

# Consolidated Mining & Smelting's

## Activities

**I**N THE four articles that have gone before, technical data have been given of the mining and metallurgical practice of the Consolidated Mining & Smelting Company of Canada, Ltd., at its British Columbia properties. In concluding this series, a statistical review of the scope of this company's work will be given and its history will be traced briefly, pointing out the fundamental considerations that have been kept in mind by its officials in building up one of the great mining and metallurgical enterprises.

Production of Consolidated amounted in 1930 to 152,000 tons of lead, 120,000 tons of zinc, 7,000 tons of copper, 228 tons of cadmium, 7,000,000 oz. of silver, 26,000 oz. of gold, and, in addition, considerable sulphuric acid, some bismuth, and a small quantity of antimony. The company's principal reduction plant is at Trail, B. C., and its chief mine and concentrating plant are at Kimberley, 200 miles or so away, but in the same province. The production represents a consistent growth, which combines technical skill and business acumen of high quality.

The company was incorporated in 1905 in Canada as the Canadian Consolidated Mines, Ltd. Its name was changed to the present form in 1906. The original company was formed to take over the War Eagle Consolidated Mining & Development Company, the Centre Star Mining Company, the St. Eugene Consolidated Mining Company, the Rossland Power Company, and the Trail smelter. In 1916 the company acquired control of the West Kootenay Power & Light Company. The dominating financial influence is the Canadian Pacific Railway.

Rossland mines were the company's most important mines at the start, but with the developing of the electrolytic zinc process, in which the company pioneered, the Sullivan mine became the important ore source after 1915. Rossland mines were worked and supplied a small amount of ore to the end of 1928, after which they were practically abandoned. The total ore from this source amounted to 5,439,821 tons. St. Eugene mine supplied 1,026,435 tons of lead-zinc ore, and until recently its tailings, aggregating 524,354 tons, were worked. During 1930, apart from custom business, the metallic ore treated was derived principally from the Sullivan mine, only two other mines contributing small amounts. The Oliver property supplied 430 tons of silica and the Star phosphate claims contributed

*Last of a series of five articles on British Columbia's greatest mining enterprise*

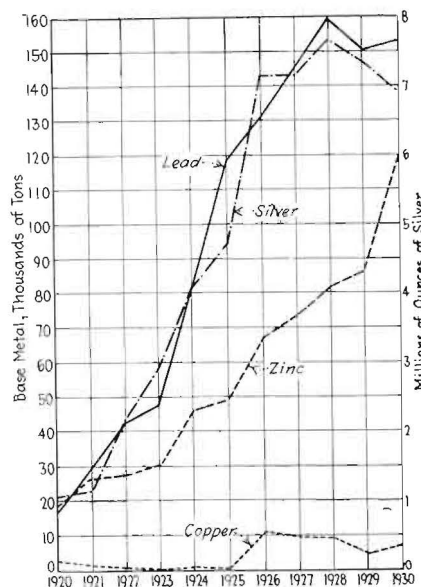


Fig. 1—Production of Consolidated in the last ten years

1,376 tons of phosphate rock. Sullivan mine produced 1,911,000 tons of milling ore and 13,000 tons of lead ore.

Aggregate ore production from the Sullivan mine to the end of 1930 was 12,000,000 tons. Totals from other company mines to the same date were about 7,900,000 tons of ore, which includes the Rossland production of more than 5,400,000 tons. Twenty mines, including the Rossland group as one, produced this total, and of these only four produced in 1930.

Apart from the Sullivan, the company's older mines appear to be pretty well worked out. All of the mines produced to the end of 1930 close to 20,000,000 tons of ore, both of mill and shipping grade and including some concentrates. Total metals produced were 1,345,000 tons of lead, 643,000 tons of zinc, 92,000 tons of copper, 83,662,000 oz. of silver, 2,229,000 oz. of gold, and 860 tons of cadmium. The time interval involved in this production is 36 years. Fig. 1 shows that the great increase in metal production of the Consolidated was in the last ten years.

The Trail plant is also a custom smelter, and during 1930 it purchased \$4,063,125 worth of custom ore, bullion, and copper. During the period 1920 to 1930, inclusive, custom ore purchases

totaled \$27,290,304. Part of this ore was derived from the United States, but most of it came from British Columbia.

