for the handling of the coal once it arrives, and he must so correlate supplies and requirements to prevent over-stocking and yet have available sufficient coal to satisfy his customers.

The handling of United States bituminous coal, due to the great number of American suppliers and the wide variety of coals, does not follow any set pattern, and it is comparatively easy for any distributor to make his own arrangements to secure a supply of this fuel. It is handled in Central Canada principally by the following companies, each of whose annual tonnage of coal handled both as importer and as broker is in the neighbourhood of one million tons or more: Canada Coal Limited, Empire Hanna Coal Company Limited, Pittsburgh Coal Company Limited, Rochester and Pittsburgh Coal Company (Canada) Limited, Valley Camp Coal Company of Canada Limited, (all of which are subsidiaries of or affiliated with United States producers), and Boon-Strachan Coal Company Limited, Canadian Import Company Limited, Mongeau and Robert Compagnie Limitée, and F. P. Weaver Coal Company Limited, which are amongst the largest of the Canadian-owned companies.

United States Anthracite

United States anthracite, being generally rail-shipped, does not involve quite the same complications as is the case with bituminous coal. Some of it is handled over the docks, but as a general rule it is shipped direct to the yard of the retailer. Most of it originates in the mines of the "line companies", which are comparatively few in number and are the principal suppliers to the Canadian market. Some of these companies have incorporated marketing subsidiaries in Canada and in other cases grant exclusive agency agreements either for all Canada or for a particular area.

The principal American suppliers to the Canadian market are the Delaware Lackawanna and Western Coal Company, Philadelphia and Reading Coal and Iron Company, Jeddo-Highland Coal Company, Pittston Coal Sales Company, Lehigh Navigation Coal Company, Lehigh Valley Coal Sales Company, M. A. Hanna Company, and Delaware and Hudson Coal Company. The three first named distribute their coal in Canada through Canadian subsidiaries or affiliates, while the others are represented in Central Canada by independent concerns, of which the largest are Canadian Import Company Limited, Empire Hanna Coal Company Limited, Scotch Anthracite Coal Company Limited, St. Lawrence Importing and Distributing Company Limited, and F. P. Weaver Coal Company Limited. Anthracite Sales Limited, which also supplies a large quantity of anthracite to the Canadian market, handles principally coals produced by a number of the "off-line" or independent mines in the anthracite fields.

United Kingdom Anthracite

United Kingdom anthracite had a substantial market in Central Canada during the pre-war years, and this trade may revive although its future is uncertain. As it was all water-borne, it had to be handled on docks in somewhat the same manner as the handling of United States bituminous coal already dealt with, except that, arriving by freighter, it required more elaborate dock equipment for unloading. Welsh anthracite was handled principally by the British Coal Corporation of Montreal, a wholly-owned subsidiary of the Canadian Import Company Limited, which is exclusive agent for a sales company in the United Kingdom controlling distribution of nearly 70 per cent of Welsh production. Other firms imported some Welsh coal, but most had discontinued doing so. Scotch anthracite was handled by the Scotch Anthracite Company of Montreal, a subsidiary of the exporter in London. While United States anthracite

degrades only slightly, the softer structure of United Kingdom anthracite, and the squeezing and crushing on the ocean voyage, caused up to 30 or 35 per cent of domestic sizes to degrade to buckwheat and screenings. Much of it was also imported in large lumps, which required the installation of breaking machinery on the Canadian docks, and importers in Montreal have made large investments in plant equipment to break, screen and otherwise prepare this coal for market. British Coal Corporation wholesaled through its parent firm, Canadian Import Company, and through the F. P. Weaver Coal Company. United Kingdom anthracite also entered the Toronto market, being sold wholesale through the F. P. Weaver Coal Company and through Elias Rogers Coal Company Limited and the Milnes Coal Company Limited, both of which also retailed it.

Canadian Coal

Nearly all the Maritime coal entering Central Canada comes from mining subsidiaries and affiliates of the Dominion Steel and Coal Corporation Limited, and it has been the policy of Dosco to market as much of its production as possible without the intervention of any sales agency. About 85 per cent of its sales are direct. It maintains a coal sales department at Montreal and branch offices and salesmen elsewhere in Central Canada, and in the pre-war years it supplied the bulk of the industrial coal in the Montreal area. This coal moves during the navigation season into the St. Lawrence dock terminals at Quebec, Levis, Three Rivers and Montreal. Some is stock-piled and is shipped as required by rail and truck, depending on the nature of the receiving facilities at the point of consumption, and the distance from the supply dock. That going to Ontario is either forwarded from the docks by rail or is trans-shipped into canalers and sent on to water delivery points on the St. Lawrence and the Great Lakes as far west as Little Current on Georgian Bay. Dosco also maintains docks at Toronto where the coal is stock-piled for delivery to consumers and dealers.

Coal from independent Nova Scotia mines and from mines in New Brunswick is shipped into the Montreal area in comparatively small quantities. The movement is almost entirely by rail. It is generally sold through exclusive sales representatives.

Western coal has not been so far of great importance in the Central Canadian market and, as a result of wartime conditions, its supply to that market was greatly curtailed after 1942. When the subventions first commenced many western producers opened sales offices in Ontario, but all but one of these have now been closed. Some sales agents were salaried employees of the mine, but others were paid commissions ranging from 15 cents to 35 cents per ton. Such coal as does come in is shipped by rail direct to the premises of the consumer or the retailer. There have been some sales direct to the consumer, but the bulk of the movement has been through dealers. Western coal found its best market in the northern part of Ontario where competing coal was also delivered by rail. It was widely used there for railway and industrial purposes and was also used extensively for domestic heating, the heating equipment, which was designed for wood, being readily adaptable to western "domestic" coal.

Cost of Wholesaling

The profit taken by the wholesaler or the importer-wholesaler varies considerably, depending on the type of coal and the service he performs. On United States bituminous coal in pre-war days, competition between producers and between distributors resulted in a variety of arrangements. Some coal would be purchased by the Canadian importer and resold by him, both purchase and resale being at the best price obtainable. In some cases there was both a discount and a selling commission. The National Bituminous Coal Act of 1937,

first effective in the Fall of 1940, established minimum prices, maximum discounts and selling commissions, and required contracts with sales agents and wholesalers to be approved. With the establishment of maximum prices by the United States Office of Price Administration, the subsequent expiry of the National Bituminous Coal Act, and the change to a position of short supply, the practice of granting discounts practically disappeared and most sales thereafter were at ceiling price, in which case the Canadian importer simply added his margin to the mine price, the margin varying from 10 cents to 50 cents per ton, depending on the competitive position, the tonnage involved, and the grade of coal delivered. At present, the Wartime Prices and Trade Board limits to 45 cents per ton the total mark-up on bituminous coal shipped by rail to retail dealers. These figures, of course, apply only to direct sales. Where the coal is handled over the importer's docks, the expense of dock handling is added.

During the life of the National Bituminous Coal Act, discounts ranged from about 10 cents per ton, applying usually to railway fuel, to about 50 cents per ton in the case of cannel coal, with some discounts being on a percentage basis such as 6 to 8 per cent of the f.o.b. mine cost of the coal. The general discount to Canadian importers was about 12 cents to 15 cents. In addition, producers sometimes paid commissions to their sales agents amounting in general to 6 per cent to 8 per cent of the mine cost.

United States anthracite is handled on a somewhat different basis. The large producers periodically issue a circular, establishing a price to the retail trade f.o.b. cars at the mine, and the exclusive agent in Canada is generally entitled on all sales to a discount of about 25 cents per ton on domestic sizes and 10 cents to 15 cents per ton on the smaller sizes used in stokers and blowers. Usually a further discount of 5 cents to 15 cents per ton is given for prompt payment, which is invariably passed on to the retailer for prompt payment by him. The coal is normally invoiced to the wholesaler at the mine price less the discount, and the retailer is billed at the mine price. The retailer usually pays the freight and the exchange, if any, on United States funds. As is the case with most wholesale transactions, the wholesaler accepts the credit risk of his customer.

The price of United Kingdom anthracite is to a considerable degree dependent on the price of competing United States anthracite. Examination of financial statements of companies engaged in importing this fuel indicates that it was not unduly profitable business. It would appear, however, that margins allowed to wholesalers for selling United Kingdom anthracite are somewhat in excess of those given by suppliers of United States anthracite.

As has been stated, Maritime coal is largely distributed by the producing company or its affiliates. Dealers wishing to buy this coal normally pay the same price as consumers, except at points where Dosco has no sales office of its own, in which case their coal is distributed through an agency arrangement and a discount ranging from 10 cents to 25 cents a ton is allowed off the established dock price. Dealers supplying apartments, stores, institutions and smaller industrial accounts in places such as Montreal usually take a mark-up of about 25 cents per ton over the Montreal dock price, in addition to their normal delivery charge. In Ontario, wholesalers desiring Dosco coal are given a discount of 10 cents per ton, but compared with margins on other coals it is not sufficient to attract them, except where their customers desire it.

The sales representatives of coal from independent Nova Scotia mines and from New Brunswick mines generally operate on a gross margin of 25 cents per ton, and where sales are through wholesalers no discount is granted.

Where coal is handled by a wholesaler over his own coal dock, his charge is based on the service rendered, depending on whether the coal arrives by bulk freighter or self-unloader, and whether it requires screening or oil-treating. The

actual cost of dock handling of coal probably runs from 25 cents to 75 cents per ton, exclusive of such items as degradation, shortages, interest on the money invested in coal, depreciation and the cost of administration. Due to the many varieties of coal handled over each dock, it is almost impossible to ascertain the exact amount of profit on any particular type of coal handled. Degradation has to be considered in dock spreads, and on a friable coal such as Pocahontas stove sizes considerably more gross margin is required than on a coal where no degradation occurs, as resulting screenings are either lost or mixed with slack and sold at a reduced price for industrial purposes.

The principal operating costs of a dock are rent, taxes, labour, insurance, depreciation on equipment, maintenance and repair, and such miscellaneous expenses as power, light, tools, et cetera, and there are, of course, general supervision and administrative expenses. The majority of these expenses are fixed and bear little relation to the tonnage of coal handled. If a dock can operate for an expense of, say, 60 cents per ton on 130,000 tons, it is probable that this would be closer to $1.00 per ton if the tonnage should drop to 80,000 or 90,000 tons. Then, too, docks handling coal for substantial industrial accounts with a year-round business have a comparatively low overhead and are able to turn over coal on a given space twice or even oftener each year. Dock owners supplying domestic coals for the dealer trade require a great deal more equipment and, as these coals normally enjoy much larger sales in the winter than in the summer, there is not the same rapidity of turnover of inventory, requiring greater use of dock space and requiring that capital be tied up for longer periods in inventories.

Complete financial information was tendered by all of the larger importers but, as their administration expenses include both direct and off-dock sales, it is difficult to ascertain the profits of the dock operations alone. This information, however, does indicate that salaries paid are reasonable and, considering the total tonnage of coal handled and the amount of money employed in the business, the profits are not excessive. They do appear large in many cases in relation to the capitalization of the company, but most wholesale companies, particularly those that are Canadian subsidiaries of United States firms, have capitalized only sufficient to take care of the investment in docks and in coal when their inventories are at the low point, the additional money required in building up inventories being obtained either by bank loans or credit extended by United States suppliers. The net profits of one large importer who maintains docks and handles coal of many kinds, both by direct and off-dock sales, amounted in 1945 to just over 11 cents per ton before tax, and this is probably a fair sample in the case of Central Canada importers. Some of the direct sales of large quantities of coal to consumers of good financial standing appear at times to give a substantial revenue to the wholesaler at very little cost or trouble to him, but it is necessary to look at his over-all operations to determine whether his profit is too high. Due to the fact that most wholesalers deal principally in two or three varieties of coal, often with exclusive contracts, there is a certain amount of dealing between wholesalers, in which event there is some splitting of commissions. This, however, does not appear to be undesirable, as, due to the range of coals required by the market in this area, it is impossible for one dealer to have contacts or be familiar with the entire range.

The Retailer

The established retailer maintains one or more coal yards in the city in which he does business. He has a considerable capital investment in his yards, office, coal storage sheds, screening and treating equipment, weigh scales, and trucks or wagons for delivery. Some of the larger yards have costly installations for unloading railway hopper or dump cars direct into storage bins, or have

crawler cranes for the same purpose. Others unload onto the ground and use portable conveyers to transport the coal to the storage area or bin. The smaller retailers unload and store the coal by hand labour. A retailer may handle as many as eighteen or twenty different types and sizes of coal and two or three sizes of coke, requiring at least that many storage bins. The amount of equipment depends entirely on the financial position of the retailer and whether the tonnage involved justifies the expense.

Many retailers throughout Central Canada have acquired agencies for oil-burning equipment, and some have installed oil storage tanks. The trend to automatic stokers has also put them in many cases in the stoker business and has changed, to some extent, the type of coal which they handle.

The retailer is usually licensed by the town or city in which he operates. In some cities he must have his weights checked at city weigh scales and furnish a city weight ticket along with his own invoice, while in others he is subject to spot checking of weights by the local police. The retailer sometimes purchases his coal direct from the mine, but in most cases from a wholesaler with whom he establishes a contact. Even large retailers indicate that there is no special advantage in buying direct. Water-borne coal may be trucked to the retailer's yard from the docks in the dock operator's vehicles. More often it will be picked up at the docks by the retailer's trucks, sometimes being screened, treated and bagged on the premises of the dock owner, and being transported direct to the domestic consumer without going near the retail yard. In the case of yards located at considerable distance from the dock, it may be brought to the yard in large heavy-duty trucks or truck-trailer combinations maintained by the retailer. Rail-shipped coal is usually consigned direct from the mine to the yard of the retailer, and there unloaded and placed in storage or, if he has no siding facilities, it will be trucked to his yard from the railroad siding in his town.

A large retailer in a city like Toronto will handle possibly 50,000 to 100,000 tons of coal a year, and in smaller towns the retailer's tonnage may be as low as a few hundred tons. In the former case he will deal in a considerable quantity of coal for commercial enterprises such as apartments, stores, theatres and office buildings and small industries requiring less than about 200 tons per year. The smaller retailer may supply domestic requirements only.

Only in the case of the larger retailer in the more populous centre will his activities be confined to coal and other solid fuels. Most of the smaller yards, particularly in the rural areas, deal in a variety of other products, generally some commodity with which the coal business can be combined. Commonly, the retailer deals in building products, or he may deal in such things as grain and feed or ice, all of which require storage space and trucks for deliveries.

There are in Central Canada about 3,400 licensed retailers. It is estimated that there were in Toronto before the war 300 coal dealers, which figure has now dropped to about 150. During the depression years many individuals, owning a truck used in general hauling or on construction work during the summer, made a practice of coming into the cities in the Fall where, with no establishment other than a truck and a telephone, they engaged in the coal business, purchasing coal in small lots for delivery direct to the consumer. They could earn in this way somewhat more than by letting their services and their trucks to some established concern. Known to the coal trade as "snowbirds", these individuals were considered to give unfair competition to established dealers, as, maintaining no offices, storage space or staff, they were able to cut prices below the minimum required by a year-round business and possibly forced out of business some established retail concerns. The availability of more remunerative employment did much to eliminate this competition, and it completely disappeared in Toronto and many other larger centres by municipal regulations requiring the possession of some storage space and the maintenance on hand of a certain quantity of fuel as a prerequisite to obtaining a retail licence.

At many points on the Lakes or the St. Lawrence, retailers act as their own importers, maintaining storage docks and taking for themselves what profit there may be in dock handling. In some cases they may also have an interest in a ship, enabling them to share in the profits of transporting their own coal. Such cases, however, are unusual. Most retailers do not concern themselves with anything but the retail trade.

The retailer must, in the case of coal passing through his yards and screened and treated by him, take such loss as there may be on degradation and find means of disposing of the resultant screenings in the same manner as outlined previously in the description of dock operation. This is not a particular problem with the smaller retailer handling principally rail-shipped anthracite but is a very important item to the retailer who handles any large quantity of bituminous coal for domestic use.

A typical large retailer, handling over the last six years tonnages ranging from 50,000 to 100,000 tons per year and practically all of whose coal was brought in by rail, showed net profits before tax running from 87 cents per ton down to a low of 16 cents per ton. This variation is accounted for by the fact that the expenses in handling, particularly labour costs and the cost of maintenance of equipment, have risen rapidly, while the stabilized price has prevented this increase being passed on to the consumer. The tonnage of coal used by domestic consumers in recent years has been far in excess of the consumption in pre-war years, and this has enabled the retailer to operate on the pre-war margin notwithstanding increased costs.

The retail-dealer "spread", including cartage, storage, screening, and all work incidental to the delivery of coal into the consumer's premises, ranges, in the larger centres of population in Central Canada, from 90 cents to $3.50 per ton. This depends on the type and quantity of coal involved, the amount of preparation required, the method of delivery, and the area served. In some cities and towns coal is delivered principally in bulk and is placed by a chute or by a small portable conveyer into the basement of the consumer. In many of the largest cities most of the coal has to be delivered in bags; in some cases, in Montreal for example, it frequently has to be delivered to a third or fourth floor apartment. In some places the charge for bagging is included in the standard price, with occasionally some discount for bulk delivery. In other cases the retail price excludes bagged delivery, a special charge of 50 cents per ton or thereabouts being made for bagging. Sometimes an additional charge is made if delivery of bagged coal is required at other than ground floor or basement level. In rural points the farm trade is important, a discount of about 50 cents per ton being given generally when the farmer takes delivery of the coal in his own truck or wagon at the retail yard. Information secured as to retail spreads in urban centres in the United States indicates that Canadian spreads are at least as low. The retail business is highly competitive. The retailer occupies a position which is essential in the distribution of coal, and his profits do not appear to be in any degree excessive.

Before leaving the subject of the retailer in Central Canada, it might be well to deal briefly with the effect on his business of the various government control measures. He was obliged for a time, by order of the Coal Controller, to deliver fuels of a lower classification with superior fuels, in order to spread the available quantity of select domestic coals as far as possible. This entailed an additional amount of labour in loading coal at his yard, as weights of each type of fuel must be checked and the load must be taken from more than one bin.

The retailer is also obliged, on account of the subsidy plan, to do additional bookkeeping, which entails considerable additional cost. He must report periodically to the Dominion Bureau of Statistics with respect to his sales and his stocks on hand, and he must keep a record of all transactions to support his

claim for subsidy on sales to domestic consumers. This is not a problem to him in the case of anthracite bought through a wholesaler, for this coal, all of which is classed as consumer goods, is billed to him by the wholesaler at the mine price less the appropriate subsidy; but in the case of bituminous coals he is billed at the mine price and he must transmit to his wholesaler or direct to the Commodity Prices Stabilization Corporation such supporting material as is necessary to enable his claim for subsidy to be made. Reference may be made to the chapter on Government in Relation to the Coal Industry for an explanation of the import subsidy.

The following table shows the items going to make up the retail prices of United States anthracite in Montreal and Toronto as of September, 1946. Due to the wide range of bituminous coals and the widely varying prices and margins in the basic period, any figures given with respect to such coal might be misleading.

—	Toronto	Montreal
	$	$
Mine price (line mines, nut and stove size)	10.15	10.15
Wholesale commission	(Included in price)	(Included in price)
Rail freight	3.57	3.75
Exchange	0.05	0.05
Duty	0.50	0.50
Laid-down cost	14.27	14.45
Less subsidy	1.91	1.91
Net cost to dealer	12.36	12.54
Retail margin	3.14	3.71
Retail selling price	15.50*	16.25

* Includes bagged delivery.

MARITIME PROVINCES

The distribution of coal in the Maritimes varies somewhat from that in Central Canada. Most of the coal consumed is produced in the Maritimes and is usually sold by the management or the sales department of the producing company without the intervention of any outside selling agency. Of the coal that is imported, most arrives normally in bulk freighters and requires a different method of handling.

