N. E. I. Tin Mining Resumed

By J. VAN DEN BERG • MINING ENGINEER; MEMBER, AIME

This is the dramatic story of the Billiton Co.'s return after the war to the tin islands of Billiton, Banka, and Singkep in the Netherlands East Indies. Although many hardships were encountered, because of the occupation of the Japanese who had ruined much of the mining equipment and impoverished the natives, the natives welcomed the return of the Company and, for the most part, labor relations have been harmonious. Although production was rapidly being restored and the outlook was apparently bright, recent political developments are foreboding. Mr. Van den Berg wrote this article for ME in the fall of 1948 before these developments.

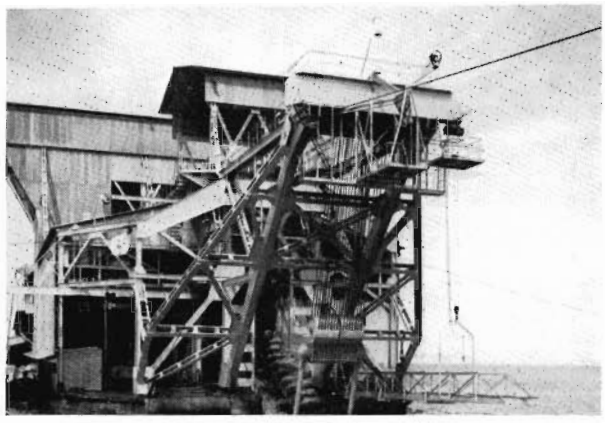
Tin production and export from the Far East are still a long way off from the prewar figures. The Malayan Peninsula, which had a rather good start directly after the war largely because of stock piles found in Singapore and elsewhere, has since been hampered in the rehabilitation of its tin mines and dredging operations by material shortages and, more recently and more severely, by revolts and attacks of communist elements and gangster bands. These hindrances make working in the mines dangerous and form a daily threat against the valuable and highly vulnerable dredges.

Contrary to the conditions in Malaya are those on the tin islands of Billiton, Banka, and Singkep—all in the Netherlands East Indies—where the Dutch have re-established peaceful relations with the population. Dutch efforts since the fall of 1945 have been rewarded by continuously increasing production, extension of production facilities, and return of moderate prosperity, complete safety, and all-out co-operation among the population—native and Chinese—to the benefit of all concerned.

Current tin production on the three islands is approximately 35,000 long tons a year, a rate that is higher than the average one of the thirties. A further increase may well be expected since Banka, the island with the greatest potentiality, recently came under the management of a private corporation, the Billiton Co., which should expedite operations.

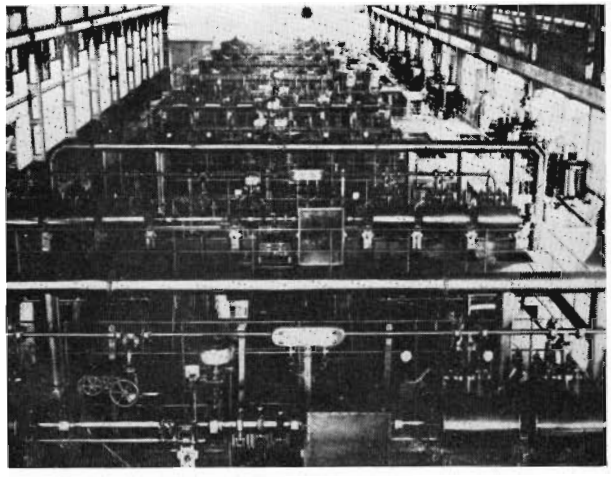
The Billiton enterprise was started in 1850 by three prominent Netherlanders, one of whom, Prince Hendrik, was the brother of the king ruling at that time. While Banka, under the N.E.I. Government, had been producing tin for more than a century, the island of Billiton had remained *terra incognita*, as far as tin was concerned. A party sent to Billiton by the Government in 1849 had, after a short time of prospecting, reported that no tin deposits of any value might be expected there. In spite of this verdict and the island's inhabitants—pirates and dangerous aborigines—the three individuals' spirit of enterprise prevailed.

Although tin definitely was found by the pioneers in 1851, a hard time came for those men. Of the twelve European employes engaged from 1852 to 1855, only five survived; diseases, such as malaria and dysentery, claimed some and murder a few more. In addition, labor had to be imported from Singapore, as the natives were



Famous Karimata dredge, which produced over 1000 tons of tin concentrate containing about 800 long tons of metallic tin in one record month, digging for tin ore along the coast of Billiton island. This dredge was built in Holland in 1936.