Properly to visualize the present position of Consolidated, some comparisons are necessary. World production of lead in 1930 was 1,835,000 tons. Consolidated's production was over 8 per cent of that. World zinc production in 1930 was 1,555,000 tons, of which Consolidated produced 7.7 per cent. Of the lead-producing countries, the lead production of this company exceeds the production of Spain, Germany, and Burma, India, and is exceeded by that of the United States, Australia, and Mexico. Only one of the United States—Missouri—exceeds its production. Of zinc-producing countries, the United States, Belgium (from ore imports), and Upper Silesia (Poland) are probably the only countries exceeding the zinc production of this single company. In the United States, no one state equaled Consolidated's zinc production last year.

The great lead-zinc mines of the world are the Sullivan, the Bawdwin, the Broken Hills group (Australia), the Poland-Silesia group, and now Mount Isa may also be included.

An annual metal production of about 280,000 tons places the Consolidated company among the world's great metal producers. The fact that most of this is derived from the Sullivan mine, at Kimberley, establishes this mine among the most notable lead-zinc-silver deposits.

On Oct. 4, 1915, Consolidated started a hydrometallurgical plant for the electrolytic recovery of zinc. The event marks the beginning of a fifteen-year period of progressive development. Production of the Sullivan mine in 1916 was 91,130 tons. At the time, selective mining was practiced and a zinc ore approximating 25 per cent zinc and 11 per cent lead, and a lead ore containing 14 per cent lead and 12 per cent zinc, were shipped to Trail. One was treated in the zinc plant and the other smelted in lead blast furnaces, which also handled the lead-bearing residues of the zinc plant. This treatment scheme was supplemented by milling, and an active campaign of research was begun, having for its object the concentration of the

Sullivan ores. The result of the research was the adoption of selective flotation and the construction of the Kimberley concentrator, which had an initial capacity of 3,000 tons per day. Its metallurgical results were decisive. The iron sulphide plus a low percentage of gangue constituents was largely eliminated. An approximate ratio of

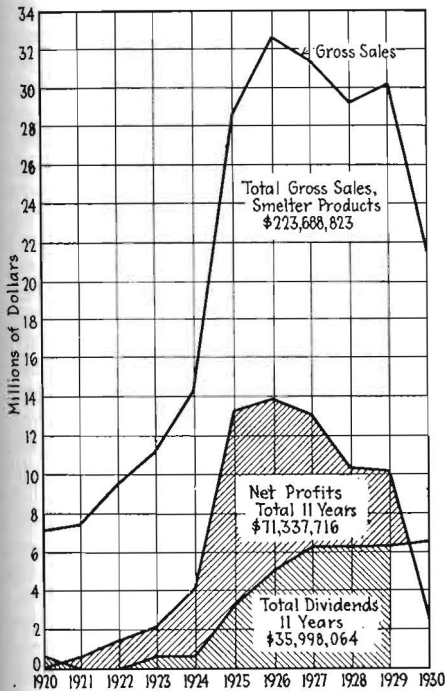


Fig. 2—Gross sales, net profits, and dividends

concentration of 3 to 1 resulted in the elimination of almost 70 per cent of the ore weight and the production of high-grade zinc and lead concentrates.

Coincident with the milling program outlined in the foregoing, the zinc plant was doubled in capacity and the lead refinery increased to 325 tons per day. In 1925, the concentrator was enlarged to 4,000 tons, and increased zinc plant capacity followed. In 1929, the concentrator was enlarged to 6,000 tons' daily capacity. Zinc-plant capacity was increased to 300 tons. Mine facilities as well as accessory facilities at the Trail plants were increased to handle these additional tonnages. One of the dominating motives of this expansion in milling capacity was the desire to bring capacity up to the position where lower-grade ores could be handled profitably, thus providing for a more even mining of the large deposit, which theretofore had been selectively mined. With the present capacity, ore is now taken from a larger number of stopes, and the higher-grade stopes are less heavily drawn upon.

For the time being, the company's milling program has reached a static position at 6,000 tons per day, and attention will now be directed to the improvement of different parts of the plants at Kimberley and at Trail. One of the major improvements at Trail was the construction of a zinc-fuming plant

for the treatment of the lead blast-furnace slags. Whatever zinc escaped the hydrometallurgical plant in the residues, together with the zinc in the lead ore and lead concentrate, was eliminated in the lead blast-furnace slag and smelter gases. About 85 per cent of this zinc is now being retrieved in the form of zinc oxide along with the lead formerly lost in the slag. This zinc-lead fume is treated in a separate hydrometallurgical plant, where the zinc is dissolved in sulphuric acid and the lead-bearing residue returned to the blast-furnace circuit. The dissolved zinc is electrolytically deposited.