Wholesale Distribution

Imported Coal

The functions of the importer-wholesaler, who deals mainly in coal from Great Britain or the United States, are the anticipation of requirements with respect to quantity and grade, the contracting for the movement of the coal from the foreign ship-loading point to the retail dealer or consumer, and the financing of the coal purchased. Under his supervision, and financed by him, ships must be chartered, insurance placed and cargo discharged. He must also provide dock space to store and handle 5,000 to 7,000 tons of coal. He must also provide re-screening facilities. When fuel is imported by such a firm for distribution to the retail trade, the selling price must include the expenses of these items and also take care of the degradation of the higher-priced stove sizes to the lower-priced nut, pea and fines, the latter grade selling at less than cost.

In Nova Scotia the principal importers are S. Cunard and Company Limited and A. T. O'Leary Company Limited, which lease or own dock space in Halifax and represent European and United States suppliers. Both companies will arrange not only to load ships at foreign ports and discharge them at this port, but will also, as tonnage requirements permit, arrange for small cargoes to discharge at smaller ports in Nova Scotia and Prince Edward Island.

The Cunard Company also operates as retail dealer in the Halifax area, while the O'Leary Company engages in the coal trade solely as importer and wholesaler. Both companies sell their screened product, as required, to retail dealers throughout the Maritimes, either over their own docks or from ships discharging at other ports in Nova Scotia or Prince Edward Island.

In New Brunswick the chief port of entry for water-borne imported fuels is Saint John. The chief importer-wholesalers are C. R. Nelson Limited, R. P. and W. T. Starr Limited, Eastern Coal Company, Consumers' Coal Company, and Parker D. Mitchell Limited; the first named being the exclusive representative for New Brunswick for one Welsh supplier, the others purchasing their requirements through other Canadian representatives. All of these firms also engage in the retail trade in Saint John, and each firm imports United States fuels by water for distribution in a similar manner. Most of the imported fuel is anthracite. On receipt, the coal is trans-shipped by truck or by railway car either direct to the consumer or to the retailer's stock bin, and later to the consumer as required.

As most of the coal imported into the Maritimes is water-borne by bulk freighters and as the docks do not generally have the same facilities for unloading coal as is the case in the more populous centres of Central Canada, the greatest risk in arriving at the price is in estimating demurrage and discharging costs. Demurrage will vary with each shipment, depending on the availability of cargo on arrival of the ship at the loading port and on the availability of dock space and labour at the port of discharge. The structure of the ship will also be a factor, as discharging costs will vary with its type, depending on whether a greater or lesser number of men are required in moving out the coal from parts of the ship difficult of access. The gross margin for importers has been difficult to determine accurately, due to the consolidation of the coal import with other business of the same firm such as retail selling, shipping, bunkering and allied interests. It is estimated, however, that the gross margin over c.i.f. costs covering the discharge of the coal, storing and handling on the docks, loss through degradation, and all services up to the delivery to trucks on the docks, would be in the neighbourhood of $3.00 per ton.

While the foregoing describes the importation of coal into the Maritimes as it existed prior to the war, practically all coal now entering the eastern provinces, due to the shortage of shipping space, is carried by rail.

Canadian Coal

The distribution of Canadian coal, chiefly bituminous coal with some quantities of coke, is generally conducted by sales departments of the producing companies, the largest being Dominion Coal Company Limited distributing coal from the Dominion, Old Sydney, Acadia, and Cumberland coal companies, and coke from the Dominion Steel and Coal Corporation. Sales offices located throughout the Maritimes receive orders and forward them to the producing companies. Deliveries are usually made by water, rail or truck direct to the industry or the railways, while fuel for domestic use is distributed by a retail dealer ordering his fuel through the sales office. In Halifax and Saint John the Dominion Coal Company maintains dock space, either wholly-owned or owned by an exclusive representative, to which shipments are made by water, discharged on the dock, and screened (if necessary) for loading into dealers' trucks.

Coal for bunkering requirements is largely distributed by the Dominion Coal Company and by coal importers who maintain facilities for this at larger ports in the Maritimes.

Of the independent bituminous producers, two firms contract with a wholesaler to market their output in selected areas, each company reserving the right to market its fuel to the railways and to areas not covered by the contract. The remaining independent producers distribute their output in a manner similar to that of the Dominion Coal Company, each company handling its own sales direct, usually by rail movement, to industry or to retail dealers for further distribution to the domestic consumer. Inland districts not served by rail or by water transport rely on truckers for the distribution of coal. A trucker delivering some commodity in the area in the neighbourhood of a mine, or of a dealer, will usually arrange for a return load of coal for a party or parties in his operating area. The wholesaler, representing Canadian coal in a given area, being concerned only with selling expenses and financing, will not require as much capital in connection with coal distribution as will an importer. His expense is usually covered by a gross margin averaging 45 cents per ton.

The Retailer

As elsewhere, the retail dealer in the Maritimes must anticipate the needs of the consumer, maintain coal handling facilities, and keep a sufficient supply of the various grades of fuel on hand to meet the immediate needs of the domestic purchaser. He must provide for the delivery of fuel from his storage area to the consumer's bin by truck or cart, in bulk or in bags, must generally finance the purchase of carload lots, and must assume the retail credit risk.

The tonnage handled by dealers in the Maritimes is relatively small in in comparison with the total coal sold. This results in a net profit too small to enable the retailer to carry on business solely as a coal dealer. As is the case in Central Canada, many retailers engaged in other business such as the handling of building supplies, hay, feed and flour, and through diversification of sales, are able to offer coal at a lower cost than would otherwise be the case. The cost of coal to the retail dealer is, in the case of imported coal, f.o.b. cars or trucks at the point of discharge, and in the case of Canadian coal, f.o.b. trucks or cars at the mine. The retail dealer determines the selling price by adding to the above, freight, overhead administration, truck charges and profit. His gross margin, including all of these items except freight, generally averages about $3.00 per ton. Where coal has to be bagged, an additional charge is made for this service, so this is not considered by the retailer in arriving at his selling price. Examples of the price paid, in September, 1946, by the consumer in Halifax on some commonly used varieties of coal, with a break-down of these prices into the various component parts, is as follows:

—	Dominion Screened Lump	American Anthracite (line mines)
	$	$
Mine price	7.95	10.15*
Freight	1.60	7.96
Exchange	.....	0.05
Laid-down cost	9.55	18.16
Less subsidy	.....	2.66
Net cost to dealer	9.55	15.50
Retail margin	2.70	3.00
Retail selling price	12.25	18.50

* Including wholesale margin.

THE PRAIRIE PROVINCES

Wholesale Distribution

The distribution of coal in the Provinces of Manitoba, Saskatchewan and Alberta varies somewhat from the patterns prevailing in Central Canada and the Maritimes. In the first place, except for a small volume of United States coal, the consumption of which is confined to Winnipeg and the areas east of that city, practically all of the coal consumed on the Prairies comes from mines in Saskatchewan, Alberta and the Rocky Mountain section of British Columbia. It is all shipped by rail and the wholesalers do not as a rule take delivery of any coal but occupy the position of broker. As the "domestic" mines in Western Canada are usually small and their market is scattered it is difficult for a single mine to take care of its own wholesale distribution.

The wholesaler usually has salesmen throughout the western provinces and at the coast who can approach the consumer with a full range of coals. Some of the large wholesalers own or control mines in the West and are interested primarily in building a market for their own coal, although they do handle other coal under contract from the producer, exclusive or otherwise. Other wholesalers largely operate under some kind of exclusive arrangement with several mines, so they have sufficient coverage to supply the requirements of their customers. Some of the producers have their own selling agencies, handling only coals produced by their particular mine.

One of the chief functions of the wholesaler is financial. The producer, being often a small operator, may be dependent on the orders shipped during the month to meet his current payroll. The usual practice is for the wholesaler to pay on the fifteenth of the month for all coal shipped on his orders during the preceding month. In return, he bills the retailer, giving him usually thirty days, but in case of necessity sixty or ninety days, in which to pay.

An important function of the wholesaler is the encouragement of "off-peak" buying. To enable the operators to keep at least a skeleton staff of well-trained men in the mines during the summer, developing the mines for further production during the following winter, a market for the coal thereby produced must be found. The wholesaler, therefore, endeavours to have his retail customers stock their bins during the summer months. During the war years, as householders became aware of the coal shortage and practised summer buying, this constituted no problem, but it was a very real problem during the depression years before the war when the operation of practically all western "domestic" mines was on a seasonal basis.

Winnipeg is the largest consuming point in this section and there are about nine or ten wholesalers in that city, some of the largest of whom, being also large scale retailers, do some stocking in their retail yards for wholesale purposes. One, at least, of the large Winnipeg wholesalers maintains on his staff a qualified combustion engineer for the purpose of advising customers or potential customers.

United States coal is supplied to the Winnipeg market largely by two concerns, James Murphy Coal Company of Fort William which has a dock at that point and a selling agency in Winnipeg, and the Empire Hanna Coal Company which has a Winnipeg office but does not maintain a dock, paying instead a dock handling charge at Fort William. United States coal, which at one time dominated the Winnipeg market, by 1939 had been almost entirely supplanted by coal from Alberta, Saskatchewan, and the Crowsnest Pass region in British Columbia, Saskatchewan coal in more recent years having become a widely used industrial fuel.

The railways purchase most of their coal from about a dozen mines producing bituminous coal in the mountain sections of Alberta and British Columbia. They usually buy direct from the mines, no sales commission being paid. Complaints are frequently made that the mass buying power of the railways enables them to depress unduly the price paid to the producer and that they virtually set the price they pay for coal. It would seem, however, that whatever powers in this direction they possess, their larger suppliers in the West are in a somewhat better financial position than is the western coal-mining industry in general. Railway purchases of fuel for stations, roundhouses, et cetera, are from various mines, their business distributed partially on the basis of the amount of freight originating from those mines.

Farther west, in the coal-mining areas, very little coal is sold locally through wholesalers. The producers in most cases, even when an exclusive distribution contract exists, exclude direct sales from the mines and, as the Alberta "domestic" mines cover a very wide area, a substantial tonnage of coal is sold to truckers, farmers and local consumers, and hauled direct from the mine. Truckers can supplement their income with this type of business, and in the years immediately prior to the war constituted a severe threat to both the railways and the retail dealers. Frequently the trucker found it very convenient, when he happened to be in the neighbourhood of a mine delivering a load of some other commodity, to pick up a load of coal for delivery to a particular customer or in the expectation that he would be able to sell his coal when he returned to his home district. This gradually developed into a fairly substantial business. Some years ago, to meet this competition, the railways introduced special rates into areas largely served by truck, and the dealers agreed to reduce their margins of profit to co-operate with the railway. With the advent of the war, the shortage of trucks put an end to this type of competition, but it may develop again with a return to pre-war conditions.

There are about fifty wholesalers handling western coals, either on an exclusive or a jobber's basis. The wholesaler's gross profit ranges from about 41 cents per ton on United States coal down to an average of 25 cents on western coal. One large wholesaler, dealing exclusively in western coal and owning or controlling producing companies in both the Saskatchewan and Drumheller fields, charges a straight margin of 15 cents per ton on all coal produced by its companies. It is doubtful if it would be possible for the company to operate on this margin were it not for large bulk sales, including sales to the railways from its Saskatchewan mine. It would probably be fair to say that the margin ranges from 10 cents to 35 cents per ton, depending on the type of coal and whether the order is for a single car lot to a remote district or by daily delivery to a bulk customer.

The handling of coal by the companies engaged in the grain trade in western Canada, about which more will be said under the heading Retail Distribution, represents a variation from the general pattern and is peculiar to that section of the country. A number of such companies some years ago formed a wholesale coal agency now operating under the name of the Occidental Coal Company Limited. Unlike most wholesalers who have exclusive contracts with producers to promote sales of their coal, this company acts principally as an agent of the buyers, its member grain companies having some hundreds of retail outlets in the three Prairie Provinces. It takes the same spread, generally 25 cents per ton, as do the other wholesalers, but its expenses of operation are small as it maintains no salesmen on the road. The financial risk taken is negligible, since practically all of its sales are to its member companies and its income is consequently large in relation to the capital employed. Most of this income is distributed to the member companies on the basis of the tonnage of coal purchased by each during the year. This company operates, as do other wholesalers, in buying coal and arranging for direct shipments to the retail point but, unlike

most, it also takes care of the freight charges. Criticism has been levelled at this company by producers and other wholesalers, claiming that it simply forced a reduced price because of its mass buying power. Two of the largest of the grain companies are not shareholders in Occidental but, in normal times at least, probably obtain trade discounts similar to those granted to wholesalers due to their volume buying. Occidental, through the combined volume of its member companies, is however in perhaps a better position than any of its members would be individually to obtain favourable prices from the mine. Other wholesalers with exclusive contracts from particular mines frequently sell to Occidental, in which case they are obliged to divide their commissions with that company. An order of the Coal Administrator issued in the summer of 1946 has permitted the mines to re-negotiate their contracts with wholesalers in the light of present-day marketing conditions, notwithstanding the general provision in the Maximum Prices Regulations prohibiting any variation in special trade discounts granted during the basic period. This may eliminate some commissions to companies like Occidental during periods like the present when the coal produced can find a ready market. Where Occidental purchases through other wholesalers and the commission has heretofore been split, this order may have the effect of increasing (at the expense of Occidental) the net profit to the wholesaler holding the exclusive contract with the supplying mine. The Occidental Company handled during 1945 more than 300,000 tons of coal.

It has been suggested that a central selling agency might be desirable, eliminating some wholesalers and reducing the cost of marketing coal. Though a central selling agency might reduce to some extent wholesaling costs, individual producers might suffer under the scheme. An energetic and efficient producer would obviously be reluctant to be under compulsion to share his market with a less efficient producer. In any event, any improvement in this direction must rest with the producers and, if the scheme is desirable, it can be effected by the producers themselves. With respect to sales in Ontario of domestic coal, assisted by transportation subvention, some system of unified selling might be desirable.

The average wholesaler handles coal from possibly six or seven different companies, his tonnage ranging from 100,000 to 200,000 tons per year. Shipment is made by carload lots and coal is billed to the wholesaler and re-billed to the customer with the margin added, or is billed direct to the consumer at a price including the wholesaler's margin which is paid to him later by the mine.

The wholesaler undoubtedly plays a useful part in the distribution of western coal, and the gross margin for the service rendered does not appear to be unduly large. The records of one large wholesaler show a gross profit on sales of a little over 5 per cent and a net profit of less than 1 per cent. Net profit of the average large wholesaler appears to be about 5 cents per ton before making provision for income tax.

Retail Distribution

Retail distribution in Western Canada does not vary greatly from that in other parts of Canada except that, unlike some of the cities in Eastern and Central Canada, delivery in bulk without bagging can be made in most Prairie cities and towns. Winnipeg is an exception. There, most coal for household use is bagged and apparently no extra charge is made for this service, the competitive position of Winnipeg retailers having, before the stabilizing of price in 1941, established the practice of quoting the same price for bagged as for bulk delivery.

Like retailers in Ontario and Quebec, most of those on the Prairies find it impossible to make coal their sole business. Most of them deal in ice, engage in general hauling, or handle gravel or other commodities to keep their delivery trucks occupied during the summer. They may also handle building products

or feed. The largest retailer in Winnipeg would handle about 50,000 tons of coal a year and have considerable equipment for unloading cars and storing and treating the coal. The average retailer would probably handle 5,000 to 10,000 tons, while in the small Prairie points the tonnage might be no more than a few hundred tons.

Perhaps the principal difference between the retail distribution of coal in the Prairies and that elsewhere is the position occupied by the grain trade. The grain companies, which maintain siding facilities and have weigh scales in connection with their grain business, saw many years ago the possibilities inherent in the handling of coal as a means of encouraging farmers to deliver grain to their elevators. It was a simple matter to build a coal shed adjacent to the elevator where farmers might, after unloading their grain, fill their wagons with coal for the return trip to the farm. At many points on the Prairies the operator of the local grain elevator is the only retail coal dealer, his competition having prevented others from entering the coal business. There are in the three Prairie Provinces more than 1,600 of such outlets, of which about 1,100 are operated by the "line" elevator companies and about 500 by the United Grain Growers and the Wheat Pools. The coal operations of the grain dealers have been conducted on a very modest margin as they involve practically no additional labour, the coal not being treated in any way but simply delivered in bulk into the wagon of the farmer. Their margin runs as low as $1.00 to $1.50 per ton.

Apart from the coal handled in bulk as by the elevator companies, the established coal dealer must service the coal in much the same way as he does in other centres, although the coal, being rail-shipped and not subject to breakage to the same degree as water-borne coal, screening is not usually required. The coal will, however, be "forked" when being loaded into delivery trucks.

The margin to the retailer other than the grain dealer runs in Winnipeg from $3.50 a ton on Coalspur coal down to $2.55 a ton on Saskatchewan lignite, with a prevailing spread of $3.25 per ton on the top grades of Drumheller coal. The margin probably averages $3.00 a ton in the larger centres throughout the Prairies.

During the depression years, when the western mines were lacking markets, there was a great deal of price cutting and almost anyone requiring a substantial quantity of coal could command a preferred price. This resulted in an unduly depressed price to the producer. During this period also competition from the grain trade and from the consumer co-operatives, who were able to sell on a small margin, and from the "snowbirds" who operated in the same manner as those in Central Canada, as outlined in the section dealing with that area, or who occasionally brought a car of coal to a given Prairie point and sold direct from the car, depressed the retail price of coal to the point where many retail dealers were obliged to discontinue business.

Winnipeg prices of some coals in common domestic use are as follows, the items making up the prices being shown:

	Saskatchewan Shaft-lump	Saskatchewan Strip-lump	Drumheller Standard lump
	$	$	$
Mine price* (including wholesale margin)	2.25	1.60	5.15
Freight	2.30	2.30	4.70
Retail margin	2.65	2.55	3.25
Retail Selling Price*	7.20	6.45	13.10

* These prices do not include the increase granted by orders of the Coal Administrator made during October and November, 1946.

THE PACIFIC COAST

This coal market is divided between Vancouver Island mines, the greater part of whose tonnage is controlled by Canadian Collieries (Dunsmuir) Limited, and the mines of Alberta and the Rocky Mountain and inland regions of British Columbia. As indicated in the chapter on Markets, the principal consuming area in the Province is Greater Vancouver and, while for many years the Island mines dominated that market, the demand for Alberta coal has increased greatly in recent years, leading to the acquisition in 1941 of the assets of McLeod River Hard Coal Limited at Mercoal, Alberta, by Canadian Collieries (Dunsmuir) Limited.

Before the war the Island mines supplied about 100,000 tons annually to the railways, but the diversion of fuel oil supplies and the shortage of wood fuel meant increased domestic coal requirements, and the railways were obliged to use for their requirements coal from the steam coal mines of Western Alberta and the Crowsnest Pass.

Wholesale Distribution

Except for the domestic market, sales in the Coast area are made direct by and from the mine to the consumer, without the intervention of any marketing agency. There being no great concentration of industry as is found in Central Canada, and cheap water transportation being normally available from the Californian and South American oil fields resulting in the use of that fuel in substantial quantities in industry, it has not been necessary to stock-pile coal in quantity to serve the industrial market. The uniform distribution practice, therefore, is direct shipment from the mine to the industrial plant. The plants being generally located on water, the coal scows from the Island mines are unloaded directly onto the premises of the consuming industry.

Canadian Collieries serves the domestic market with both Island and McLeod River coals through the medium of its subsidiary and selling agency, Vancouver Island Coals Limited. This company in 1931 entered into an agreement with the firm of Evans, Coleman and Evans Limited, and its several affiliated companies dealing in coal and owning or having under lease docks with storage and coal handling facilities and equipment at various points on the Vancouver and New Westminster waterfronts. The object of this agreement was to reduce the price of Vancouver Island coal to meet the growing competition from Alberta coal by providing a more efficient and uniform method of grading and distributing it. Under this agreement, the responsibility for grading the coal was with the producers, but the handling of coal from the scows to the retailer was done by the "associated companies" at a fixed price. The agreement provided for payment of a rental of 40 cents per ton for all coal handled over the docks in any year, with a reduction to 20 cents on tonnage in excess of 75,000, and the associated companies were to be paid handling charges for unloading, handling, screening, weighing, sacking, and delivery into trucks, ranging from 90 cents per ton on sacked coal, including provision of the sacks, down to 25 cents per ton for pea and fines in bulk. The sales agency was allowed to fix the retail delivered price above which the associated companies and their dealers could not sell, these companies to pay the sales agency for the most popular grades of domestic coal loaded on trucks at the prevailing retail price less $1.70 per ton. The sales agency reserved the right to sell direct, and it does so in the case of large consumers as outlined above.