Banka exploration drills make a 6-in. hole using aluminum rods. Platforms are floated on oil-drum pontoons. Offshore drilling, as shown here, near Klappa Kampit, is only possible during the few quiet months of the east monsoon.



Manggar power station as it looked prior to the Japanese occupation. Of its prewar capacity of 22,000 hp, only 50 hp was left intact when the Dutch returned to the islands in October 1945; most of the engines being shipped elsewhere by the Japs.

not accustomed to digging pits, and operations were primitive. It seemed that the tin content of the soil hardly paid for the high cost of production. After about eight years of strenuous efforts the pioneers, not able to borrow money to continue operations, had to sell out. Thereupon, in 1860, the Billiton Co. was formed.

The first years of this new enterprise were difficult because of a drop in the price of tin and a shortage of equipment due to insufficient working capital. But after 1868, the introduction of the Akkringa prospecting drill, the discovery of richer deposits, and the rapid influx of mine workers from China, followed by some mechanization, turned the chances. Yearly production increased from approximately 200 tons in 1860 to about 3000 tons in 1870, and 6000 tons in 1890.

The native population, which before contact with white men lived from farming, fishing, and piracy, increased under the better living conditions provided by the Company from 10,000 in 1860 to about 40,000 in the beginning of this century. The Chinese population, mostly by direct immigration from China, increased from about 600 to 20,000 in that same period. In 1941 the total population amounted to approximately 90,000. These figures show clearly the influence of better living conditions brought about by the introduction of foreign capital.

When the Japanese entered they found complete harmony between natives, Chinese, and Europeans; grade schools and training schools for crafts; swimming pools, soccer fields, and permanent housing; Chinese singing on their way to the mine or dredge; and natives with smiles in their deep brown eyes.

I had known those conditions for about fourteen years, working there before the war. Hence, I was rather surprised, upon my return to Batavia in October 1945, by the high officials who said it was impossible to continue my trip to the tin islands because they were in an uproar that could be pacified only by an army. As the situation on Java had to be cleared first, it would be impossible for our party to visit the islands and report on the condition of the mines and dredges.

Matters on Java went from bad to worse, leaving our party in an awkward situation. But we decided not to give up without trying. We put our personal knowledge of the population and its friendliness towards the Company above the advice of the authorities and followed a course of knocking at each prominent door in Batavia.

After ten days' search for assistance, we made a strike. A personal friend, a Dutch Navy Captain in Admiral Helfrich's office, was allowed by the British High Command to appoint passengers for the Dutch Catalina flying boats of the Batavia-Singapore service. No intermediate landings were permitted. We were satisfied though, for we would be able to observe the land, dredges, and mines from the air.

We started off for Singapore the next morning, with no other passengers on board. When we were over Billiton, approaching the mines and dredges, the pilot dropped us to a lower altitude and circled his plane around all the important points of our operations. In the villages, people started waving at us. As we flew over the capital, Tandjong Tandan, people crowded the streets, looking and waving at us. Ours was the first Dutch plane they

had seen in about four years, since most of the aircraft were lost in fighting over Malaya. The pilot, for some reason, had to make an emergency landing on the wide river Tjiroetjoek. The crowd, called dangerous and rebellious by the authorities in Batavia, gathered at the landing pier in thousands. Some of them loosened their boats and canoes and paddled quickly towards the plane. When they recognized our party, tears flowed from their friendly Chinese and native eyes. They dragged us from the plane, into their boats, and rushed us to shore where the crowd was waiting. Once ashore, there was no end to handshakes, nose kissing, and embraces. Without any weapons we had landed among people for whom, according to the officials, an army would be needed. Their first question was "We have been looking out for more than six weeks for your return; where have you been all this time?" A few low-bowing Japanese soldiers eventually made room for us and, at the shore end of the pier, a band started to play the Dutch national anthem.