Along with the increase in smelting capacity in 1924, and in anticipation of changed conditions resulting therefrom, a new zinc roaster stack 400 ft. high and 21 ft. in diameter, of brick-lined concrete construction, was built, and in 1925 a similar stack, 400 ft. high and 25 ft. in diameter, was provided for the lead smelter. Accessory flues and Cottrells were included in this construction, and the stacks were considered high enough to diffuse the increased volume of sulphur dioxide resulting from the larger tonnages handled. After Mr. T. A. Rickard visited Trail in 1916 he wrote: "The smelter is not bothered by 'smoke suits,' the Consolidated company having purchased the adjacent land to avoid this very trouble. Now that the operations of the smelter support a community of increasing size and create a market for agricultural products, the farmers are buying back the land under agreements to which a smoke clause is attached."

But when I visited Trail in 1922 the manager, Mr. Blaylock, was in the throes of settling up local "smoke suits." Although Consolidated has installed the most modern facilities in stacks, flues, dust chambers, and Cottrell treaters, the topography at Trail imposes natural disadvantages. The narrow Columbia River valley continues to the south across the international boundary 7 miles' distance. Twenty miles south is Northport, and still further, 40 miles, is Marcus, where the Columbia River valley widens. American farmers and horticulturists have claimed damages from smelter smoke in the valley south of the international line and almost as far as Marcus. Recently the International Joint Commission has been delving into the subject, and awarded \$350,000 to the farmers, a decision that satisfied neither the farmers nor the company, so it is being appealed. With this we are not especially concerned, but we may note the steps that are being taken by Consolidated to lessen the amount of effluent sulphur dioxide, and what it is going to do with this gas.

I do not know of a smelting organization that has been more active in applying whatever new thought has developed in stack, flue, and treater equipment, toward lessening smelter-smoke difficulties, than the one at Trail. Apart from this, great progress has been made

in reducing the ratio of sulphur to metal content in the concentrates delivered at the smelter. In 1916, crude ore was shipped to Trail. The accessory pyrrhotite and pyrite necessarily accompanied the zinc and lead to the roasters, and the sulphur had to be oxidized and passed into the atmosphere as sulphur dioxide. Concentration reduced the ratio of sulphur to metal content, and selective flotation finally succeeded in eliminating a great proportion of the iron sulphide. Obviously, the sulphur locked to the lead and to the zinc could not be separated mechanically, but the greater proportion of all of the other sulphur is sent to the tailing pond at the Kimberley concentrator. Thus the company sent no more sulphur to Trail than could be avoided. Its dust and fume equipment removed suspensions from the smelter gases and its stacks discharged at such a height (400 ft.) as to warrant the assumption that diffusion would reduce the concentration of sulphur dioxide sufficiently to result in comparatively small harm outside of a radius of 6 to 10 miles. Topography, however, concentrated the gas diffusion in the southerly direction, and presumably local gas concentrations extended beyond the limits mentioned, and persisted sufficiently to cause some damage. Extension of the zone of damage followed upon the increase in plant capacity. The reduction of the

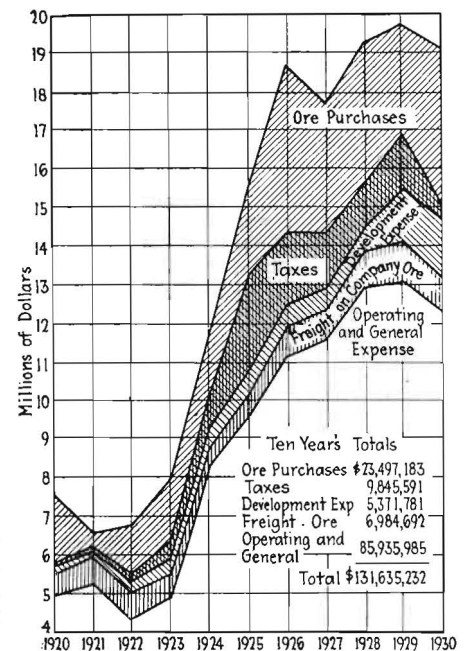


Fig. 3—Expenses for eleven years

amount of liberated sulphur dioxide was the obvious remedy, but this would have required either less capacity or the utilization of part of the sulphur dioxide in some way.