The sale of Alberta coal in the coastal area is largely confined to domestic coal, and the manner of distribution is the same as that prevailing in the Prairies. There are several wholesale agencies operating in Vancouver and handling

Alberta domestic fuel, one of the largest of these being Coal Sellers Limited. They generally handle a variety of Alberta coals, charging commissions ranging from 5 cents per ton to 35 cents per ton, depending on the grade. Some of the Alberta coal mining companies have their own sales representatives in the coast city and do not operate through wholesalers. None of the wholesalers takes delivery of any coal but arranges to have it shipped direct to the industrial consumer or to the retail dealer.

Retail Distribution

Retail distribution in Vancouver is probably a simpler matter than in most cities, due to the fact that, at least with respect to the tonnage procured from Vancouver Island Coals Limited, the screening and sacking is done at the coal docks as above set forth, and the retailer simply has his truck loaded at the dock for delivery to the customer. This led during depression years to a very large increase in the number of retailers, many without yard facilities, and inevitably to the attendant price cutting.

The coal dealer, however, is still obliged to maintain yards for the handling of rail-shipped coal originating in Alberta, and the handling of such coal is in no way different than the handling of the same coal on the Prairies except that practically all domestic coal in Vancouver area requires to be bagged. The margin taken by the retailer ranges from $1.20 per ton on some Vancouver Island coals to $3.50 per ton on higher grades of Alberta coal, the latter price including bagging.

Mine prices, freight and retail margins on typical domestic coals sold in Vancouver are as follows:

—	Wellington Lump	Drumheller Lump
	$	$
Mine price[1]	9.80[2]	4.90[3]
Freight		4.35[4]
Retail margin	3.25[5]	3.25[5]
Retail selling price	13.05	12.50

[1] These mine and retail prices do not include the increases granted by orders of the Coal Administrator made during October and November, 1946.

[2] Price delivered on Vancouver docks.

[3] Discount of 25 cents from mine price of $5.15 on coal shipped into subvention area. Permission granted in summer of 1946 to discontinue this discount.

[4] Freight rate is $5.00 less subvention of 65 cents. Subvention withdrawn December 1, 1946.

[5] Includes bagged delivery and, in case of Wellington lump, includes all dock services.

CHAPTER VIII

SOURCES OF ENERGY

Coal is important principally because it is a source of energy. Almost all the coal used in Canada is burned to produce heat and heat is a form of energy. The energy thus obtained may be used in the form of heat as, for example, in space heating, or it may be converted by various means into mechanical energy as, for example, in railway locomotives. Compared with the amount of coal used as a source of energy, that amount used as a raw material for non-energy purposes is very small.

Although coal is an important source of energy in Canada, it is not the only important source; we also obtain considerable amounts of energy from water power, petroleum, wood fuel and natural gas. All these other sources except water power are like coal in that they are stored potential heat; in common with coal, these materials will, under favourable circumstances, react chemically with oxygen, releasing thereby substantial quantities of heat. Water power is different. The cycle of evaporation, condensation and precipitation provides, under favourable circumstances, an opportunity to use the gravitational pull on water collected above sea level to develop mechanical energy. The mechanical energy thus made available may be used as such or, as is more common, it may be converted into electrical energy for transmission purposes, and then converted to the type of energy required at the point where the energy is used.

There are a number of other sources of energy, not now important but some of which may in time become so. For many years there has been a good deal of interest in the possibility of generating electricity from tidal power in the Bay of Fundy. The use of tidal power appears to be practicable, but the recent report of H. G. Acres & Company on tidal power in the Petitcodiac and Memramcook estuaries, made to the Dominion Department of Mines and Resources, suggests that other sources of energy will continue to be cheaper. There has been considerable attention paid on this continent to the possibility of using solar radiation for space heating, but with little direct application so far in Canada. Very recently there has arisen the possibility of the peacetime use of atomic energy. So much attention has been paid to this possibility that some comment will be made on it later. There are various other sources of energy which, though interesting to speculate about, seem to offer little prospect of successful exploitation in Canada at present. Included among these sources are the earth's internal heat, terrestrial temperature differences and atmospheric electricity. A further source of energy, the wind, is used to a very limited extent in Canada. It is now much less important than it was in the days of sailing vessels and its importance will probably continue to decline.

During recent years several attempts have been made to estimate the energy obtained annually in Canada from various sources. All such estimates are no more than rough approximations and they all suffer from the fact that the statistics on wood fuel consumption are not adequate to allow that source to be included in the estimates. This is unfortunate for wood fuel is in Canada an important source of energy, providing in some years as much as perhaps 10 per cent of the energy obtained from all sources. However, estimates of total energy obtained from water power and the mineral fuels are useful as an indication of the change from year to year in Canada's energy requirements and of the relative importance of the sources included.

The best estimates of energy obtained from water power and the mineral fuels are those published by the Bank of Canada in its Statistical Summary of October-November, 1946, covering the years 1926 to 1945, inclusive. These

74634—25½

estimates are reprinted in the Appendix to this report. Inasmuch as the following paragraphs are based on them, and inasmuch as the estimates are somewhat arbitrary, the method used in making them should be understood. The first step was to estimate the consumption in Canada of coal in pounds, petroleum products in gallons, natural gas in cubic feet and water power in kilowatt hours of electricity. The second step was to reduce each of the physical amounts to a common denominator, the British thermal unit. In the case of fuels, the conversion to B.t.u. was achieved by multiplying the number of physical units by the number of B.t.u. which, under ideal conditions, each unit would liberate during combustion. In the case of water power, primary and secondary power were treated separately. The conversion to B.t.u. of primary power was achieved by estimating the quantity of coal that would have been required to generate the same amount of primary electricity as was in fact generated hydraulically and then converting that amount of coal into B.t.u. Secondary power was converted at its actual B.t.u. equivalent.

In the period since 1926 the amount of energy obtained annually from water power and the mineral fuels has fluctuated rather violently. Letting the energy used in 1926 be 100, the use of energy dropped to 85 in 1933 and rose to 175 in 1944. The annual variations are due to a number of factors, the most important undoubtedly being fluctuations in the level of business activity. During the depression years of the early 'thirties, business conditions were unfavourable and the wheels of industry turned only slowly or stopped altogether. Under such conditions, relatively small quantities of energy were required. During the last six years the reverse has been true. The demands of war were enormous, production rose rapidly and energy requirements rose accordingly. A close relationship is to be expected between energy used and any index of the level of economic activity. One such index is that of total employment in eight major industries, published by the Dominion Bureau of Statistics. The relation between that index and energy obtained from water power and the mineral fuels is shown in Chart D. Both variables are plotted as index numbers on the base 1926 = 100.

The closeness of the relationship of these two variables is quite impressive. It indicates that energy requirements vary directly with and proportionately to the volume of employment. The nature of this relationship is of particular importance in connection with any forecast of energy requirements. If employment is high, we shall require a relatively large amount of energy; if it is low, we shall require very much less. Furthermore, if employment fluctuates considerably from year to year, energy consumption may be expected to fluctuate similarly. The problem of stabilizing energy requirements is substantially the same problem as stabilizing the level of employment.

Coal is the major source of energy used in Canada, providing more than one-half of the energy provided by water power and the mineral fuels. Next in importance is water power. The importance of water power as a source of energy is much greater than is generally realized. It has provided substantially more energy in most recent years than have the Canadian coal mines. Over the last decade it has furnished nearly 30 per cent of total energy obtained from water power and the mineral fuels. Petroleum ranks next after water power and is about one-half as important a contributor to Canadian energy needs. The amount of energy obtained from natural gas is relatively small in comparison with the total, largely because the areas in which it is available are more limited. Wood fuel as a source of energy ranks between petroleum and natural gas, probably rather nearer to the former than the latter in importance. Chart E shows the relative importance of water power, coal, petroleum and natural gas as sources of energy in each of the years 1926 to 1945. In the case of both coal and petroleum, home-produced fuel and imported fuel are shown separately.

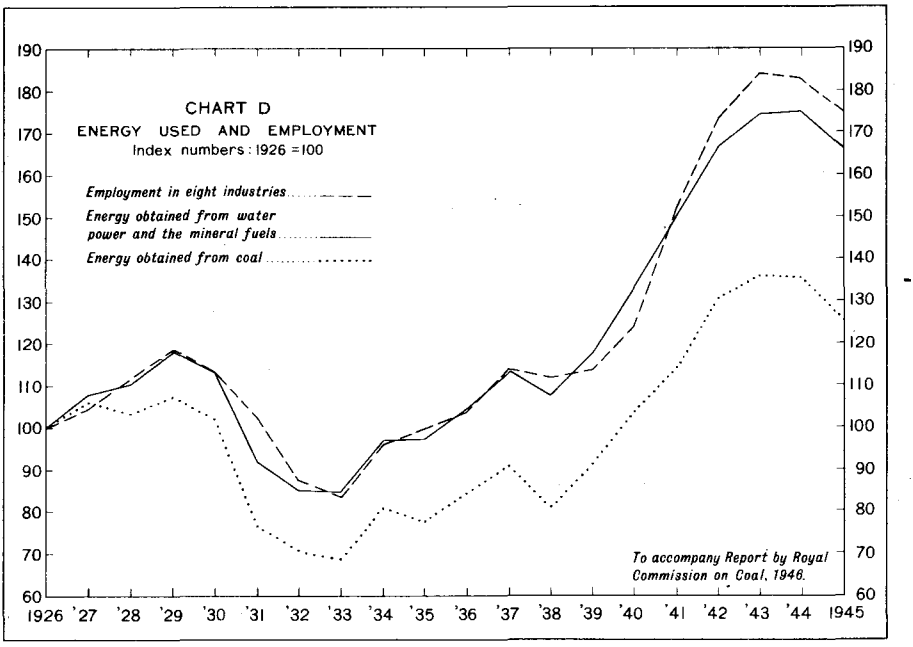


CHART D
ENERGY USED AND EMPLOYMENT
Index numbers: 1926 = 100
Employment in eight industries
Energy obtained from water power and the mineral fuels
Energy obtained from coal
To accompany Report by Royal Commission on Coal, 1946.
190
180
170
160
150
140
130
120
110
100
90
80
70
60
1926 '27 '28 '29 '30 '31 '32 '33 '34 '35 '36 '37 '38 '39 '40 '41 '42 '43 '44 1945

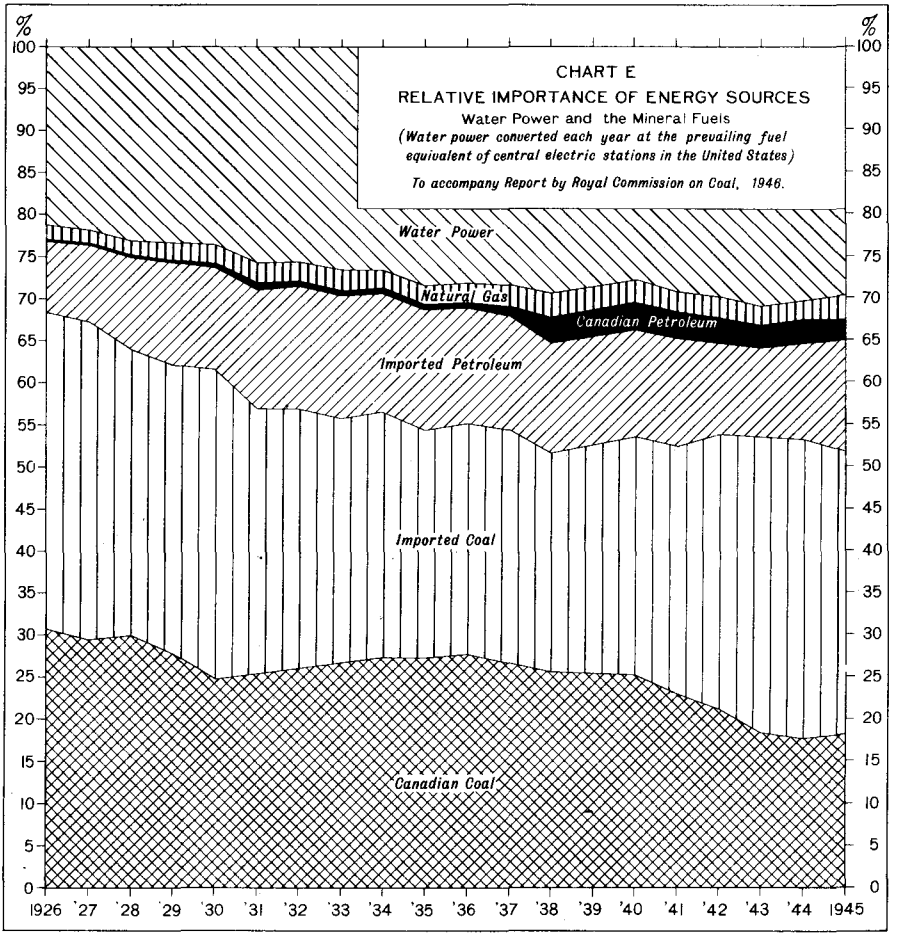


CHART E
RELATIVE IMPORTANCE OF ENERGY SOURCES
Water Power and the Mineral Fuels
(Water power converted each year at the prevailing fuel equivalent of central electric stations in the United States)
To accompany Report by Royal Commission on Coal, 1946.
%
Water Power
Natural Gas
Canadian Petroleum
Imported Petroleum
Imported Coal
Canadian Coal
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
1926 '27 '28 '29 '30 '31 '32 '33 '34 '35 '36 '37 '38 '39 '40 '41 '42 '43 '44 1945

The estimates on which Chart E is based ignore any difference at any one time or any changes over the years in the efficiency with which the various sources of energy are utilized. To the extent, therefore, that one fuel is normally utilized more efficiently than another, the importance of the first fuel is understated and of the second overstated in the chart. Also, to the extent that the efficiency of utilization of one fuel improves more over the years than does that of another, the importance of the first will be understated as the years pass. With respect to the first qualification, the efficiency with which any one fuel is utilized varies so greatly in different combustion equipments that we are unable to make any generalization about the relative efficiencies with which the different fuels are utilized, but with respect to the second qualification we would point out that the efficiency with which coal is utilized has increased considerably since 1926. The main Canadian railways, for example, report reductions over the period covered by the chart of 12.5 per cent and 18.5 per cent in the pounds of coal burned by locomotives per gross ton mile of freight handled. Improvements in the utilization of coal have not been restricted to the railways, although they have been outstanding there. To what extent the efficiency of coal utilization has increased relative to that of other fuels is difficult to say, but the relative increase has probably been significant. Since this change has been ignored in the preparation of the chart, the chart probably exaggerates the decline in the relative importance of coal as a source of energy.

Although coal's importance as a source of energy may be declining rather less than the chart suggests, because of increasing efficiency in the utilization of coal, that very increase in the efficiency of utilization is restricting the market for coal. Coal producers are today faced by the necessity of either encouraging increased efficiency in the use of their product, reducing thereby the tonnage required to serve any given purpose, or running the risk of losing the business entirely to some competing source of energy. The possibilities for the more efficient use of coal are at present by no means exhausted. Therefore, even should the importance of coal as a source of energy remain constant in the future, it will probably be associated with a relative decline in the tonnage of coal necessary to provide coal's share of our total energy requirements.

In the course of enquiring into the market for coal in the various sections of Canada, it was considered necessary to attempt estimates of the importance of various sources of energy on a regional basis. Estimates were made for 1937 and for 1943 and are presented below. Further reference to these estimates is made in the chapter on Markets.

RELATIVE IMPORTANCE OF MAJOR SOURCES OF ENERGY IN CANADA BY REGIONS
1937 AND 1943
(All figures are percentages)

	Maritimes		Ontario and Quebec		Prairie Provinces		British Columbia	
	1937	1943	1937	1943	1937	1943	1937	1943
Water Power	10.7	8.5	33.7	37.8	12.2	11.0	33.3	37.9
Natural Gas	0.7	0.5	1.3	0.6	10.0	11.3	Nil	Nil
Petroleum—Canadian	Nil	Nil	0.1	0.1	7.7	17.5	Nil	Nil
Imported	11.3	18.8	12.1	8.9	8.1	1.5	33.3	29.4
Coal—Canadian	73.3	68.9	10.3	2.5	60.2	50.1	33.4	32.7
Imported	4.0	3.3	42.5	50.1	1.8	8.6	Nil	Nil
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
of which Canadian	84.7	77.9	45.4	41.0	90.1	89.9	66.7	70.6
Energy used in the Region as a percentage of Canadian use	10.5	9.9	65.7	67.4	15.4	15.6	8.4	7.1
Wood Fuel[1]—shown as percentage of energy from all other sources	13	.....	9	.....	15	.....	17	.....

[1] Figures on wood fuel are very rough estimates. They are based on estimates of wood fuel consumption in 1940.

The primary concern of this Commission is, of course, with coal rather than with the other energy sources. However, since the demand for coal is basically a demand for energy which could be supplied in many cases from other sources, the demand for coal is determined jointly by the overall demand for energy and by the ability of coal to compete in the energy market. The effect of both of these influences in the years since 1926 is illustrated in Chart D. It is clear that the index of coal available for consumption (used as an index of the energy obtained from coal) rises and falls over the years with the index of energy consumption, but the year-to-year fluctuations in the former index appear to be superimposed on a general downward trend relative to energy consumption. The downward trend is the equivalent of the declining relative importance of coal shown on Chart E.

We intend to say very little about the probable trend of total energy requirements in Canada in the future. The relationship discussed in earlier paragraphs between energy used and the level of employment indicates that to forecast total energy requirements would be in effect to forecast the level of employment; to make such a forecast is far beyond the scope of this Commission. Energy requirements have declined slowly from the peak of 1944 and will probably continue to decline for a time. What will follow then we do not know. It may be that total energy requirements will fluctuate from period to period as they did from 1926 to 1939; if so, the amount of coal required will fluctuate more or less sympathetically. Such cyclical fluctuations have had and, if they continue, will have very unfortunate consequences on the Canadian coal industry, but they have unfortunate consequences to a greater or lesser extent on all other industries. The elimination of cyclical fluctuations would be of great benefit to the coal industry, but the problem of eliminating them is not peculiar to the coal industry, and the solution to that problem is not to be found by studying the coal industry.

We have, however, felt it necessary to examine the nature of the competition between coal and other sources of energy, with particular reference to the probable trends in the relative competitive strengths of coal and these alternative sources. In the following pages are presented, therefore, comments on water power, petroleum, wood fuel, natural gas, peat and atomic energy.

WATER POWER

On the basis of estimates described above, water power has provided during the last decade more than 25 per cent of the energy obtained in Canada from all sources. If the same amount and kind of energy as was obtained from water power had been obtained from coal, it is estimated that it would have required about 15 million tons of bituminous coal in 1937 and about 25 million tons in 1943. This is not to say that 15 million tons of coal in 1937 and 25 million tons of coal in 1943 were displaced by water power. Much of the industrial development in Canada has been possible only because cheap hydro-electric power has been available. Since nearly all industries use some coal even when hydro-electricity is cheap, industrial development based on cheap hydro-electric power may actually have increased the demand for coal. Water power and coal as sources of energy are, therefore, complementary as well as competitive. This point is stressed here because in most of what follows attention is directed to the competitive aspect rather than the complementary aspect of water power and coal. There are instances in which hydro-electricity has actually displaced coal, and our primary interest is in the extent to which coal requirements in the future are likely to be affected by competition from water power.

The Dominion Water and Power Bureau of the Department of Mines and Resources publishes annually an estimate by provinces of the available and developed water power in Canada. The estimate of this Bureau as at December 31, 1945, is reproduced below.

AVAILABLE AND DEVELOPED WATER POWER IN CANADA DECEMBER 31, 1945

Province	Available 24-hour power at 80 per cent efficiency		Turbine Installation h.p.
	At Ordinary Min. Flow h.p.	At Ordinary six mos. flow h.p.	
1	2	3	4
British Columbia	7,023,000	10,998,000	864,024
Alberta	390,000	1,049,500	94,997
Saskatchewan	542,000	1,082,000	90,835
Manitoba	3,309,000	5,344,500	422,825
Ontario	5,407,000	7,261,000	2,673,290
Quebec	8,459,000	13,064,000	5,848,572
New Brunswick	68,600	169,100	133,347
Nova Scotia	20,800	128,300	133,384
Prince Edward Island	3,000	5,300	2,617
Yukon and Northwest Territories	294,000	731,000	19,719
Canada	25,516,400	39,832,700	10,283,610

The Dominion Water and Power Bureau emphasizes that the figures in columns 2 and 3 of the table above are of water power resources recorded at present and are therefore minimum figures. It also stresses that, because turbine installations throughout the Dominion average 30 per cent greater than the corresponding available power figures for developed sites calculated as in column 3, the figures in column 4 should not be compared directly with those in columns 2 and 3. It is estimated that water power resources presently recorded, both developed and undeveloped, will permit of a turbine installation of more than 51,780,000 horse-power.

The development of Canada's water power resources has taken place almost entirely since 1900, at which time there was only an installed capacity of 173,323 h.p. The increase was more or less regular up until 1939. The increased power requirements of World War II stimulated the development of water power and the increase of installed capacity from December 31, 1939, to December 31, 1945, was nearly 2,000,000 h.p., distributed as follows:

Quebec	1,763,809 h.p.
British Columbia	116,011 h.p.
Ontario	76,491 h.p.
Alberta	23,000 h.p.

The increase in installed capacity in Quebec was due largely to the construction of the 1,200,000 h.p. Shipshaw plant to supply the aluminum industry.

A comparison of the developed and potential water power resources of Canada with those of other countries is possible for the year 1938 by virtue of estimates compiled by the Geological Survey of the United States Department of the Interior. These estimates indicate that in 1938 Canada's total developed water power was exceeded only by that of the United States and that in per capita installation Canada was surpassed only by Norway and Newfoundland. In potential power Canada is shown as fifth among the countries listed (with

the U.S.S.R., India and Ceylon, Brazil and the United States leading), but if account be taken of the availability of power resources to existing markets, it is believed that Canada is outranked only by the United States in potential resources.

As at December 31, 1945, about 90 per cent of the turbine capacity installed in Canada was in central electric stations, with two-thirds of the remainder being in pulp and paper mills and the other one-third in other industries.* The hydraulic installations are used almost entirely for the generation of electricity. There are instances in which turbines are connected by mechanical coupling to machines other than generators but they are few in number and not important. The concentration of water power resources on the generation of electricity was in many cases a condition of their development, for many of them are some miles removed from the areas which require the energy they develop, and only in the form of electricity is the transmission of that energy feasible. Without relatively long-distance transmission important power sites, such as those on the Bow River in Alberta, on the Winnipeg River in Manitoba and on the St. Maurice River in Quebec, would be of relatively little value. At the present time 200 to 250 miles is the practical limit for electricity transmission in Canada; transmissions beyond that range are possible but only at sharply increasing costs per mile. This consideration is of first-rate importance in assessing the prospects for future development of Canada's vast undeveloped water power resources. A very considerable portion of these resources are located at points well outside the present workable transmission range of the main energy-using areas. The enormous resources on the Nelson River in Manitoba, and on a number of rivers running westward into James Bay, are examples of potential water power sites which are at present too far removed to be of immediate value. Until there are either substantial improvements in transmission techniques or very large shifts of industry in the appropriate directions, this situation will continue. It follows, therefore, that the figures of potential water power resources given above vastly exaggerate the water power development that will in the immediate future be practicable.

Not only is almost all hydraulic equipment in Canada used to generate electricity but also almost all of the electricity generated in Canada is produced by hydraulic equipment. Over the past ten years almost exactly 98 per cent of the output of the central electric station industry has been hydraulically generated. A comparable figure for other generating stations is not available but, although a few fairly large thermal generating stations are known to be among them, it is believed that most of the power generated by these stations is also generated hydraulically. Therefore, it is estimated that well over 90 per cent, and probably over 97 per cent, of the electricity produced in Canada is generated from water power.

It must be emphasized here that the generalization that electricity in Canada is produced almost entirely by water power is not true for all areas in the country. In Saskatchewan, for example, while there are two hydraulic stations in the Province, almost all of the electricity output is fuel generated. In Alberta and in the Maritimes an appreciable proportion of the electricity produced is fuel generated. Nevertheless, the tremendous over-all preponderance of hydraulic

* As defined for census purposes, central electric stations are companies, municipalities or individuals selling or distributing electric energy, whether generated by themselves or purchased for resale. Many of the stations owned and operated by industries and producing electricity for their own use fall within this definition.

generation in Canada is a very distinguishing feature of our electricity production. It contrasts sharply with the situation in the United States, where over the last decade only slightly more than one-third of the electricity produced by all plants contributing to the public supply was hydraulically generated.

The geographical distribution of water power development in Canada may be summarized briefly as follows: as far as power generation is concerned, the only important river system in the Maritimes is that of the St. John, on which there are a number of developed sites, particularly in the vicinity of Grand Falls. Throughout each of the Maritime Provinces there are a considerable number of small hydraulic stations on smaller rivers. In Ontario and Quebec the main power plants are located on the rivers making up the St. Lawrence drainage system. There are large hydraulic installations in the vicinity of Niagara Falls, on the upper tributaries of the Ottawa River, particularly on the Montreal River and the Quinze River, in the vicinity of the City of Ottawa on the Ottawa River itself and on its tributaries, the Madawaska, the Gatineau and the Lievre Rivers, on the St. Lawrence River near Montreal, at various points on the St. Maurice River and on the Saguenay River near Lake St. John. There are also large installations on numerous rivers, particularly the Nipigon, draining into Lake Superior and on the Abitibi and Mattagami Rivers draining into James Bay. In addition, and particularly in southwestern Ontario, there are a great many smaller installations on a number of smaller rivers. In the Prairie Provinces developed hydraulic sites are largely restricted to the Winnipeg River east of Winnipeg, to the Churchill River near the Saskatchewan-Manitoba border, and to the Bow River west of Calgary. In British Columbia the most important installations are on the Kootenay River near Nelson, on the Stave River near Vancouver, and on the North Arm of Burrard Inlet fed from Coquitlam Lake.

Use of Electricity in Canada

On the following page is presented a table, based on figures published by the Dominion Bureau of Statistics, of the use of electricity in Canada in 1939 and 1943. From the material in that table and the additional fact that about 90 per cent of the electricity used by the manufacturing and mining industries is purchased from central electric stations, it is estimated that of the electricity used in Canada roughly one-third is used by the manufacturing and mining industries for power, and a second third by the manufacturing industries for purposes other than power and light.

By 1943 just over 80 per cent of the power equipment installed in the manufacturing and mining industries in Canada was electrically driven. For many years there has been a steady trend toward electric drive. This trend has undoubtedly been encouraged by the availability of cheap hydro-electric power in many parts of Canada, but it cannot be explained entirely by that circumstance. In the United States, where about two-thirds of the electricity produced in recent years has been thermally generated, the trend toward electrification has also been pronounced. The convenience and efficiency of distributing power in the form of electricity is so great that it is being more and more widely used regardless of the source of the energy. The significance of this trend to the coal industry lies in the fact that the prospects of coal supplying the power needs of industry depend very largely upon coal's ability to compete with other energy sources in the generation of electricity.

USE OF ELECTRICITY IN CANADA 1939 AND 1943

Industries	1939			1943		
	Electricity Used (including own generation)		Per cent of the power purchased from central electric stations used for other than power and light	Electricity Used (including own generation)		Per cent of the power purchased from central electric stations used for other than power and light
	In millions of kilowatt-hours	As per cent of total electricity used		In millions of kilowatt-hours	As per cent of total electricity used	
Manufacturing Industries	19,430	62.7	55	29,611	67.4	60
of which Pulp and Paper	11,085	35.8	55	8,039	18.3	25
Primary Iron and Steel	529	1.7	55	2,017	4.6	76
Non-ferrous Smelting and Refining	3,493	11.3	78	11,280	25.7	92
Non-metallic Mineral Products	676	2.2	56	1,641	3.7	73
Acids, Alkalies and Salts	1,000	3.2	89	1,881	4.3	73
Mining Industries	1,761	5.7	1	1,895	4.3	1
of which Metal Mining	1,418	4.6	1	1,474	3.4	1
Other Industries	1,235	3.9	.....	2,073	4.7	.....
Domestic Service (Residential)	2,311	7.5	.....	2,844	6.5	.....
Commercial Lighting	1,109	3.6	.....	1,261	2.9	.....
Street Lighting	204	.7	.....	193	.4	.....
Free Service (other than street lighting)	17	.1	.....	67	.1	.....
Exports to U.S.A. (net)	1,908	6.1	.....	2,544	5.8	.....
Losses	2,993	9.7	.....	3,451	7.9	.....
Total	30,970	100.0		43,940	100.0	

The use of electricity by the manufacturing industries for purposes other than power and light include its use for steam generation, for other process heating, and for electrolytic processes. The last use is the smallest; although a number of non-ferrous metals are refined and various chemical compounds produced electrolytically, the amount of electricity used does not constitute an appreciable portion of the total.

The use of electricity for steam generation accounted for about three-quarters in 1939 and one-eighth in 1943 of the electricity used for "other purposes". The principal user for steam raising was the pulp and paper industry, although substantial amounts were used before the war by the aluminum industry and lesser amounts by various other industries. There is no technical reason for using electricity for steam raising; it is used only when steam can be generated more cheaply from it than from coal. The amount of coal displaced by electric steam generation is so considerable that a fuller discussion of this use of electricity will follow later.

The largest user of electricity for other process heating is the aluminum industry. Electricity is used in that industry for the reduction of alumina (Al_2O_3) to aluminum. The process requires 9 to 10 kilowatt-hours per pound of aluminum produced. The process of reduction is actually an electrolytic one, although it has never been carried on successfully on a commercial scale except by the use of heat from electricity to provide and maintain the molten cryolite bath in which the process is carried on. Another substantial user of heat from electricity is the primary iron and steel industry. In that industry there is an increasing use made of electric furnaces for the production of both steel and steel alloys. The rated annual capacity of electric furnaces in the iron and steel industry very nearly tripled for the years from 1939 to 1943. Additional large quantities of electricity are used for heating purposes in the manufacture of fused alumina and silicon carbide abrasives. Finally, various chemical compounds, particularly calcium carbide and calcium cyanamid, are produced with the aid of large quantities of heat obtained from electricity.

Except for electric steam generation, the use of electricity by industry for "other purposes" is explained by the technical advantages that result from its use. Most of the electricity so used is used to produce heat and, generally speaking, the higher the temperature required and the more important temperature control the greater is the advantage of using electricity rather than coal or coke. Normally coal is a much stronger competitor with water power in the production of heat than it is in the production of power (for reasons explained later). It is, therefore, somewhat surprising to discover how extensively water power is used to provide industrial heat. It appears that in most cases coal would be used to provide this heat only if it were a cheaper source of electricity.

The conclusion suggested by this brief survey of the uses made of electricity in Canada is that, except for the generation of steam by electricity, the supply of energy in the electrical form has so many advantages that there is little chance for coal to compete directly. The prospects for coal capturing any of the energy market at present served by water power depend largely upon its ability to compete with water power in the production of electricity.

Coal versus Water Power for the Generation of Electricity

It is quite impossible to generalize about the relative costs of generating electricity from coal and from water power. In any given situation a competent engineer can determine which source will be the cheaper, but his conclusions will have no necessary validity for any other situation. There are, however, a number of considerations which must be taken into account in any determination

of the cost of producing electricity from alternative sources. Some comment on these considerations may help to explain the nature of the competition between them.

The capital cost per horse-power and therefore the annual interest charge is usually appreciably greater for a hydro installation than for a steam one. The capital cost of developing any given water power site depends largely on the physical characteristics of that site—on the topography, the stream flow, the accessibility of the site, etc. The major outlay is likely to be on the engineering tasks necessary to prepare the site—building dams and retaining walls, flumes or penstocks, dredging a tail-race channel, developing water storage facilities and flow control, etc. In comparison, the cost of the generating equipment and of the buildings to house it may be relatively small. For this reason it is rarely economical to develop only a part of the power of a site. The amount of energy that a given water power site can be made to produce is dependent on the head and on the water supply available, but once the site is developed the total cost of producing energy is practically independent of the amount of energy produced. It follows from this that, as the amount of energy produced by a hydro installation increases, the cost per unit of the energy declines steadily.

Very little improvement of the site is usually necessary for a steam plant. The principal initial outlay is for equipment and for the buildings to house it. This outlay varies more or less directly with the capacity of the plant and one is allowed, therefore, much more latitude in respect of capacity in erecting a steam plant than in developing a water power site. Once a steam plant is built considerable additional costs are involved in operating it, the main one being for fuel. Under Canadian operating conditions, a fuel cost per unit of output amounting to one-half of total cost per unit of output would not be unusual. The cost per unit of output of a steam plant will not, therefore, decline nearly so rapidly with an increase in output.

The way to obtain the lowest cost of unit per output with either type of plant is to operate continuously at capacity but this is rarely possible. The output of a hydro plant is limited by the amount of water available, which normally varies seasonally and annually. The demand for electricity fluctuates daily and seasonally and, since electricity cannot be stored economically, it must be generated when it is wanted.

The different relationship between unit cost and output for steam and water plants, the variations in stream flow, and the necessity of meeting a fluctuating demand for electricity, sometimes permit steam to be used in conjunction with hydro even where hydro resources are abundant. There are a number of ways in which plants may be integrated. In some cases, and particularly during the wetter seasons, it is advantageous to have hydro stations operate as near to capacity as possible, using steam only for peak periods, if at all; in the dry seasons, then, the situation may be reversed, with steam carrying the base load and the limited water used to meet the peaks. In other cases, where storage facilities are fairly good, any over-all shortage of water can be made up by using steam at any time convenient. In this way, off-peak power of a steam system can be used; this is what is, on occasion, done in Alberta. Where a hydro system has some storage facilities, the addition of a steam unit may actually increase the hydro output by allowing an increase in the range through which water storage may be drawn down without running the risk of being short of power before more water becomes available. The number of possible combinations is great, and the choice of the best one can be made only by competent persons familiar with the details of any particular situation. The important point is that, even where hydro resources are abundant, the use of steam is not necessarily precluded; there is always a possibility of the two methods being able to supplement each other economically. This possibility is important, for in the Maritimes, Central Canada and Alberta it offers the best prospect for coal insofar as the generation of electricity is concerned.

The cost of delivered electricity includes the cost of generation plus the costs of transmission and distribution. These latter costs are a much larger fraction of total cost than is generally appreciated; they may, in fact, far exceed the cost of generation. Normally, hydro plants are not as near the centre of load as are steam plants and the transmission costs for hydro plants are, therefore, usually greater. It is the total cost of delivered electricity which must be considered when determining whether to use steam or water power and thus the farther the power site is from the centre of load the more competitive will coal be.

To generate electricity, mechanical energy is needed to drive the generators. If coal is to supply the energy, the heat energy liberated from coal by combustion must be converted into mechanical energy. This conversion is effected in engines designed for the purpose, the common examples of which are steam reciprocating engines and steam turbines. An important characteristic of these heat engines is that there is both a theoretical and practical limit to their efficiencies, and these limits are relatively low. Of the useful sensible heat obtained from coal rather less than half can be converted into mechanical energy by the most efficient equipment available; the rest of the heat is lost. Heat is lost in various ways, but the most important loss arises from the fact that the latent heat absorbed by the water in its conversion to steam cannot be utilized in the heat engine, and is lost in the process of condensing the exhaust steam for return to the boiler. In the coal to kilowatts cycle there will be, in addition to the heat engine losses, combustion losses in developing heat from the coal at one end and generator losses in converting the mechanical energy at the other. Since combustion efficiencies of 87 per cent and generator efficiencies of over 95 per cent are not unusual, these losses are much smaller than those unavoidable in the heat engine. Total losses in the coal to kilowatt cycle, using the most efficient (steam turbine) equipment available, amount to very nearly two-thirds of the potential heat of the coal used. The most efficient conversion achieved at present in the United States is about 10,000 B.t.u. of potential heat in coal to one net kilowatt-hour and, since a kilowatt-hour is 3,415 B.t.u., the overall thermal efficiency of the equipment is 34 per cent. Experiments have been carried on with equipment using mercury vapour, for which, before the war, thermal efficiencies of about 37 per cent were expected. Engineers working on a closed cycle gas turbine have recently claimed performances superior to the conventional steam turbine. Future improvements in thermal efficiency are therefore likely, but progress appears to be slow.

In contrast with the best performance attainable, most installed equipment is much less efficient. The average of all fuel stations contributing to public supply in the United States in 1945 was 1.31 pounds of coal (or its equivalent) per kilowatt-hour, which, assuming 13,000 B.t.u. per pound coal, works out to a thermal efficiency of about 20 per cent. Operating statistics are not readily available for many Canadian plants, but tests run under steady load in the 12,500 kilowatt steam-electric station of the Nova Scotia Light and Power Company Limited, built in Halifax in 1944, indicated a consumption of about 13,700 B.t.u. per net kilowatt-hour, or an overall thermal efficiency of about 25 per cent. Among Canadian plants this is undoubtedly one of the most efficient.

One interesting consequence of the losses involved in the coal to kilowatt cycle is that coal is much less competitive with water power in the production of power than it is in the production of heat. If coal is used to generate electricity and the electricity is used for heating purposes less than one-quarter of the potential heat of the coal will normally be recovered. If, on the other hand, the heat from coal is used directly, something more than 80 per cent of the potential heat of the coal may be utilized.

A second interesting consequence of the losses normally associated with the coal to kilowatt cycle is that, if there exists a demand for a considerable amount of medium or low pressure steam, the more serious losses involved in thermal generation of electricity may be avoided. Where steam would have been raised in any event it can be raised at a somewhat higher pressure than would otherwise have been done and fed through turbines before it is used for heating purposes. The loss of heat in condensers, which normally serves no useful purposes, is here avoided for the steam exhausted from the turbines is used for, and properly chargeable to, those operations for which it would have been raised in any event. The drop in temperature of the steam in passing through the turbines must be offset by increasing the steam temperature in the boilers, but additional heat added can, under these circumstances, be converted into mechanical energy with high efficiency. The electricity made available is a sort of by-product and may cost less than one-half as much as that generated by means of condensing turbines. Such by-product generation is limited to situations where the demand for steam for heating purposes is both large and steady. It so happens that in Canada at present most of the steam demand of that type has been met by the use of hydro-electric boilers. As long as this situation continues the prospects of the kind of by-product electricity generation here described from coal will be very limited.

It is beyond the scope of this report to investigate the advantages and disadvantages of hydro and steam generation in all of the numerous areas in Canada where electricity is generated. It has already been indicated that possibly as much as 97 per cent of the electricity produced in Canada is generated from water power. The importance of thermal generation is, however, quite considerable in some provinces. In 1939, for example, thermal generation accounted for nearly 100 per cent of the central electric station output in Saskatchewan, 97 per cent in Prince Edward Island, 42 per cent in Alberta, 32 per cent in Nova Scotia and 12 per cent in New Brunswick. For most of the thermal generation, coal was the fuel used. Coal consumption in central electric stations in that year amounted to 450,000 tons. Within the field of thermal generation, however, coal met stiff competition from petroleum products. For small generating stations in more or less isolated communities, the diesel engine is much more satisfactory than the steam engine for electricity generation. There are in Canada nearly 500 gas and oil engines, with an average capacity of under 90 h.p., in use in central electric stations. The fuel consumption of these engines was the equivalent of about 50,000 tons of coal in 1939.