The company directed its research to reducing sulphur dioxide to sulphur and is continuing this work. Conversion of sulphur dioxide to sulphuric acid obviously necessitated the discovery of

some use to which the sulphuric acid could be put. A contact acid plant of 35 tons' capacity per day was erected, displacing a small chamber-acid plant which supplied the sulphuric acid requirements of the zinc plant and the refineries. The practicability of the manufacture of concentrated fertilizers at the plant was also investigated. Other kinds of fertilizers seemed to be out of the question on account of the freight rates to prospective markets. The possibilities of developing a market for concentrated fertilizers also were investigated, and after several years of systematic experimentation in the prairie provinces results were obtained which showed that such fertilizers would be of economic advantage to the farmers of that region. Whereupon the company decided to solve its smoke troubles by the erection of sulphuric acid plants, which with the plant already in operation would give it an outturn of 380 tons of sulphuric acid per day and which would reduce the amount of liberated sulphur dioxide by about 38 per cent.

Erection of a fertilizer plant for the manufacture of concentrated fertilizers is being completed. Thus the new work has to do with smelter byproducts, as in the recovery of zinc contained in the smelter slag. The new sulphuric acid and the fertilizer units, involving an investment of about \$10,000,000, represent the establishment of a huge chemical industry that is destined, in my opinion, to have far-reaching effects. Furthermore, the program reflects the stamina and courage of the management and directorate of this company, for the field is new, the market is undeveloped, and the undertaking involves a different sort of merchandising from that involved in the marketing of metals. But the company has proved its ability to pioneer metallurgically and to market its products. It has sent its technical men to Europe to study the latest developments in ammonia synthesis and in superphosphate technology and is bringing the best of these modern processes to its new enterprise. A division of agricultural research has been established and its future position, in this field, though in the lap of the gods to some extent, is headed in a direction defined by an intelligent preview of a difficult situation.

The great advance in production, sales, profits, and dividends, as well as plant expansion of the company, began in 1924 and continued during the last seven years, the culminating feature of expansion being the construction of the fertilizer plant in 1930. Fig. 2 gives graphically gross sales of smelter products, net profits, and dividends for the period beginning with 1920. Fig. 3 is the graphic presentation of expenditures and includes operating and general expenses, freight cost between Kimberley and Trail, development expense, taxes, and ore purchases. The total of these expenditures has recently approached \$20,000,000. This in itself indicates the

tremendous economic importance of the company's operations to British Columbia and to Canada.

Fig. 4 indicates the amounts involved in plant expenditures and purchases of mining property. The total of these expenditures was \$9,280,010 in 1930, of which plant accounted for \$6,365,736 and property \$2,914,274, making the total money outgo for that year, including operating, almost \$22,000,000. The outgo of 1930 and of the preceding five years indicates that the company is

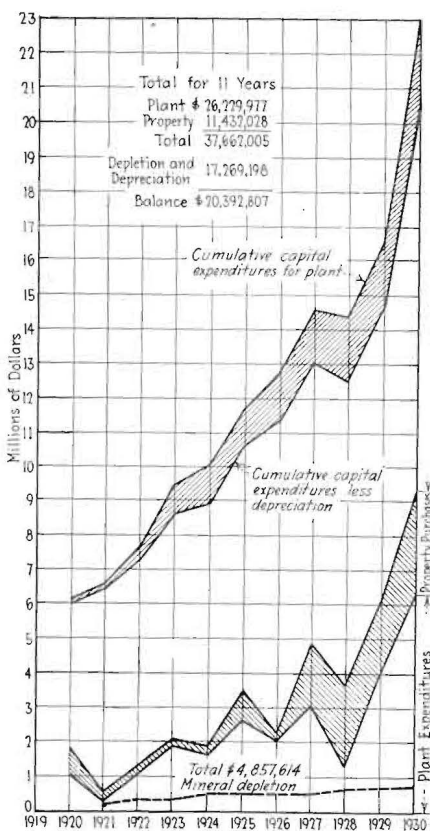


Fig. 4—Expenditures for plant and purchase of properties

engaged upon a constructive program which has for its objective the placing of its plants upon the most efficient basis and the extension of its mining properties to include additional ore reserves beyond those contained in the great Sullivan mine.

Apart from expansions at Trail and Kimberley, the outstanding objective of the company is its search for new mines. Operation, exploration, and examination work are managed by W. M. Archibald, vice-president in charge of mines, who has an operating staff of nineteen engineers and assistants and an exploration and mine examination force of 27 engineers and assistants. An air service was organized early in 1929. The company has its own corps of trained pilots. Flying equipment is used in the transportation of men and supplies to properties under option in northern Saskatchewan, Manitoba, and Ontario, and provides for the transportation needs of examining engineers in the same localities. In 1930, total hours

flown was 3,921, covering 325,162 miles. Equipment includes Curtiss-Robin monoplanes, Gypsy Moth seaplanes, a Puss Moth monoplane, and Fairchild 71's.