Use of Electricity for Steam Raising

The generation of steam from electricity is cheaper than from coal only when electricity is very cheap relative to coal. Before the war the price paid for electricity for this purpose was about one mill per kilowatt-hour. Some producers now contend that, with the increased price of coal, electricity is worth 1.4 mills per kilowatt-hour for steam raising. Whichever figure one takes, the fact remains that such prices are far below the total cost of generating electricity hydraulically. But they do exceed hydro operating costs, and for that reason such sales are profitable to the producers providing that the generating capacity has already been installed and that there is no other market. The power thus sold is surplus power and is called secondary power. In order to maintain his freedom to meet demands for other purposes for which a higher price will be paid, the producer normally retains the right to cut off surplus power users at his

discretion. The supply of secondary power is thus not usually guaranteed, which distinguishes it from primary power, which is guaranteed. As a rule primary power is not sold at a price below the sum of the fixed and operating costs involved in its generation. That price may, in Canada, be anywhere from about $12.00 per h.p. per year up, depending upon the area, the load factor,[1] the point of delivery, etc. Since even the 1.4 mills per kilowatt-hour mentioned above is the equivalent at an 86 per cent load factor of less than $8.00 per h.p. per year[2], it is clear that primary power could not normally be used for electric steam generation.

The availability of secondary power depends on surplus generating capacity. The surplus capacity of any given hydro plant will be, at any one moment, the difference between the plant's primary load and the output which, with due regard to the water available, the operator feels free to attain. Because of the necessity of conserving sufficient water to safeguard the primary load, the amount of secondary power which is available will usually vary from wet to dry seasons and from wet to dry years. In addition, the ability to provide secondary power will vary inversely with the primary load. If peak primary demands in a system do not approach the available output, secondary power may be available continuously, as it is at present in the Lake Saint John area. If peak primary demands do approach the available output, secondary power will necessarily be intermittent. This has been the situation in the Montreal area, where secondary power users have been cut off for a short period each week-day afternoon.

Surplus generating capacity and enough water to run it are not the only requirements for secondary power sales. There must be surplus transmission capacity as well. It has been emphasized that the original cost of transmission systems is great and, therefore, if the full cost of transmission were to be charged to secondary power, the total cost of that power in plants other than those in the immediate vicinity of the supplying station would exceed its value for steam raising.

The only important use of secondary power in Canada is for steam raising. For this purpose, an electric boiler is used. It is believed that all of the electric boilers used in Canada are of the water-resistance type, in which electrodes are submerged in water and heat is generated by the passage of current between the electrodes, the water itself forming the resistance. They vary in size, the largest so far installed being of 37,500 kilowatt capacity. They produce saturated steam at pressures up to 275 pounds per square inch. The overall thermal efficiency of these electric boilers is very high, being of the order of 95 per cent. If one assumes a thermal efficiency of about 82 per cent (which is fairly high) for a coal-fired boiler and 95 per cent for an electric boiler, then one ton of 13,000 B.t.u. per

[1] Load factor is the average load (or demand) as a percentage of the maximum load.

[2]

Energy Equivalents		
Kilowatt-Hour	Horsepower-hour	B.t.u.
1	1.341	3,415
0.7457	1	2,545

pound coal is the equivalent, for steam raising purposes, of about 6,550 kwh*. On this basis, the coal equivalent of secondary power used in Canada has been estimated for the years 1934-1945 inclusive and is shown below.

ESTIMATED COAL EQUIVALENT IN TONS OF SECONDARY POWER USED IN CANADA[1]

—	Canada[2]	New Brunswick	Quebec	Ontario	Manitoba
1934	851,000	7,000	596,000	212,000	36,000
1935	1,014,000	4,000	700,000	262,000	47,000
1936	1,113,000	7,000	813,000	225,000	66,000
1937	1,191,000	6,000	883,000	228,000	73,000
1938	936,000	12,000	650,000	206,000	67,000
1939	1,074,000	8,000	729,000	264,000	73,000
1940	828,000	3,000	556,000	212,000	56,000
1941	516,000	5,000	297,000	144,000	69,000
1942	342,000	4,000	134,000	126,000	78,000
1943	323,000	2,000	115,000	122,000	83,000
1944	419,000	2,000	193,000	148,000	75,000
1945	848,000	2,000	606,000	157,000	83,000

[1] Based on Dominion Bureau of Statistics figures of secondary power consumption in Canada and converted at 6,550 kwh. equal 1 ton.

[2] Includes small amounts used in other provinces.

It is estimated that by the end of 1946 the following electric steam generators (boilers) will have been installed in Canada:

—	Number of Generators	Kilowatt Capacity	Percentage of Total Capacity Installed
Quebec	91	1,303,700	75.6
Ontario	28	264,250	15.3
Manitoba	39	88,750	5.2
British Columbia	9	46,000	2.7
New Brunswick	4	21,500	1.2
Yukon	1	500	.....
Canada	172	1,724,700	100.0

It is not known how many of the above generators are, or will be, in use. Some of them are probably unusable. But the life of an electric steam generator is usually a long one, and so almost all of the total capacity that has been installed can be considered as a potential outlet for secondary power. Collectively they could absorb the output of some 2,300,000 h.p. of generating capacity, and, if their load factor averaged 75 per cent, they could consume over 11,000,000,000 kwh. of electricity per year, or the equivalent of about 1.7 million tons of bituminous coal. These figures are given to indicate the size of the market that exists for secondary power. They are not to be interpreted as an estimate of the extent to which that market will be supplied.

Of the total capacity installed, 1,382,900 kw. or about 80 per cent is estimated to be installed in the pulp and paper industry. In that industry they are used to provide the enormous quantities of steam needed in digesters and for drying paper, as well as for space heating. The remaining 341,800 kw. capacity has been installed for a variety of uses. Some 128,000 kw. capacity has been installed in various plants of the Aluminum Company of Canada, primarily to provide steam for the earlier stages of bauxite refining, but also for space

6,550 kwh. is also the equivalent of one horse-power year (at 100 per cent load factor.)

heating. Approximately 45,000 kw. capacity has been installed in Winnipeg, chiefly to supplement steam boilers in generating steam for district heating purposes. A further 43,000 kw. capacity is installed in textile mills, and about the same in metal smelting, refining and fabricating plants. The remainder is installed mainly for use in chemicals, rubber goods and brewery products manufacturing and for space heating.

There are certain advantages of electric steam generators over and above their ability to use cheap secondary power. Compared with coal-fired boilers they are very simple in construction, they save on operating labour, and they are completely clean. But they also have disadvantages. They are much smaller per unit of capacity than is coal-burning equipment but, because the supply of secondary power is not guaranteed, fuel-burning equipment must normally be installed anyway, and so electric steam generation uses rather than saves space. They are not readily adjusted to take care of quick variations of load. Steam accumulators have been used with them, but they add to the initial capital outlay. The fact that they produce saturated steam is claimed to be a disadvantage by some pulp and paper users, largely on the grounds that saturated steam increases the dilution of acid in sulphite pulp digesters and thus increases sulphur consumption.

The greatest wartime increase in hydro generating capacity was in the Saguenay district of Quebec. To provide electricity for aluminum production, a 1,200,000 h.p. development, called the Shipshaw Plant, was built on the Saguenay River. With that addition, the hydro installations on the Saguenay River, all owned and operated by the Aluminum Company of Canada or its subsidiaries, total 2,040,000 h.p. Aluminum Company engineers estimate that, after allowance for variation in stream flow, they will have on the average 1,500,000 effective h.p. During the war aluminum output absorbed practically all of the power available in the Saguenay district and primary power was brought into the area to meet the requirements of other users. Since the end of the war the decline in aluminum output has freed a substantial amount of power for other purposes. During the summer of 1946 about 600,000 h.p. was being used to provide secondary power for paper mills in the Lake Saint John and Quebec City areas, and for the aluminum plant. Assuming that 1 horsepower-year is the equivalent of 0.9 tons of bituminous coal*, secondary power generated in the Saguenay district is currently displacing about 540,000 tons of coal per year. The primary demand for aluminum production may rise to a million horse-power within a year. If this happens, the supply of secondary power in the Saguenay district may be somewhat curtailed.

During the war years the Shawinigan Water and Power Company made two additions to its capacity, 225,000 h.p. on the St. Maurice River at La Tuque, and 40,000 h.p. on the same river at Rapide Blanc. During the immediate pre-war years, the Shawinigan Water and Power Company generated about 1,500 million kwh. per year of secondary power in addition to its purchases (mostly from the Saguenay Plants) for resale as such. At that time the Company was the largest supplier of secondary power in Quebec. During the war there was very little surplus capacity in the system, but now that the war is over the Company has again been selling about as much secondary power as pre-war. Should such sales continue, they will be the equivalent of over 200,000 tons of coal annually.

The Quebec Hydro-Electric Commission expects that sales of secondary power from its system will not increase substantially over the pre-war rate despite the wartime addition of 212,000 h.p. to the Beauharnois Plant. The sales

* The coal equivalent of 1 horsepower-year has been variously estimated at from 0.8 to 1 ton of 13,000 B.t.u. coal. The estimate one arrives at depends largely upon the load factor used. One horsepower-year at 100 per cent load factor is the approximate equivalent of 1 ton of coal. Paper mills in the Saguenay area have recently been operating at a 24-hour day, 6-day week; under such conditions, their load factor would appear to be about 86 per cent. The conversion ratio, 1 horsepower-year=0.9 tons of coal, seems, therefore, to be reasonable for our purpose.

of secondary power by that system totalled 352,000,000 kwh. in 1939, or the equivalent of over 50,000 tons of coal. Even though the Montreal district has some 10 to 15 per cent surplus generating capacity in the summer months, there is not the surplus transmission capacity available to distribute secondary power to potential metropolitan users.

In the pre-war years the Gatineau Power Company sold on the average about 650,000,000 kwh. of secondary power annually. Most of it was used by the Gatineau Mill of the Canadian International Paper Company for steam raising. In the future, the Gatineau Power Company expects to deliver more power to the Ontario Hydro-Electric Power Commission than it did in the pre-war years, and its annual secondary power sales are expected to be in the neighbourhood of 300,000,000 kwh, or the equivalent of about 45,000 tons of coal.

During 1946 there appears to have been about as much secondary power used in the Province of Quebec as in any pre-war year with a displacement of more than 750,000 tons of coal. The amount of coal that will be displaced in future years depends upon the demand that there may be for primary power. Over a period of years primary demand will undoubtedly grow but for the next few years very appreciable tonnages of coal will continue to be displaced by the use of secondary power for steam generation.

In comparison with Quebec, secondary power consumption in Ontario is small. For years the problem of the Hydro-Electric Power Commission of Ontario has been to expand its generating capacity at a rate adequate to meet its growing primary load, and therefore such surplus capacity as it may have from time to time is of the intermittent off-peak type. Moreover, the United States provides a more profitable market for much of the surplus power available in the Niagara Falls area. For these reasons, the use of hydro electricity for steam raising is not likely to exceed by much the 1945 total of one thousand million kilowatt-hours (about 150,000 tons of coal).

There is no reason to expect any increase in the use of secondary power in Manitoba. The consumption of secondary power has been fairly constant at about 500,000,000 kwh. per year for several years and no changes in either generating capacity or primary load great enough to affect secondary power consumption are anticipated. In the other provinces of Canada no appreciable use of secondary power is foreseen.

Space Heating by Primary Power

The use of primary power for space heating is at present very limited. Small electric heaters in domestic establishments are, of course, common, but the proportion of the total heat which is obtained from them is usually very small. In some Canadian cities there are houses heated entirely by electricity, but so far there are not many. Because of the convenience of electricity for space heating it is interesting to examine the chances of hydro electricity capturing the space heating market.

There are three characteristics of the space heating market that reduce the competitive strength of hydro in it. The first of these is that, because it is a heat market, hydro's initial competitive strength is less than it would be in a mechanical energy market. The losses inevitable in the conversion of heat energy to mechanical energy, which reduce the ability of fuels to provide mechanical energy cheaply, are avoided in this market. The second characteristic is that the supply of heat for space heating purposes must be continuous over the months in which it is required. Since secondary power is a product of surplus capacity, secondary power would be satisfactory for space heating only where the necessary surplus capacity existed continuously over the period when heat was required. Such a situation would be unusual. The space heating load of office

buildings, domestic establishments, etc. would far exceed the load for any other purpose, and, if electric space heating were widely practised, present transmission and distribution capacity would be quite inadequate. This is particularly true in that the space heating peaks, both seasonal and daily, would tend to coincide with the same peaks for all other purposes. Since the daily load factor of most potential space heating customers is at present fairly low, there is at present intermittent surplus capacity, but most of those potential customers would consider intermittent heat most unsatisfactory. The opportunities, therefore, of using secondary power for space heating are seriously limited. If electric space heating is to be widely used, there will have to be a substantial investment made in transmission and, in most areas, in generating capacity. Most of the electricity so used would in effect be primary power, and would have to be paid for at primary power rates. The third characteristic unfavourable to hydro of the space heating market is that it is a seasonal market. The annual load factor for a space heating load is usually estimated at from 30 to 35 per cent. It has already been emphasized that the cost per unit output of a hydro system varies more or less inversely with the system's output. A load where average output is so far below capacity means a relatively high average cost per kilowatt hour and, therefore, relatively high cost heating. The seasonal nature of the space heating demand has the result, therefore, of increasing substantially the cost of space heating by electricity.

No attempt has been made to estimate what the relative cost of space heating by hydro electricity and by coal would be for any particular area. However, assuming that electricity could be delivered for $20 per h.p. per annum (which is cheaper than it is delivered for power in most parts of Ontario) and that the space heating load factor was 35 per cent, the cost per kilowatt-hour would be about 8.7 mills. Assuming further that the thermal efficiency of electric heating is 95 per cent and that of coal heating is 70 per cent, the equivalent cost of anthracite coal (13,600 B.t.u. per pound) would be about $51 per ton. Since these assumptions are collectively more favourable to hydro than appears to be typical, it does seem that, even after full allowance for the convenience of electricity, space heating by primary power is not competitive with coal.

One development that may somewhat alter this situation in the future is that of the "reversed refrigeration cycle" method of space heating. Just as the refrigeration plant of the ordinary electric refrigerator extracts heat from the refrigerator cabinet and dissipates it in the surrounding air, so the same kind of plant can be used to extract heat from the outside air and transfer it to the inside of a building. Because the purpose of such equipment is to transfer heat from one place to another, it is called a "heat pump". The advantages of the heat pump arise from the fact that the heat it can be made to deliver far exceeds the equivalent of the electric input necessary to make it operate. Under favourable conditions, the ratio of heat output to heat equivalent of the electric input, known as the coefficient of performance, may be more than four; there are reports of installations in use in the United States giving coefficients of performance greater than 3. Such performance is possible because the electricity used is not used to generate heat but rather to move heat from one place to another. The result is to reduce substantially the amount of electricity needed to make available any given quantity of heat. The value of electricity for space heating, and consequently, the price that can be paid for it, rises accordingly. There is, in addition, the advantage that the same equipment can be used to pump heat from inside to outside during hot weather.

Probably the most serious limitation of the heat pump, insofar as its application to Canadian conditions is concerned, is that the coefficient of performance falls as the difference between inside and outside temperature increases. According to estimates presented before the American Institute of Electrical Engineers

in June, 1944, the coefficient of performance for an inside temperature of 70° F. drops from about 4 at an outside temperature of 55° to just over 2 at 0° F. Thus, just when the demand for heat is greatest the performance of the heat pump is poorest. But that is not all. When the outdoor temperature falls to or below freezing there are serious difficulties encountered. Air-served evaporators plug with frost, and, while an ample and low-cost supply of not-too-cold water would be an excellent alternative heat source, it is rarely available. The problem of finding a suitable heat source for cold weather operation is one that must be solved before the heat pump can make much of a contribution to Canadian space heating needs.

PETROLEUM

Petroleum ranks third among the sources of energy used in Canada. In the immediate pre-war years and during the war it provided roughly one-seventh of the energy obtained from all sources. In recent years it has been about one-half as large a contributor to our energy requirements as water power and about one-third as large a contributor as coal. In the United States about one-third of the energy obtained from all sources in the pre-war years came from petroleum.

The relative importance of petroleum as a source of energy in Canada appears to have grown over the past two decades. The evidence of the estimates in this respect is supported by comments of coal men from coast to coast. In both this country and the United States coal producers have experienced increasingly intense competition from liquid fuel. The extent to which that competition may continue in the future is difficult to estimate, but it is of real concern to the coal industry. The purpose of this section is to examine rather briefly the extent to which, and the purposes for which, petroleum is used in Canada, where it comes from, and what the considerations are which are most likely to affect its competitive position relative to coal in the near future.

The Use of Petroleum Products in Canada

There are very many petroleum products, but fortunately we need to deal with only the few that are of greatest importance. The nomenclature and specifications for these few vary considerably, but they include gasoline, kerosene, light fuel oils or distillates (including diesel fuel, stove oil, furnace oil, etc.), heavy fuel oils (sometimes called bunker fuel oil, industrial fuel oil, residual fuel oil, etc.), and petroleum coke. Within each group there are a varying number of commercial grades or qualities, each differing from the others in specific gravity, volatility, viscosity and other respects. All of them are hydrocarbons, all of them are obtained from crude petroleum, and all of them, except petroleum coke, are liquids at normal temperature. The liquid hydrocarbons are usually classified according to their specific gravity, the gasoline range being the lightest and the heavy fuel oil range the heaviest*.

For some petroleum products no satisfactory substitutes are available. The development of the internal combustion engine burning gasoline or distillate has provided a light mobile power unit which has revolutionized transportation and, while it is not impossible, it is difficult to supply the energy required from any other source. The internal combustion engine is also a very satisfactory source of stationary power wherever power requirements are relatively small, or are intermittent, or occur in places difficult of access, and where hydro-electricity is not available. Thus diesel engines are widely used in some mining operations and in small plants generating electricity.

* The specific gravity of any grade may be expressed in the normal way, (that is, its weight relative to that of water as 1), or it may be stated according to a standard established by the American Petroleum Institute, called the A.P.I. gravity. This scale expresses specific gravity as so many degrees, the number of degrees increasing as the specific gravity decreases.

For the greater part, the use of petroleum fuels in internal combustion engines is only indirectly competitive with coal. To the extent that road transport reduces the ton-miles or passenger-miles operated by the railways, the demand of the railways for coal is reduced, but coal could not supply directly the energy required by light mobile power units. However, as the size of the petroleum-fed engine increases the competition it offers to coal becomes more direct. In the transportation field the use of diesel locomotives is seen by the American coal producers as a serious invasion of their market. In the case of stationary diesel engines coal is always a practicable alternative even though, particularly for small power requirements, its competitive strength is weak. In general, however, the power demand met at present in Canada by internal combustion engines and for which coal is even a remotely practical alternative, is too small to be of much consequence to the coal industry.

Aside from the provision of power directly petroleum products are used to produce heat. For this purpose the heavier fractions, ranging from lighter furnace oils to residual fuel oil, are used. In some cases the heat is used to raise steam for power purposes, in others for processing purposes, and in others for space heating. As a rough estimate, these three uses of petroleum accounted for 40 per cent of the petroleum consumed in Canada in the pre-war years. At that time the coal equivalent of petroleum products so used was approaching 4,000,000 tons annually; during the war it rose to well over 5,000,000. The size of the heat market supplied by petroleum is thus large enough to be of consequence to the coal industry.

In the table below are presented figures in millions of Imperial gallons of petroleum fuel delivered for various purposes.

USE IN CANADA OF THE HEAVIER PETROLEUM FUELS*

(In millions of Imperial gallons)

Year	Delivered for Domestic and Building Heating	Delivered for Industrial Heating and for Power	Delivered to Railways	Delivered for Bunkering	Total
1933	100	81	43	129	353
1935	109	115	47	137	408
1937	118	158	53	161	490
1939	136	173	54	205	568
1941	147	290	73	275	785
1943	95	313	78	234	720

*Excluding all deliveries of gasoline and kerosene and excluding deliveries of distillate and fuel oil for use in motor vehicles and central electric stations.

SOURCE: Department of Mines and Resources, Pamphlets No. 808 and No. 814.

To permit the reader to obtain a rough idea of what these figures mean in terms of coal, it is suggested that one million gallons (1 unit in the table above) is the equivalent in heat value of about 7,000 tons of bituminous coal.

There was a steady increase in the use of oil for domestic and building heating throughout the 1930's and into the war years until wartime shortages required the Oil Controller to restrict deliveries for that purpose. According to the Housing Census of 1941, there were at that time 67,000 dwellings in Canada heated principally by oil. Nearly 90 per cent of these were in the Provinces of Quebec (25,800), Ontario (20,900) and British Columbia (13,800). In addition, there were

a large but unknown number of oil-burning installations used to heat stores and office buildings. Finally, there were in use several tens of thousands of small oil-burners of various types used chiefly for cooking and hot water heating.

The advantages of oil over coal for the space heating of small buildings are too well-known to require comment. Probably the greatest single advantage of oil is that it is normally used in equipment that is completely automatic. Coal-burning equipment that is completely automatic is also now available but it is still rather uncommon, the more usual domestic coal stoker requiring periodic attention to refill the hopper and to remove ash.

The principal disadvantage usually associated with the use of oil for domestic heating is its cost. The Commission has not undertaken the extensive survey that would have been necessary for it to determine the relative costs of oil and coal in various types of operations. A straightforward comparison on a cost-per-B.t.u. basis is of doubtful value for various installations burn different grades of fuel oil which sell at different prices and different types of oil and coal-burning equipment have different thermal efficiencies. Moreover, the adjustments for variations in cost other than for fuel, which would be necessary if the comparisons were to be accurate, are very difficult to estimate. To a considerable extent oil has been and will continue to be a luxury fuel for one simple reason, if no other, that the initial expenditure necessary for oil-burning equipment runs to several hundreds of dollars and is in itself a strong deterrent to the use of liquid fuel by the vast majority of coal users.

Nevertheless, there is much evidence to suggest that the trend toward oil for domestic heating will continue. We have received comments on current trends in the retail fuel market from well over 100 coal dealers from coast to coast and the great majority forsee some increase in the use of oil. This they attribute in part to a general trend towards more automatic heating equipment, in part, particularly in Central Canada, to reaction against some of the inferior coal available for domestic use during the later war years and in part to increases in the price of coal. It appears that in most, perhaps all, parts of Canada coal remains a cheaper fuel than oil and the use of liquid fuel, as of coal stokers, will continue to be restricted to those who can afford to pay for the convenience of automatic heat.

The consumption of petroleum products by industry for heating and for power is largely restricted to plants for the production, tempering and fabricating of steel, plants for the recovery of base and precious metals and by the heavy chemical, pulp and paper, sugar refining, liquor distilling and canning industries. The use of oil by central electric stations and under boilers in oil refineries has been excluded from the figures given above. Of the oil used by industry in 1939, about 70 per cent was used in Ontario and Quebec and a further 22 per cent in British Columbia.

There is a considerable variety in the industrial uses made of fuel oil and there is, consequently, considerable variation in the adequacy of coal as a substitute, apart from the cost factor. Where fuel oil is used for steam raising, as a large percentage of it is, coal is usually a satisfactory substitute, though in industries such as food products, laundries, film manufacture, glassware, etc., considerations of cleanliness and the absence of abrasive dust are very important. For several other uses coal could not be substituted directly. Examples of such uses are the heating of open-hearth furnaces and the dehydration of alumina.

Generally speaking, the fuel oil used by industry is much heavier than that used for domestic and building heating and it sells at a substantially lower price. In the fuel market it competes with bituminous coal. Even where coal could be substituted directly, industrial fuel oil is normally able to command a higher price than its theoretical heat value compared to coal would suggest, because the handling and firing costs of oil are usually lower. The increase in the

price of coal during the war years has increased the competitive strength of fuel oil in the industrial market and the indications at present are that the use of fuel oil by industry may continue to expand.

The reasons put forward by the railways for their use of oil as a locomotive fuel are summarized in the chapter on Markets. Except on mountain divisions, the consumption of oil by the railways is insignificant. There are a number of diesel switching locomotives used in Canada but their total annual fuel requirements are small. Current trends in the design of both coal and diesel locomotives in the United States are discussed in the chapter on Combustion. There is no indication that either major railway is contemplating the introduction into Canada of freight or passenger diesel locomotives.

Petroleum has competed more successfully with coal in the ships' bunkering market than in any other. The trend towards oil-burning ships was well established before 1914 and it has been estimated that by the end of 1937, of the world tonnage of merchant ocean-going vessels of 2,000 gross tons and over, about one-quarter was powered by diesel motors and the remainder was split equally between oil-fired and coal-fired boilers.

Oil has many advantages over coal for use in vessels. It can be stored in odd-shaped tanks built wherever desirable in the ship and can be loaded more quickly than can coal. Oil has greater heat value for weight and volume than has coal and, therefore, allows either more fuel or more cargo to be carried. On passenger ships cleanliness is a further advantage. So great, in fact, are the advantages of oil that the United States National Resources Committee declared in its report, published in 1939, that "cost may not even be a major determinant in deciding what fuel to use for marine service. Oil is so advantageous for steamships that there is a question whether coal is an effective competitor in that field."

The consumption in Canada of petroleum coke as a fuel has never exceeded 100,000 tons annually in the last two decades. In contrast to other products of petroleum, its use as a fuel has declined. The main use of petroleum coke is as a raw material. In 1944, 298,000 net tons of petroleum coke were so used as compared with 26,000 tons used as fuel.

Factors Affecting the Supply of Petroleum Products

The supply of the various products of petroleum is an excellent example of joint supply. With one or two exceptions, all liquid petroleum products are obtained from crude petroleum. As it comes from the ground crude petroleum is a mixture of a large number of hydrocarbons of varying volatilities. The most volatile liquid hydrocarbons constitute gasoline and, in descending order of volatility, come kerosene and the illuminating oils, light distillates such as stove oil, diesel fuel and furnace oil, and finally the residuals used in larger oil-burning equipments. Each of the above groups is a "fraction" or "cut" of the crude petroleum. The number of fractions that can be obtained is almost limitless but, for practical purposes, the specifications of marketable grades are usually widened sufficiently to reduce the number of fractions to manageable proportions.

The process of separating out of crude oil the various fractions desired is known as refining. Modern refining techniques are too complicated to allow of simple and yet accurate description but, unfortunately, it is impossible to understand the factors determining the supply of fuel oil without some appreciation of refining procedures. We shall, therefore, attempt an extremely simple statement of the main principles involved in the refining process.

The process is basically one of selective distillation. Since the various fractions have different boiling points, it is possible to separate them by simple distillation, a procedure known as "topping" the crude. The heating of the crude

may cause slight thermal decomposition but the operation of topping is essentially a physical one rather than a chemical one. The amounts of the various fractions obtained will vary with the character of the crude used and will be substantially the same as those previously existing in mixture in the crude.

The refining operation may stop with topping but there are at least two reasons for proceeding further. The first is that the yield of gasoline, the most valuable fraction, will be relatively small from topping, and the second is that the gasoline so obtained, called "straight-run" or "raw", has unsatisfactory knocking properties when used in a high compression engine. Other hydrocarbons resulting from further refining when mixed with straight-run gasoline reduce the tendency to knock.

After topping, the process is known as "cracking". This process employs high temperatures and pressures, and some of the heavier hydrocarbon molecules subjected to it are broken down, or cracked, into lighter ones. Thus an additional volume of hydrocarbons within the gasoline range of volatility is obtained. The additional gasoline is obtained at the expense of heavier hydrocarbons and so the further the cracking is carried the lower will be the volume of the fractions heavier than gasoline obtained from any given amount of crude.

In recent years there have been developed new cracking processes utilizing the catalytic technique and this development was accelerated during the war in order to supply high octane aviation gasoline, aromatics and raw materials for rubber synthesis. The catalytic cracking operation permits the refiner to further decrease the yield of residual fuel from any given crude.

The process of refining is by no means as simple as this description might lead one to suspect. There are many variations in conditions and methods and many additional treatments required for both the crude and the various fractions to improve their quality. For our purposes, however, it is sufficient to recognize that for any given crude the yield of heavier hydrocarbons will vary within wide limits depending upon the refining technique employed.

For any given refining technique the yield of the various fractions will vary considerably with different crudes, for crudes differ widely. Generally speaking, the lower the specific gravity of the crude used the higher will be the yield of gasoline. For that reason the price of crude petroleum at the well tends to vary inversely with its specific gravity.

Anyone who wishes to refine and market petroleum products thus finds himself forced to choose from a wide range of crude oils at different prices and a wide range of refining techniques. He will also find himself able to dispose of various volumes of the different fractions at various prices in the market open to him. His problem is to choose a combination of crude oil and refining technique such that, after disposing of the fractions resulting, the excess of his total revenue over his total costs is the largest possible. Since the gasoline fraction is normally the most valuable one, it might seem that the best refining procedure in any situation would be that which gave the greatest gasoline yield. There is a tendency for this to be the case but it is not necessarily so and it is, in fact, somet mes not so. The basic economics of petroleum cracking is that cracking will be profitable only when gasoline can be obtained more cheaply from the residue left from topping than from crude oil. In this connection the cost to the operator of the residue cracked must be taken as the amount for which it could have been sold. The profitability of cracking, or of further cracking, depends therefore on the relationship between the cost of crude oil and the price of fuel oil.

There is no doubt that the relationship between the cost of crude oil and the price of fuel oil varies from area to area and that this variation is at least part of the explanation of the difference in the extent to which crudes are cracked. In the United States, fuel oil must meet the competition of cheap coal in the industrial energy market with the result that the value of fuel oil relative to the value of crude oil tends to be low. For this reason, United States refineries have consistently tended to intensify their processing of crudes, and the percentage yield of fuel oil from United States refineries fell from about 31 per cent in 1930 to about 24 per cent in 1940. In catalytic cracking equipment fuel oil yields of 10 per cent or less are possible, and the installation of catalytic cracking facilities in the United States occurred to such a large extent during World War II that the fuel oil yield of all United States refineries is expected to be still lower in the future.

It is doubtful whether there is the same pressure on refineries in Canada to reduce the yield of fuel oil. Due to transportation costs the cost of crude oil in most parts of Canada is higher than it is in most parts of the United States, but the price at which fuel oil can be sold is also generally higher and the relationship of the value of crude oil to the value of fuel oil appears to be less favourable to intensive processing. In some measure this is probably due to the fact that coal is more expensive in most parts of Canada than in most parts of the United States. The relationship between coal prices and fuel oil prices in any particular area is sometimes a very complicated one, but, because coal is a more or less satisfactory substitute for fuel oil for many of the purposes for which fuel oil is used, the price of coal provides an upper limit beyond which the price of fuel oil cannot rise if fuel oil is to be used for those purposes. There are, however, areas in Canada where the price of fuel oil appears to be somewhat lower than the price of coal. The areas are those having free access to ocean tankers, and the price of fuel oil in these areas is very much influenced by the price at which fuel oil can be imported. In British Columbia, for example, fuel oil can be imported from California, and it is in fact imported in considerable volume. The price at which Canadian refineries can sell fuel oil is limited by the laid down cost of imported fuel oil and may bear no direct relationship to the price of coal. Refineries in British Columbia do little more than top relatively heavy crudes and the fuel oil yield of the refineries is therefore high. If they were to crack extensively, the gasoline requirements of the area could be made from a considerably smaller volume of crude but much more fuel oil would be imported, and the resulting situation would not necessarily be any more favourable to the producers of coal in the Province.

Whatever the explanation, it seems that high fuel oil yields are less unsatisfactory to the refiner in Canada than they are in the United States. Imperial Oil Limited and McColl Frontenac Oil Company Limited are at present planning the erection of modern catalytic cracking plants at Montreal, but the plants are required to improve the quality of the lighter fractions rather than to decrease the volume of the heavier fractions. It seems reasonable to expect that the gasoline yield of Canadian refineries will not change materially in the near future and that the increase in gasoline consumption which may be expected will be accompanied by an increase in fuel oil marketed, providing that there is no considerable increase in the cost of crude oil to these refineries. Attention must therefore be directed to the sources of crude petroleum used in Canada and to the factors affecting future supply and price of crude petroleum.

The Supply of Crude Petroleum

Most of the petroleum products used in Canada are refined in Canadian refineries. The dependence of Canadian refineries on foreign sources for their crude petroleum is shown in the following table:

REFINERY REQUIREMENTS AND CANADIAN PRODUCTION OF CRUDE PETROLEUM: 1939 AND 1944

(In Barrels of 35 Imperial Gallons per day)

	1939		1944	
	Refinery Requirements	Canadian Production	Refinery Requirements	Canadian Production
Maritimes	12,000	60	20,000	60
Quebec	41,000	Nil	45,000	Nil
Ontario	34,000	560	60,000	360
Prairies and Northwest Territories	21,000	20,800	35,000	27,000
West Coast	15,000	Nil	20,000	Nil
Canada	123,000	21,420	180,000	27,420

Only on the Prairies is there any appreciable amount of crude petroleum produced in Canada. The main producing field there is that of Turner Valley in Alberta, which reached a peak crude production of about 26,500 barrels per day in 1942, in addition to 830 barrels per day of natural gasoline. Since that year crude production has declined to 20,300 barrels per day in 1945. All other fields in Alberta produced 1,730 barrels per day of crude petroleum in 1945. In late war years the Norman field in the Mackenzie District of the Northwest Territories has grown in importance. Its crude output grew from 200 barrels per day in 1942 to 3,100 barrels in 1944. The development of that field, part of the Canol Project, was undertaken jointly by the Governments of Canada and the United States to develop oil in the Northwest Territories for defence purposes. The Norman field is too remote to be of immediate importance in supplying the normal petroleum requirements of the Prairie Provinces.

In pre-war years, Alberta oil production was adequate to supply Prairie oil requirements as far east as Winnipeg. With the wartime increase in demand and the falling off in the Turner Valley output, domestic production was able to meet the demands of Alberta and the eastern fringe of British Columbia only. Saskatchewan and Manitoba refineries turned therefore to United States sources, first to Montana, then to Wyoming and Oklahoma fields, and, on occasion, even to Texas and Louisiana. In recent months Montana has been providing this market with some 3,000 barrels per day, and Wyoming and Oklahoma with some 10,000 to 11,000 barrels per day.

The crude supply for British Columbia refineries comes normally from Southern California, although during the war emergency and at other times under special conditions, crudes from Venezuela, Colombia and Ecuador have been used.

Most of the crude oil used in Ontario comes from Illinois and the Mid-Continent (mainly Kansas and Oklahoma) field. During the war this oil was moved by pipeline to Toledo and then by tanker to Toronto, or by tanker or pipeline to Sarnia, at which points the largest refineries are located. During the war some crude came by pipeline to Ontario from as far as Texas. Ontario's access to both pipeline supply and water-borne shipments is important for it allows more freedom of choice between South American and United States crudes than would otherwise exist.

Crude oil for Quebec and Maritime refineries now comes almost entirely from South America, mostly from Venezuela but also from Colombia. Both Montreal and Halifax have ready access to southern United States sources as well as South American sources. Wartime construction of the Portland-Montreal pipeline has given Montreal year-round access to the eastern seaboard oil market. It is not expected, however, that the use of that line will reduce the transportation charges on crude imports below the pre-war tanker rates.

There is general agreement that the petroleum requirements on the North American continent will continue to expand for some time in the future. At the same time concern has frequently been expressed as to the adequacy of United States sources to meet the growing demand. If, in fact, a shortage should develop, the price which Canadian importers would have to pay for their crude requirements would rise considerably, probably inducing them to alter their refining techniques. It is, therefore, relevant to enquire into the adequacy of supply in the world market for crude petroleum.

The world crude petroleum production in 1938, the last fairly normal pre-war year, and in 1945 was as follows:

CRUDE OIL PRODUCTION

	1938		1945	
	Barrels per Day	Per cent of World Production	Barrels per Day	Per cent of World Production
North America	3,500,000	64	4,900,000	65
of which U.S.	3,300,000	61	4,700,000	62
South America	670,000	13	1,050,000	14
of which Venezuela	520,000	10	880,000	12
Europe	720,000	13	980,000	13
of which U.S.S.R.	560,000	10	820,000	11
Middle East	330,000	6	490,000	6
Far East	220,000	4	160,000	2
Total World Production	5,440,000	100	7,580,000	100

SOURCE: The Oil Weekly for February 11, 1946.

Of these areas, the U.S.S.R. and the Far East consumed in 1938 about what they produced. The great vacuum for oil was Western Europe, and oil poured in from North America (about 250,000 barrels a day), South America (about 300,000 barrels) and the Middle East (about 170,000 barrels)*.

The figures of production in 1945 are of interest in that they show how the recent war was "oiled", and they give an indication of productive capacity in the short run, but they are not necessarily reliable as an indication of supply in the long run. The rates of production achieved during the war can be maintained, and, in time, increased, only if there is enough oil left in the ground to allow it.

What the war has done to United States petroleum reserves depends in large part on how the question is defined. There are two methods used to estimate the annual change in United States reserves, and they differ in the treatment they give to oil found during the year. Oil is found only by drilling, but the oil so found may be that of a newly discovered pool, or it may be that of a pool already known but the size of which has been underestimated. The former is found by explanatory drilling, the latter by development drilling. The practice of the American Petroleum Institute is to treat oil found in a year by either kind of drilling as an addition to proven reserves in that year, and to compare that addition with the year's production to determine whether proven reserves rose or declined during the year. On this basis the A.P.I. estimate that United

* From evidence given by W. B. Heroy, U.S. Petroleum Administration for War, before the Pilot Hydrogenation Plant Committee in Ottawa, January 21, 1946.

States proven reserves have increased continuously since 1933, except for 1943. Proven reserves at the end of 1933 were estimated at 12 billion barrels; they increased rapidly to 19 billion at the end of 1940 and then slowly to 21 billion barrels at the end of 1945.

The United States Petroleum Administration for War was necessarily concerned principally with the rate at which new sources of supply were being discovered. Therefore it began its own compilation of reserve estimates and credited all oil proved by development drilling back to the year in which the source of supply was discovered, on the grounds that the pool had already been found and that later development had merely furnished a more accurate estimate of the size of the original discovery. On that basis known crude reserves reached a peak of 24.5 billion barrels at the end of 1938 and have declined steadily, except for 1940, to 22.5 billion barrels as at January 1, 1945. The Petroleum Administration recognizes that the method used exaggerates somewhat the downward trend since 1938 for the size of new oil pools found in the period may have been underestimated, but it maintains that such exaggeration as there may be, however, does not obviate the important fact that the discoveries have not kept pace with consumption.

From a study of the results of exploration the Petroleum Administration came to the conclusion that the discovery of new fields, especially prolific fields, was becoming increasingly difficult and costly. The fields which are easiest to find seem to have been found, and new discoveries are being made at progressively greater depths, and after more expensive geophysical analysis. The average drilling depth during the war period showed an increase of about 16 per cent. In spite of the fact that from 1937 to 1945 wildcat drilling (i.e. drilling in search of new oil pools) increased by about 75 per cent and geophysical prospecting by about 90 per cent the rate of discovery began to diminish in 1939.

The realization that increased United States petroleum production has not been accompanied by an equal rate of discovery of new oil pools has led to two very different schools of thought in that country. The oil producers tend to favour import restrictions in the belief that supply and demand economics would operate to maintain adequate supplies. Others feel that some effort should be made to conserve home oil resources by bringing in from foreign countries oils which would move most economically. These would tend to be the heavier crudes, used primarily to provide heat. This is the basic issue in petroleum policy in the United States today.