Results of the 1929 and 1930 exploration campaigns are indicated in the company's annual reports. Three methods are followed: (1) Purchasing of a controlling or minority interest in existing companies, the money to be expended in exploration; (2) optioning properties; (3) by prospecting agreements and prospecting parties. Much underground work, including diamond drilling, is done at the properties under option. Apparently no good showing of mineralization is allowed to escape systematic drilling or underground exploration.

Every year numerous options are taken for properties on which subsequent work is done, and the company's own engineers are in a large number of fields. Even in the unfavorable year 1930, 452 properties were reported on, 188 of which were in British Columbia, 63 in Ontario, 50 in Manitoba, 15 in Saskatchewan, 43 in Quebec, 12 in Nova Scotia, 4 in New Brunswick, 13 in the Yukon and Northwest Territories, 5 in Newfoundland, 43 in the United States and Alaska, and 16 in South Africa. But as a result, in part, of unfavorable metal prices and the future outlook, tentative options were taken on only 16 properties. On half of these, further sampling and preliminary surface work resulted in their abandonment; on six others diamond drilling or underground development was carried on before abandonment. Two of the options are being continued.

The finding of commercial orebodies is probably not as difficult as winning a "hole in one," but it is difficult enough, as mining experience has shown. Still, much can be expected of an exploration organization managed by experienced mining men and with ample funds and facilities at its command.

The company has an 11 per cent interest in the Copper Cliff copper refinery of Ontario Refining Company, Ltd., where all of its copper refining is done.

The great volume of metals produced by Consolidated necessarily involves special selling arrangements. For Canada, a sales office in Montreal is maintained. In 1924 an interest in A. Cameron & Company, Ltd., was acquired, which company represents the Consolidated in the Orient. In 1926, an interest was acquired in Henry Gardner & Company, Ltd., European representatives of the company. The last-named company has an arrangement with the British Metal Corporation, Ltd., for an association in selling metals, functioning through a holding company, the Amalgamated Metals Corporation, Ltd. Two selling organizations respectively serve the Oriental and the European countries.

Trail is 500 miles from Vancouver and Kimberley is 200 miles from Trail.

Connection hitherto between the two points has been by rail to Kootenay Landing, by boat between Kootenay Landing and Proctor, and thence by rail to Trail. But the Canadian Pacific Railway has constructed a connecting link along Kootenay Lake between Proctor and Kootenay Landing, and this now gives an all-rail route between mine and smelter.

At Fernie is an important coal field that supplies Trail with coal and coke. At Bonnington Falls on the Kootenay River, the West Kootenay Power & Light Company has two power plants, with generator capacity totaling 82,500 kva. and hydro turbines of 98,000 hp.; and at South Slocan is generator capacity of 52,500 kva. and hydro turbines of 75,000 hp., or a total of 173,000 hp.

The power company is owned by Consolidated. The greater part of its power is delivered to and used at the Trail plant. As the transmission distance is only 35 miles, and the power plants represent an asset valuation of \$11,888,074, the cost of power is comparatively low. Cheap power has made Trail, with its huge electrolytic refineries, possible. Likewise, it has made possible the exploitation of the ores of the Sullivan mine.

Fig. 5 shows the increase in power supplied by the West Kootenay plants during the ten-year period. The increase from 1924 was absorbed almost wholly by the Trail plants. At Kimberley, power is supplied by the East Kootenay Power Company, which has hydro plants at Bull River and Elko. Both plants have generator capacity of 23,000 kva., hydro turbines of 22,200 hp., and steam turbines of 6,666 hp. Consolidated has an auxiliary steam power plant at its concentrator near Kimberley.

The component parts of this great enterprise are a huge mineral deposit, cheap power, and both coal and coke near by. A concentration of exploitable natural resources thus makes it possible for the company to maintain about 5,000 employees and by its payroll of some \$8,000,000 per annum to support the towns of Trail, Rossland, and Kimberley, and less directly to stimulate business over a wide region.

Its freight payments aggregate close to \$4,000,000 per annum and it is a large purchaser of materials and sup-

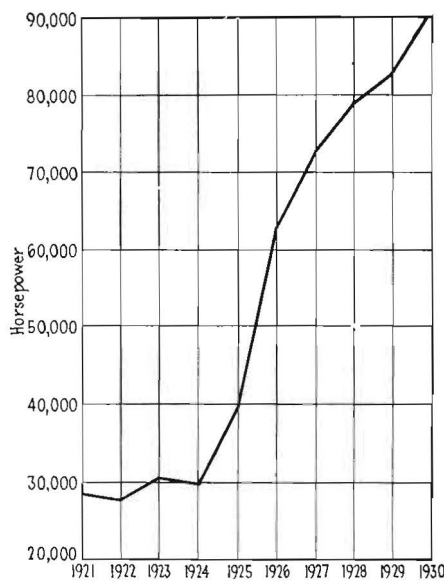


Fig. 5—Increase in power supply in ten-year period

plies of diverse kinds. Its warehouse at Tadanac maintains an average stock representing \$850,000 in value, the monthly turnover of which is \$240,000. The importance of mining in upbuilding the prosperity of its surrounding region is well illustrated by this British Columbia enterprise.

Consolidated has adopted a broad attitude in the treatment of its employees and in the development of the communities in which the men live. Labor turnover is very low. A safety program under the direction of trained safety men last year reduced the shifts lost due to accidents by 17 per cent over the record for 1929, and 42 per cent over that of 1927. Safe operating conditions receive detailed attention and change rooms and accommodations for workers are being improved. An employee representation organization consisting of 30 employees elected from various departments assists in running the plant efficiently and fairly.

A variable wage system based upon an average base price for lead and zinc at £17 per long ton in London gives a bonus of 10c. for each £1 advance above the base and a corresponding deduction for a decline. A recent concession by the company reduced the rate of deduction to 5c. for each pound sterling decline between £24 10s. and the base. In addition, an efficiency bonus has been

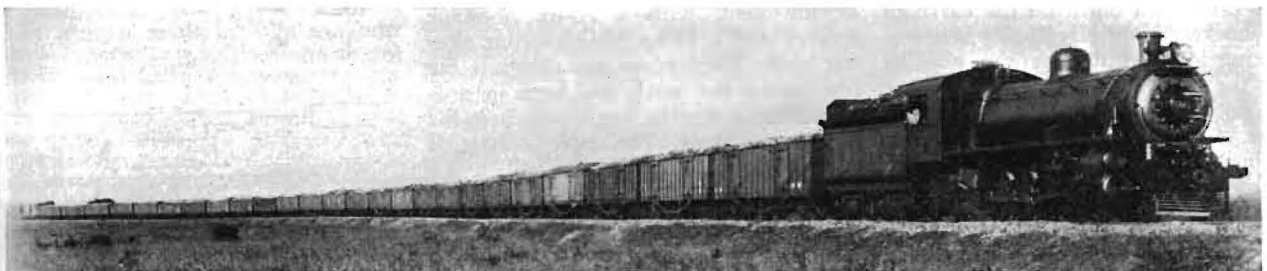
established, based upon improvement in any one department over an average performance for the six months previous to the establishment of the bonus. An annual bonus of \$50 is paid to each married man and \$25 to each single employee.

Assurance of a square deal is provided by an "open-transfer" system. Medical attention and hospitalization are provided by membership in the medical organization at a cost of \$1.80 per month, besides which the company contributes 30c. The recipient and his dependents receive medical and hospital treatment and the company pays half the cost of all specialist work.

Consolidated issues one share of its stock to each employee of three years' standing. It also maintains a group-insurance plan by which each employee receives a straight life insurance of \$500 after being employed for three months, and this automatically increases by \$100 each six months until a \$1,500 maximum is reached. Each employee has the privilege of taking out an additional \$1,000 at the group rate. The total of the insurance now in force is about \$12,000,000.

A pension system is in operation which provides for retirement payments at the age of 60 and after fifteen years or more of employment. The company also assists its employees in acquiring homes. More than 600 homes have been completed on this plan, and the housing fund of the company now totals \$750,000. Employees themselves maintain benevolent societies.

A personnel department under C. W. Guillaume supervises activities in which the company has a direct interest. I had the pleasure of a chat with Mr. Guillaume, and from him gathered an idea of the completeness of the company's efforts to make the work of its employees remunerative, safe, and healthful, and to encourage them to provide for the future.



Coal and coke for Africa copper mines. A heavily laden train leaving the Wankie Collieries, in Rhodesia