What does seem reasonably clear is that if the United States is to continue to produce at home all the oil it requires the price of crude must move steadily upward, for not only is new oil becoming more expensive to discover, but known pools are becoming more costly to exploit. Therefore, if there were not other sources of supply available to Canada there would be some cause for concern about the price we might have to pay in the future for crude petroleum. There are, however, very large proven oil reserves in various other countries. Estimates of proven reserves in the principal oil-producing countries as at January 31, 1944, are given below:

—	Billion Barrels	Percentage of World Proven Reserves
United States	20.0	40
Venezuela	5.6	11
Other South American	1.1	2
Europe—excluding U.S.S.R.	0.6	1
U.S.S.R.	5.9	12
Middle East	15.7	32
Far East	1.1	2
World Petroleum Reserves	50.0	100

It must be emphasized that the figures given are for proven reserves only. No allowance has been made for oil believed on the basis of geological or geophysical information to be present but not yet actually proven or the size of the reservoir estimated.

It is interesting to compare the extent to which reserves were drawn on annually, called the rate of extraction, in some of these countries. During the war the rate of extraction for the United States was about 8.5 per cent per year, for the Caribbean area about 5.75 per cent, for Russia it was thought to be about 5 per cent and for the Middle East it was a little over 1 per cent. These figures indicate how much less pressure there was on reserves in countries other than the United States. As time passes, these other reserves will probably be exploited increasingly and from them may well come the flow of oil necessary to offset stationary or dwindling production in the United States. As these other fields are developed it is expected that proven reserves in them may be very greatly increased. As the Middle East production is increased, it may well displace South American oil in Europe, leaving increasing quantities of South American oil available to meet the needs of the North American continent.

Conclusions

The post-war world trade in petroleum will probably be of much the same pattern as it was in 1938, except that the Middle East will probably be a much more important source of the oil flowing into Europe than it was before the war. The flow of oil into Europe from the Western Hemisphere will thus be curtailed and may even cease as soon as additional pipeline capacity can be provided to carry oil to Mediterranean loading points. Probably before 1950, the date depending a good deal on the Government's petroleum policy, the United States will be on balance an oil importer. Its imports will likely be principally the heavier oils, and will come from the Caribbean area.

Insofar as Canadian requirements are concerned, the Caribbean is likely to become an increasingly important source. For Quebec and the Maritimes that raises no particular problems, for they are buying much of their oil there now. Montreal, Toronto and Sarnia all have access to water shipments in the summer, and Montreal and Sarnia can receive oil by pipeline from the American eastern seaboard; however, Toronto and Sarnia can be supplied from the eastern seaboard only at higher costs than they have hitherto incurred. As United States consumption grows and as and when United States conservation measures are increased, British Columbia refiners may be forced to turn in part to other fields, probably to the Caribbean. Since oil from that source must come through the Panama Canal, where the toll is at present 10 cents per barrel, as well as make a longer ocean trip, costs of laid down crude could be expected to rise somewhat. But there is no reason for assuming that the increases are either imminent or will be serious.

Only on the Prairies is there any indication that the supply problem will be serious and there only if no important new oil fields are discovered. The Turner Valley and Montana fields, as now developed, are inadequate to meet current requirements. The Prairie refineries thus have to go to the Wyoming and Mid-Continent fields, with correspondingly high transportation costs. Failing new discoveries of oil on the Prairies, oil will be appreciably more expensive there than it was before the war.

For Canada generally, it appears that oil supplies in the next decade will be neither inadequate nor very much more expensive than they have been. Such price increases as do occur may well be no more than those which have occurred during the war years, or may yet occur, for coal. There thus appears no prospect of a substantial decline in the competitive position of oil in the markets where it

competes with coal. Since the information available suggests a growing demand for fuel oil, it seems probable that the invasion by oil of coal markets will continue for some years yet. The rate may taper off soon and may reverse within a decade or two. But the flow of oil has not yet reached its peak.

WOOD FUEL

It has already been emphasized that wood fuel is an important source of energy in Canada. Failure to include it in estimates of total energy used in Canada is justified only by the inadequacy of statistical material on wood fuel consumption. More wood is used in this country for firewood than for pulp and paper manufacture, and almost as much as for lumber production. According to the 1941 Census of Housing about as many dwellings were heated principally by wood and its products as by coal and coke in that year. In addition, in some areas wood fuel is used extensively for industrial steam raising. From the limited information available, it appears that the energy obtained annually from wood fuel is about the same as that obtainable from 5 to 6 million net tons of anthracite coal. The figures from 1926 to 1942 have fluctuated considerably, but no definite trend is discernible.

The wood used as fuel in Canada is mainly either cord-wood cut for fuel purposes or the by-product of lumbering operations. The by-product fuel consists of slabs and edgings, lumber trimmings, shavings and sawdust left after the manufacture of logs into lumber. This material constitutes the so-called mill-waste of sawmill operations.

More than 80 per cent of the wood fuel consumed is cut for firewood. The unit of measurement is a volume one, the cord, which is 128 cubic feet. Due to air space in the piling of cordwood, a cord has been estimated to contain on the average about 90 cubic feet of wood material. The weight of a cord varies enormously with the kind of wood but even for the lighter woods it is usually greater than one ton.

Most of the cordwood used in Canada is cut on farms. An estimate of the amount of wood so cut is provided by the decennial census. For the last three census the figures obtained were:

1920	8,529,000 cords
1930	8,086,000 cords
1940	8,467,000 cords.

Of the cordwood cut on farms, about 75 per cent is consumed on the farm; only some 25 per cent is sold. The amount of cordwood cut on farms varies greatly from province to province. Of the volume cut in 1940, 41 per cent was in Quebec, 22 per cent in Ontario, and 24 per cent in the Prairie Provinces.

In addition to cordwood cut on farms, there is an appreciable amount produced by other operations in the woods. Estimates of these amounts have been added to the farm production to give the following figures for total annual cordwood production:

FIREWOOD CUT IN OPERATONS IN THE CANADIAN WOODS

(In millions of cords)

1926	9.3	1932	8.5	1938	9.0
1927	9.4	1933	8.6	1939	9.1
1928	9.5	1934	8.7	1940	9.2
1929	9.7	1935	8.8	1941	8.6
1930	10.1	1936	8.9	1942	8.7
1931	10.3	1937	9.0		

SOURCE: Annual report "Operations in the Woods" D.B.S.

The heating value of cordwood varies greatly with the kind of wood and with the moisture content. Assuming 20 per cent moisture and 90 cubic feet of wood material per cord, the number of cords of wood required to equal 1 ton of anthracite coal runs from 1 cord for rock elm to 2.4 for balsam fir[1]. The cordwood equivalents for some of the more common fuel woods in Canada are given below:

Beech 1.13 to 1.35, Hard Maple 1.08 to 1.30, Aspen Poplar 1.77 to 2.13, Douglas Fir (coast type) 1.50, Western Red Cedar 2.25, Western Hemlock 1.95, Jack Pine 1.75.

With such variation from species to species it is difficult to arrive at a weighted national average to use in converting cordwood production to equivalent tons of coal. The rate of 1.75 cords per ton of anthracite coal is considered to be a fair estimate for the whole of Canada. On that basis, Canadian cordwood production has been the equivalent of about 5 million tons of anthracite coal. If 1.75 is the proper national average it is certainly not correct for individual regions. It is, for example, much too high for the Ottawa Valley and for southern Quebec, and much too low for the Prairies and for northern Ontario and northern Quebec.

The principal use of wood cut for fuel is in domestic establishments. According to the 1941 Housing Census, 46 per cent of Canada's dwellings were heated principally by wood (excluding sawdust) in that year. Approximately 80 per cent of farm dwellings and 60 per cent non-farm of rural dwellings were heated principally by wood. The wood fuel used for rural heating is thought to be almost entirely cordwood cut for the purpose.

In comparison with the consumption of cordwood cut for fuel purposes that of mill-waste is not great. It is, however, by no means insignificant for it appears to have amounted to well over the equivalent of 1 million cords annually in recent years. Since mill-waste is a by-product of lumbering operations, its production varies more or less with lumber output. A part of their mill-waste is used by some sawmills for steam raising, and the remainder is usually sold for fuel if there is a market to absorb it; if not, it is burned in refuse burners or carted off as refuse simply to get rid of it. Except for British Columbia, the only mill-waste that appears to be sold for fuel is slabs and edgings, for which the unit of sale is the cord. For the year 1943, just over 400,000 cords of this form of mill-waste were reported to the Dominion Bureau of Statistics as sold by sawmills in provinces other than British Columbia, about 55 per cent of it in Quebec, 30 per cent in Ontario and the rest in New Brunswick. While these figures are conceded to underestimate the importance of mill-waste fuel in these provinces, no better estimates are available.

There is apparently more mill-waste used as fuel in British Columbia than in all the rest of Canada. In addition to the use of slabwood as fuel, there are in that province large amounts of sawdust and hogged fuel used for fuel purposes. Hogged fuel is produced by feeding larger pieces of mill-waste into a "hog" or refuse chipper to reduce them to smaller sizes which may be machine-fed to furnaces. In British Columbia both sawdust and hogged fuel are sold in units of 200 cubic feet, called a "unit". No annual figures are available on the consumption of mill-waste for fuel in British Columbia, but estimates for recent years have been as high as 630,000 units of sawdust, 230,000 units of hogged fuel, and 400,000 cords of slabs and edgings, exclusive of amounts used by sawmills. Since the same volume of wood material is contained in about 1.2 units of sawdust or 1.3 units of hogged fuel as in 1 cord of slabwood[2] it appears

[1] "Heating Value of Wood Fuels" by J. D. Hale, Forest Products Laboratories of Canada, Department of Mines and Resources, 1933.

[2] Forest Service Circular 48 "The Utilization of Sawmill Waste and Sawdust for Fuel", by J. H. Jenkins and F. W. Guernsey, Forest Products Laboratories, Department of Mines and Resources.

that mill-waste sold by sawmills for fuel purposes exceeds the equivalent of 1 million cords. Additional unknown amounts are used as fuel by the sawmills. The figures are far too uncertain to allow a reliable estimate of the coal equivalent of mill-waste used as fuel in British Columbia, but very rough approximations suggest that it is probably not less than 500,000 tons and may be nearly 1 million tons of anthracite coal.

The greater part of the wood fuel used in British Columbia is used for domestic heating in the Greater Vancouver area. The burning of sawdust requires a furnace or heater attachment specially designed for the purpose. Sawdust is fed to the burner attachment by gravity from a hopper and the rate of combustion is controlled by the volume of air admitted. With such equipment sawdust is a satisfactory fuel, for it is clean, economical, and provides a steady heat with a minimum of attention. For domestic use Douglas fir sawdust is considered much preferable to western hemlock, western red cedar, or sitka spruce sawdust.

Hogged fuel is used mainly for industrial steam raising. During war years a special effort was made to increase the amount of it used in the pulp and paper plants on the west coast to replace the fuel oil normally used. In late war years three pulp and paper plants used nearly 200,000 units per annum of hogged fuel in addition to that which they manufactured from their own waste.

There is good reason to believe that the production of wood cut for fuel purposes has declined steadily and appreciably since 1941. Naturally the decline has been largely concentrated in wood produced for sale rather than for farmers' own use. According to some opinions the amount of firewood produced on farms for sale in 1940 has since been reduced by about 1 million cords, or nearly 50 per cent. The reduction is explained in part by the man-power shortage of war years and in part by the long term trend towards depletion of the more accessible wood lots. It may also reflect what has been called the "depression nature" of wood fuel production, namely, that it tends to be high when cash incomes of the producers are low and vice versa. This characteristic of cordwood production suggests that supply in the post-war period will depend to a considerable extent on the general level of prosperity in the country. If unemployment is high and farm incomes low more wood fuel will be available than if the reverse is the case. This cyclical movement will probably be superimposed on a long term downward trend due to wood-lot depletion. However, the use of wood cut for fuel purposes is expected to rise above the level of the late war years, and the probable long term decline in the energy obtained from wood cut for fuel purposes is not likely to be of more than local importance.

The future trends in the fuel use of mill-waste are more uncertain. Since mill-waste is a by-product of lumbering operations, and since lumbering operations may be expected to be maintained at a high level for some years to come, the overall production of mill-waste may be expected to be great. There are, however, indications that the amount of mill-waste used in Canada for fuel purposes may decline. In the past four years efforts have been made in Quebec and the Maritimes to prepare and market spruce mill-waste for chemical pulp chips. On the west coast the use of western hemlock chips in pulp and paper plants appears to be increasing. Hemlock mill-waste has not been an important domestic fuel, but it has been used for steam-raising and the increasing use of it for non-fuel purposes will tend to reduce the mill-waste of other species made available. Efforts are currently being made to develop a method for making wall-board from Douglas fir mill-waste. Should they be successful, they will increase the demand for that species of mill-waste.

The decline, both relative and absolute, in the importance of Douglas fir in the total British Columbia lumber production is expected to continue and it will probably further complicate the sawdust situation in Greater Vancouver. Although the installation of sawdust burners in that area continued during the

war years to such an extent that it had to be controlled, the requirements of sawdust users normally exceeded the supply of sawdust. The recent closing of the sawmill in Bellingham, Washington, has increased the pressure on producers and dealers to export mill-waste to the United States.

It seems probable, therefore, that the use of mill-waste for fuel purposes in British Columbia generally, and in Greater Vancouver in particular, will decline, although it is very difficult to say how rapid the decline will be. The development of alternative uses for mill-waste may change the situation rapidly in a fairly short period, but it seems more likely that the trend will be definite but gradual.

NATURAL GAS

Since 1926 natural gas has supplied somewhat over 2 per cent of the energy obtained in Canada from all sources. Although it is of considerable local importance elsewhere, only in Alberta is natural gas used in sufficient quantities to warrant calling it an important source of energy. In that Province it probably supplies at least one-quarter of the energy obtained from all sources.

Natural gas is essentially a petroleum product. It comprises the lighter hydrocarbon gases (largely methane, with some ethane and varying proportions of heavier hydrocarbons such as propane) which are not readily condensed or compressed to a liquid. It is frequently obtained as a by-product of oil production and it has then to be separated from the oil or liquid fractions. It may also occur as a dry gas with little or no liquid fractions. It is normally sold on a volume basis, the unit being either a cubic foot (CF) or 1,000 cubic feet (MCF). The gross heat value of natural gas is usually about 1,000 B.t.u. per cubic foot under standard conditions (14.5 lbs. per square inch pressure and 60° F.). On this basis, 26 MCF of gas are the equivalent of one ton of 13,000 B.t.u. coal, although in most combustion equipment less than 26 MCF are required to replace a ton of bituminous coal because of the higher thermal efficiency obtained with gas. In the discussion that follows it may be useful to keep in mind that 1,000,000 MCF of natural gas is the theoretical equivalent of about 40,000 tons of bituminous coal.

Natural gas is produced in Canada in every province from New Brunswick west to Alberta, inclusive. There are, however, only three areas where it is of any importance, namely, in New Brunswick near Moncton, in the southwestern tip of Ontario, and in Alberta and western Saskatchewan. In 1944 the production of each of these areas was approximately as follows:

	Natural Gas Production	Theoretical 13,000 B.t.u. Coal Equivalent
	MCF	Net Tons
New Brunswick	700,000	27,000
Ontario	7,100,000	273,000
Saskatchewan	120,000	5,000
Alberta	35,000,000*	1,350,000

* Exclusive of gas wasted.

The natural gas production of New Brunswick is relatively very small. The Stoney Creek field near Moncton supplies Moncton and Hillsborough and certain localities in Albert and Westmoreland Counties with gas used mainly for domestic purposes.

The main producing fields in Ontario are the Tillbury and Haldimand fields in Kent and Haldimand Counties. Production of natural gas in Ontario rose during the 1930's from about 7,000,000 MCF annually to over 13,000,000 MCF in 1940. Although the demand for natural gas continued to grow, the resources of the area were not adequate to allow production to continue at the 1940 level and, in the years since 1940 gas demands have had to be met increasingly by gas provided by the Imperial Oil refinery at Sarnia and by coke ovens rather than by the natural product. In 1945, natural gas production had fallen to about 7,200,000 MCF, while a further 3,500,000 MCF of gas was provided from other sources. The principal markets for natural gas in this area are the urban centres of Windsor, London, Chatham and Sarnia. A portion of the gas is used for industrial purposes but the major part is used for domestic and commercial purposes, that is, for cooking, water heating and space heating.

The inadequacy of the natural gas resources in the area to meet local market requirements has led the major distributor, the Union Gas Company of Canada, to enter into an arrangement with the Panhandle Eastern Pipeline Company of the United States for the importation of natural gas from that country. This agreement was authorized by the United States Federal Power Commission on April 23, 1946. According to the terms of the agreement, the Union Gas Company is permitted to receive from Detroit during the months of April to October inclusive up to 5,500,000 MCF of natural gas in any calendar year. The Union Gas Company proposes to pipe this gas to the partially-exhausted Dawn Field in Lambton County and there store it underground to have it available to meet the company's peak-load requirements of the winter months. When the construction necessary for this to be done is completed, the imported natural gas will supplement local production in serving the area supplied by natural gas in 1940. The first effect of the imported gas will be, therefore, not a further invasion of coal markets but a maintenance of supply in the area already served.

The Federal Power Commission has required the Panhandle Eastern Pipeline Company to give priority to all natural gas purchasers in the United States which may, in the short run, reduce somewhat the volume of natural gas available to the Union Gas Company. However, natural gas pipelines from the major United States natural gas fields of Texas, Oklahoma and Kansas into northern and eastern parts of the United States are expanding very rapidly and at least one additional pipeline from the producing fields to Michigan is planned. It is, therefore, probable that in the course of the next few years much more natural gas will be available for importation into Ontario from the United States than there is at present.

By far the largest reserves, both proven and potential, of natural gas in Canada are in Alberta and in western Saskatchewan. Until recently the discovery of gas fields has been largely incidental to the search for oil. The market has been largely limited to the local needs of Lethbridge, Calgary, Edmonton and contiguous areas, and very little need was felt to develop further gas reserves. Much more attention was directed to utilizing such gas as was produced incidental to oil production and to reducing the waste of that gas. Recently, however, active exploration has been undertaken throughout Alberta and western Saskatchewan to discover new natural gas fields. As a result of this activity, the reserve situation is at present somewhat uncertain; estimates by competent authorities vary within wide limits. There is undoubtedly a good deal more natural gas in Alberta and western Saskatchewan than was, until recently, suspected and there may be a good deal more than that which is presently known. Under such circumstances, the estimates of proven reserves quoted in this report must be considered as tentative only. The following comments on the main known reserves are intended to give no more than a general idea of these reserves as they appear at the moment.

The Turner Valley field, 30 miles southeast of Calgary, produces large quantities of wet gas incidental to the production of oil. Reserves of gas are apparently somewhere between 300 to 400 million MCF. There is still a considerable amount of gas wasted in this field but it is being steadily reduced by conservation measures. The gas contains both gasoline and sulphur and is, therefore, treated in an absorption plant to remove the gasoline and a scrubbing plant to remove the sulphur before it is distributed commercially.

The Medicine Hat-Redcliffe field lies in and west of Medicine Hat. It is a dry gas field producing from wells 1,000 to 1,500 feet deep. Reserves have been estimated at about 125 million MCF, but this is probably a minimum figure for there is cause to believe that the field is more extensive than has usually been assumed.

The Princess-Steveville field, located some 60 miles northwest of Medicine Hat, is presently also classified as a dry gas field. The gas is found at a depth of some 3,900 feet. It has known reserves of at least 80 million MCF and the possibility of much greater reserves is good.

The Viking-Kinsella field, some 70 miles southeast of Edmonton, is a dry gas field and has the largest known reserves in Alberta. Estimates of proven reserves in this field vary from 500 million MCF to nearly twice that figure. The gas is free from sulphur and is found at a depth of some 2,200 feet.

There are smaller natural gas reserves which have not been developed at Foremost, Brooks, Tilley and various other places. Very recently important new gas reserves were reported to have been discovered by the McColl Frontenac Oil Company in what is to be known as Pakowki Lake field, south of Medicine Hat. In the latter part of 1944, in the course of searching for oil, large gas flows were tapped at Jumping Pound, about 25 miles west of Calgary. Similar flows have been located at Brazeau.

The two largest fields in Saskatchewan are in the vicinity of Unity and at Lloydminster. The proven reserves of the former field amount to about 25 million MCF. The latter field, which is primarily an oil field, is thought to have a potential at least equivalent to that of the Unity field. A further field has been discovered at Lone Rock, 15 miles southeast of Lloydminster, but this field has not been developed to the point that an estimate can be given of its reserves. A good deal of exploratory drilling has been done in the southern part of the province but so far the results have not been promising.

There are four pipeline systems for the distribution of natural gas in Alberta: that of the Canadian Western Natural Gas, Light, Heat and Power Company Limited serving the Calgary-Lethbridge area, of the Northwestern Utilities Limited serving Edmonton and area, and those of two municipal systems serving Medicine Hat, Redcliffe, Vermilion and Brooks. Of these, the first is the largest. It began as a pipeline of some 170 miles from the Bow Island field to Calgary; later, as Turner Valley developed as a natural gas producer, the wells there were tied into the line and became the major source of gas for the system. From Bow Island the pipeline was also extended 30 miles south to tap the Foremost field. The system today serves a number of towns on its route from Foremost to Calgary, the largest of which is Lethbridge. The next largest system is that of Northwestern Utilities, serving Edmonton. This system draws its gas from the Viking-Kinsella field and pipes it 90 miles to Edmonton, serving a number of towns en route. An extension of this system, almost 100 miles southwards to Red Deer, is at present under construction. The two municipal systems of Medicine Hat and Redcliffe draw their supplies of natural gas from the Medicine Hat-Redcliffe field and serve their respective urban areas.

The disposition of natural gas from these systems, and also the field use and wastage of gas for the years 1939 and 1944, are shown in the following table, in units of 1,000 MCF:

—	1939	1944
	MMCF	MMCF
To Domestic Use—		
Calgary—Lethbridge System	3,437	4,262
Edmonton and Towns System	1,843	3,150
Medicine Hat—Redcliffe (estimated)	450	600
Other Towns	160	343
Total Domestic	5,890	8,255
To Commercial Use—		
Calgary—Lethbridge System	1,906	3,681
Edmonton System	1,047	2,681
Medicine Hat—Redcliffe (estimated)	200	350
Total Commercial	3,153	6,712
To Industrial Use—		
Calgary—Lethbridge System	968	2,287
Edmonton System	514	1,311
Medicine Hat City Power and Industry (by Diff.)	605	1,310
Medicine Hat—Redcliffe Area	1,364	1,790
Imperial Oil Refinery, Calgary	1,266	1,847
Alberta Nitrogen Co., Calgary	.....	3,240
Total Industrial (Excl. field use)	4,717	11,785
Field and Miscellaneous Use	9,361	8,187
Total Use	23,121	34,939
Repressured Bow Island	165	.....
Waste and Shrinkage	28,316	18,326
GRAND TOTAL	51,602	53,265

Source: Alberta Conservation Board and C.W.N.G.

The use of natural gas for domestic purposes includes its use for cooking, refrigeration, water heating and space heating. For the first two of these, it is directly in competition with electricity; for the last two, with fuel oil and coal. The largest use is undoubtedly that for space heating. It is estimated that 90 per cent of the urban dwellings in Calgary, Lethbridge and Medicine Hat, and perhaps 70 per cent of those in Edmonton, are at present heated principally by natural gas. The commercial use of gas is likewise largely for space heating of restaurants, office buildings, stores and apartment blocks in the various areas. There may be some increase in the use of natural gas for domestic and commercial purposes in the Edmonton area, but otherwise expansion of the market will depend largely on pipeline extensions. The domestic and commercial use of gas in 1944 was about 15 million MCF. or the equivalent of about 575,000 tons of 13,000 B.t.u. coal or 750,000 tons of 10,000 B.t.u. coal.

Natural gas may be used industrially as either a fuel or a raw material. As a raw material it may be used for the production of ammonia, synthetic fuels, carbon black, methyl alcohol, formaldehyde, and a great variety of other chemical compounds containing carbon and/or hydrogen. The only substantial use as a raw material at present is that by the Alberta Nitrogen Company for the manufacture of synthetic ammonia. This plant was built during the war years for the Federal Government by the Consolidated Mining and Smelting Company of Canada to make military explosives, using natural gas and hydro-electric power. It was found to have a capacity in excess of the demand for explosives and used this excess capacity for the manufacture of commercial ferilizer

for home and foreign markets. So far it has met with considerable success in this field. In the last three years this plant has used about 3 million MCF of natural gas annually. The largest single use of natural gas as an industrial fuel is in the Turner Valley oil fields for the operation of pumps, for oil refining and for space heating. The next largest industrial user is the Imperial Oil refinery at Calgary. Other important industrial users include brick plants, flour mills, a power company, a glass plant, packing plants, bakeries and laundries.

The use of natural gas in Saskatchewan is limited to the immediate vicinity of the producing fields for there are no pipeline systems of any size in that Province. It appears that reserves at Unity are adequate for the towns of Wilkie and North Battleford, and that the construction in the near future of a pipeline to serve these towns is very likely.

The following table is presented to give some indication of the comparative cost of natural gas and of coal in the areas served by the two largest natural gas distributors. It shows the average price paid by different classes of consumers for natural gas delivered by the two systems in 1944 and the equivalent value per ton of 10,000 B.t.u. coal, based on 945 B.t.u. gas at Edmonton and 1,000 B.t.u. gas at Calgary, and on the assumption of equal thermal efficiency. Since, in fact, the thermal efficiency of natural gas is usually somewhat higher than that of coal, the value of a ton of coal is in each case somewhat overstated. Finally, the table also includes delivered prices in Edmonton and Calgary of various sizes of coal from the Edmonton and Drumheller fields, respectively.

——	Canadian Western		Northwestern Utilities	
	Average Price per MCF	Equivalent Coal Value Per Net Ton	Average Price per MCF	Equivalent Coal Value Per Net Ton
	Cents	$	Cents	$
Domestic	27.2	5.44	30.4	6.43
Commercial	22.37	4.47	23.0	4.87
Industrial	16.76	3.35	17.1	3.62

Coal	1944 Retail Price at Calgary	Coal	1944 Retail Price at Edmonton
	$		$
Drumheller lump	8.25	Edmonton District lump	5.15
stove	7.25	egg or stove	4.65
nut	5.85	nut	3.65
stoker	3.50	stoker	2.35
slack	2.50	slack	1.85

The coal prices above are for coal delivered in relatively small amounts. Commercial customers were usually given a discount of about 50 cents and industrial consumers sometimes more, depending upon the competitive situation.

To forecast the use to be made of natural gas in western Canada in the next few years is extremely difficult. Natural gas reserves are clearly much more than adequate for present markets and, therefore, some considerable development in the use of the product is to be expected, but there are several lines along which such development may proceed. As an example of one of the possible lines, this Commission has had presented to it a study designed to show that, assuming adequate reserves, the transmission and distribution of natural gas from Alberta to urban centres in Saskatchewan and Manitoba is technically

feasible. It is estimated that such a development, should it occur, would displace approximately 1,000,000 tons of coal annually. If, in addition, a northern line were constructed, to serve Saskatoon, North Battleford, Prince Albert, etc., a further 200,000 tons of coal might be displaced annually.

In view of the rapid growth in the United States in recent years of long-distance transmission of natural gas, a pipeline from Alberta to Winnipeg (a distance of from 630 to 730 miles, depending upon the field chosen) would not be remarkable insofar as its length was concerned. Natural gas lines in the United States now reach from the oil and gas fields of Louisiana and Texas as far North as Chicago and Detroit and as far east as West Virginia for distances of from 1,000 to 1,500 miles. There are, however, a number of considerations which suggest that a forecast of any similar development in western Canada is somewhat premature.

In the first place, the reserve situation in western Canada is at present very uncertain. There is little agreement among competent authorities about the reserves of most of the fields, particularly about those from which the gas for such a project would be taken. Furthermore, even if it were clear that total reserves in Alberta are adequate for such a project, the undeveloped nature of Saskatchewan gas reserves would discourage pipeline construction from Alberta, for further exploration in Saskatchewan might reveal large reserves much nearer to the market to be served. It is the hope of operators in the Lloydminster-Unity-Lone Rock triangle that sufficient reserves will soon be found to supply the northern part of the Province including Saskatoon, but it appears that proven reserves are not at present sufficient to justify such an undertaking.

Even should reserves in Alberta be adequate and the economics of pipelines into Saskatchewan, and perhaps Manitoba, be sound, no company would undertake any large pipeline construction without an assurance that the Government of Alberta would allow the export of gas over a long period of years. It is by no means certain that such an assurance would be forthcoming. The present policy of the Alberta Government is to control the export of gas from the Province by a system of yearly licences. Even should proven reserves in Alberta rise substantially, it is possible that the Government would discourage the export of gas in the hope of attracting chemical industries to the Province, while at the same time offering some protection to the coal industry in the Province.

Even without any restriction on the export of gas from Alberta, unless reserves are found to be very large indeed it may happen that new chemical industries in the Province will be able to outbid potential consumers in Saskatchewan and Manitoba for such gas as may be available. In the chapter Products and By-Products the nature of chemical industries based on coal, petroleum and natural gas, and the prospects for the establishment of such industries in western Canada, are discussed. The range of such industries is enormous and at the present time natural gas may well be a cheaper material from which to start than either petroleum or coal. Synthetic liquid fuel plants alone could conceivably use more natural gas annually than is at present produced in the whole of Alberta.

PEAT

Peat has never been important as a source of energy in Canada. Annual peat production for fuel purposes has never exceeded a few thousand tons and, although the production may have been locally important, in comparison with Canada's energy requirements it has been insignificant. However, Canada has substantial peat resources and every time that a fuel shortage has threatened attention has turned to peat as a possible substitute fuel. Thus the fuel shortage of 1917 led to the appointment early in 1918 of a Joint Peat Committee*, financed

* This Committee reported in 1925 after having made a thorough study of the problem, and anyone particularly interested in peat is referred to the Final Report of the Peat Committee by B. F. Haanel, Honorary Secretary and Member Peat Committee, 1925.

equally by the Federal Government and the Government of Ontario, to conduct an investigation concerning ways and means of converting the peat content of Canadian bogs into a marketable fuel. During the recent war the Emergency Coal Production Board made further efforts to stimulate peat production. Therefore, no survey of energy sources can be complete unless some consideration is given to the possibilities of peat fuel.

Peat is the name given to the material produced by the incomplete decomposition of vegetable matter either in water or in the presence of water under such conditions that atmospheric oxygen is excluded. An accumulation of such material is called a peat bog. The absence of oxygen during the process of decomposition results in the carbonization, called humification, of the plant material. Generally speaking, the degree of humification increases from the top to the bottom of the bog. The more or less unhumified peat is known as peat moss and is used for a number of non-fuel purposes. It is from the humified peat that peat fuel is produced, and it is, therefore, with humified peat that this survey is concerned.

In respect of its physical properties, peat is exceedingly variable. The colour ranges from yellowish brown through various shades of brown to jet black. Most bogs contain more or less fibrous material. They also often contain varying amounts and forms of mineral matter which may affect their value as sources of fuel. Peat has a great capacity for taking up and holding water. Most bogs contain 90 per cent or more moisture, and even a well-drained bog ordinarily has a water content of more than 85 per cent.

The chemical composition of peat also varies widely from bog to bog. The composition of typical Canadian peat on a dry basis is said to be some 60 per cent carbon, 6 per cent hydrogen and 34 per cent oxygen. The large content of oxygen is mainly responsible for the low heating value of the substance.

The calorific value of dry peat from Canadian bogs varies usually from 8,000 to 9,500 B.t.u. per pound. It is extremely difficult to remove commercially all the moisture from peat, and so the product normally contains 25 per cent to 30 per cent water. The moisture present reduces the calorific value of the dry substance, both by displacing combustible material and by absorbing heat in evaporating during combustion. Peat that would yield 9,500 B.t.u. when dry has a calorific value of 6,795 B.t.u. with 25 per cent moisture and 6,260 B.t.u. with 30 per cent moisture.

Peat has many advantages as a fuel. Because it is easy to kindle, burns freely with a cheerful yellow flame, is hot, does not clinker and burns to a very light clean ash, it is considered to be excellent for open grates and cook stoves. But it also has disadvantages. It is about 50 per cent bulkier for weight than coal and thus requires greater storage space and more handling. Its calorific value is much lower than that for anthracite or bituminous coal and, since it burns extremely freely, peat fires must be renewed frequently. It is, therefore, not a good furnace fuel for severe weather, and it requires special burning equipment if it is to be used successfully for steam raising. In most respects peat is more comparable with wood fuel than with coal, and it is as a substitute for wood rather than coal that peat is currently regarded. Theoretically, one ton of anthracite coal is the equivalent of two tons of peat, but for open fireplaces and domestic ranges the relative value of peat is somewhat greater. A comparison with wood fuel from the heating value standpoint is difficult because of the wide variation in the heating value of different woods. One ton of peat would be more than equivalent to one cord of poor softwood and less than equivalent to one cord of good hardwood.

Only rarely does the annual Canadian consumption of peat as a fuel appear to have amounted to more than a few hundred tons. During, and for a few years after, the operation of the Peat Committee, peat fuel was shipped in

limited quantities to Ottawa and Montreal, where it was used for domestic heating in open grates, stoves, and, in spring and fall, in furnaces. For a while during the recent war small amounts of peat were used in Quebec city. For the most part, however, consumption seems to have been limited to the immediate vicinity of a few bogs in Ontario and Quebec where it was used as a substitute for wood fuel for domestic heating purposes.

Canada's peat resources were estimated by the Peat Committee to be nearly 35 billion tons but the figure was recognized to mean very little for most of the bogs occur either in unsettled areas or in areas where preferred alternative fuels are readily available. The Federal Department of Mines had investigated a number of the more important peat deposits convenient to centres of population and favourably situated as regards transportation, and its findings are given in the Peat Committee's Report and are summarized below:

No. of bogs Investigated	—	Estimated Peat Fuel with 25 per cent Moisture
		Tons
46	Ontario	112,153,000
27	Quebec	76,137,000
27	Maritimes	8,073,000
7	Manitoba	1,863,000
107		198,226,000

It is the presence of peat bogs in Ontario and Quebec, the large fuel-importing provinces, which has led to periodic efforts to develop peat production.

The major problem in peat production is that of reducing the moisture content to below 30 per cent. The removal of moisture by pressure, by artificial drying, and by air-drying have all been tried either here or in Europe, and Canadian experience indicates that air-drying is the most economic process at the present time. The disadvantage of air-drying is that the fuel must be laid out in the sun for some weeks, which requires a good deal of handling. Since the peat as dug is mostly water, 7 or 8 tons of it must be dug and handled to produce one ton of 25 per cent moisture fuel. The only other processing necessary is that of mixing and pulping, called maceration, of the raw peat. The operation increases the density and the ability to resist deterioration in handling of the dried peat, and it also reduces the effect of rains during the drying process. It is impossible to produce peat during the winter months; in Canada, experience has shown that the working season is only some 100 days. Mainly for these reasons, although probably well over 50 attempts had been made, and although the Federal Department of Mines had studied since 1908 the application of European methods to Canadian bogs, by 1918 no peat fuel industry had developed in Canada.

From 1918 to 1922 the Peat Committee conducted experiments on the Alfred bog in Ontario and by the end of 1922 had developed a production technique which offered some promise of success. In 1924 a company, Peat Fuels Limited, took over the assets of the Peat Committee and operated intermittently until 1928, but its operations resulted in marketing only 1,850 tons of peat fuel. During the 'thirties only small amounts of peat fuel were produced intermittently for local consumption from various bogs in Ontario and Quebec. During 1943 local wood fuel shortages revived interest in peat production and the

Emergency Coal Production Board contributed $62,500 for experimental operations in Quebec and Ontario, but the 1943 production of peat was only 1,500 tons in Quebec and 250 in Ontario.

The history of the peat production in Canada gives little grounds for believing that peat is likely to become an important source of energy in the foreseeable future. It may achieve local importance as a substitute for wood fuel, but its contribution towards meeting our energy requirements is likely for some years to be insignificant.

ATOMIC ENERGY

Since the bombing of Hiroshima on August 6, 1945, there has been a good deal of speculation about the peacetime implications of atomic energy. In a review of sources of energy, it seemed to us necessary to say something about these implications, particularly insofar as they affect coal. We therefore asked Dr. C. J. Mackenzie, President of the National Research Council, for his opinion as to the effects which the development of atomic energy may have on the use of coal as a source of energy. We asked him to be as specific as he could be regarding the time within which various uses of atomic energy might develop and the fields in which it might be used. Dr. Mackenzie's reply, received in October, 1946, is presented in full.

"The first thing that must be realized is that any opinion at present is of necessity more in the nature of a guess than a precise estimate because of the uncertainties surrounding the future of atomic energy. At the present time we know very little of the precise form future developments will take, how long it will take to make such developments, or what the cost will be, and all one can give is a consensus of opinion of a number of scientists and engineers who have been closely associated with the project. However, I must emphasize that individual opinions, particularly as to time and costs, vary widely within the group consulted.

"The time of developments will be directly influenced by the amount of money and effort which the nations of the world will be prepared to devote to the work in peacetime. It will also be affected by security restrictions. The only experience we have had in development work in this field has been under the abnormal conditions of war, and if that scale of effort were maintained, which is extremely unlikely, the time taken to make developments would be relatively short. On the other hand, if the effort allotted to developments is not greater than in pre-war years, the progress will probably be very slow. The true answer is to be found somewhere between these two extremes but it cannot be expressed in a definite figure.

"Again as to costs, when one talks about competitive cost figures, it can be seen that it depends again on the attitude of governments. If they support work in this field as they did in war and bear a high cost of development charges, the cost to consumers of any product would obviously be less than if private industries had to carry the development costs and added such costs to the final price; all of which makes for uncertainties in cost estimates.

"What future developments will actually take place is another factor of uncertainty, and it is well known that new scientific findings and developments often affect the time and cost of materials. Taking all these things into consideration and with a full knowledge of the danger of making estimates, I would suggest the following prediction as to what might be the situation within the various time intervals suggested by you.

"*Five Years*

No industrial use of atomic power, except on a pilot plant scale for purely experimental purposes.

"*Ten Years*

Limited use under special circumstances, where cost is not a consideration. Examples are: military uses; rockets to the moon; very long-range aircraft; naval uses to give effectively unlimited cruising range; supply of power in remote areas such as the far north.

"*Fifteen Years*

Considerable decrease in costs. Industrial uses beginning to develop. Price probably still high enough so that effect on coal is negligible.

"*Twenty Years*

Possibly costs beginning to approximate coal or hydro-electric power. New uses may very well lead to increased power consumption, and hence unlikely to decrease coal consumption.

"Regarding fields of use, the following suggestions are made under the categories suggested by you:

1. *Railways*: Might be ultimately attractive for railways but more probably through the medium of electrification.
2. *Manufacture of Electricity:* It is improbable that the cost will ever fall below that of a good hydro-electric development at least until the annihilation of matter becomes feasible. Also it should be remembered that distribution costs will still remain the major cost.
3. *Other Industrial Uses:* These will probably be many, but the majority will probably be new processes, and hence not really competing with coal.
4. *Domestic Use, including central heating:* Domestic uses, other than central heating, are unlikely. Central heating is, of course, merely a question of costs. In my opinion, for low-grade uses of power, such as heat, it is unlikely to be economical in the next twenty years.
5. *Ships' Bunkerage:* Here increased pay-load is a factor favouring atomic power. In the future this may well be one of the first widespread uses. But there probably will be no displacement of coal to any appreciable extent within twenty years. It may be noted that the cost of converting ships would probably be high so that when this use does come into play, it may be uneconomic except for new ships.

"In my opinion, the coal industry has nothing to fear in the next ten years, and very little in the next twenty. I do not think any more detailed estimate of costs can be given which has any meaning."