In honor of the return of the Billiton Co., there was a great dinner party with *rijsttafel* and such Chinese delicacies as suckling pig, Chinese hors d'oeuvres, and shark-fin soup. Best of all were the genuine prewar French brandy and the finest of prewar Dutch cigars that had been saved for more than three years for this special occasion. Many an old friend sneaked in during the dinner to shake hands, express his gratitude, and bring us news about the terrible past and the condition of the mines, workshops, and power stations. We heard a story of hunger and hard work, and of how many good men died or were carried away to unknown destinations. There were no textiles for clothing. The fishermen had no sails for their boats, or thread or hooks for their lines. All prewar prosperity had vanished. A similar story was told about the bad condition of the roads, dredges, and flooded mines. The main Diesel power station, with a prewar capacity of 22,000 hp, had been dismantled and its parts shipped off; only 50 hp could now be produced. However, the European houses had been cleaned and restored, as much as possible, soon after VJ day. More stories were told about sores, malaria, and other diseases. But, throughout the evening the population's spirit—its desire to help restore the enterprise, and its faith in the return of prosperity and health under the Company's guidance—prevailed.

The job started by the pioneers ninety years ago had been well done; neither war nor political slogans against capitalism could ever completely destroy free enterprise as long as its benefits were appreciated by the people themselves. It is remarkable how much more the Malay and Chinese care for, and go by, facts rather than mere political phrases and promises. Their almost unlimited confidence in their old employers, the officers of the Company, is striking.

We never went to Singapore, but returned, the same afternoon, to Batavia. There, with a Billiton representative for proof, we reported our adventure to Lt. Governor Van Mook, who was much surprised. The other officials, who had talked about the necessity of an army, reacted similarly. The next day, the jubilant Admiral Helfrich arranged for "Tromp," a valiant vessel, to set out for Billiton, carrying doctors, nurses, medical supplies, government officials, and a small military detachment.

After the official surrender by the Japs on board the "Tromp," we went ashore and the job of rehabilitation was started. It was not an easy job. At the outset our assets were 300 tons of tin in concentrate, found in the store house, and the co-operation of the population.

The opencast mines were all flooded; millions of gallons of water would have to be pumped out. But most of the pumps were in disorder, the electric motors that had not been carried off were damaged, and only 50 Diesel hp was available. On the other hand, the mechanical and electrical workshops were still in rather good shape, the warehouses contained some valuable spare parts, and a few cars were in running condition. These resources enabled us to make a quick survey of the dredges and mines and expedited the repair of ordinary equipment. All the dredges were still afloat, but most were deplorably worn-out. The steam engines of the wood-burning dredges had been taken off to provide an independent power station in the woods. However, the cylinders were in a damaged condition because of the lubricating oil the Japs had used for the engines. This lubricant was prepared by boiling coconut oil with damar, a local resin, until the mixture had the right S.A.E. But the Japs soon found out that the right S.A.E. is not the only requirement for a good lubricating oil.

After six months' hard work the dredges began operations. First came the self-contained wood-burning dredges; they were followed by other 7-cu ft dredges which had to rely on their own power rather than that of the now decimated main station. Fortunately, a shipment of about twenty 75kw General Motors Diesel electric plants, ordered before we left the United States, arrived and could be operated in a team on board the dredges or in a shore station close by.

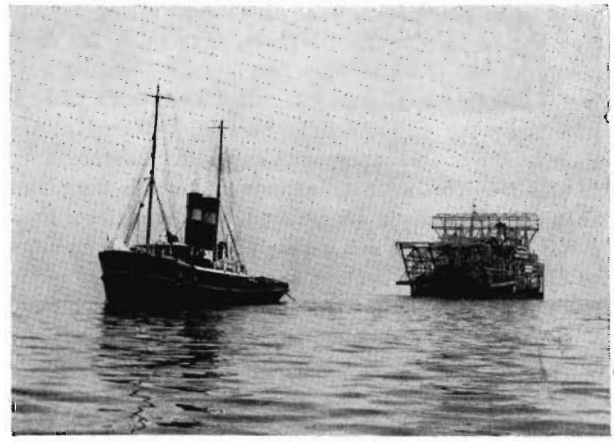
In the meantime, some of the main Diesel engines were repaired and put in operation, producing sufficient electric power to start pumping out the opencast mines in the eastern part of the island. The pumping installations on these large-scale hydraulic mines are equipped with three 150-hp pressure pumps and three 300-hp 12-in. gravel pumps driven by 3000-v a-c motors. It required about three months' pumping to empty the pits.

Pending the arrival of modern equipment, a few hydraulic mines were started using prewar wood-fired steam engines with belt-driven pumps of small capacity. But the rehabilitation of the dredges required so much of the available man power that only some of these mines could be worked. It takes a lot of labor to cut the wood, and then five months for seasoning it.

About a year passed before adequate supplies—such as steel, welding rods, steel pipes, Diesel engines, and pumps—started to arrive. In the meantime, however, the management had plenty of other problems, of which the most important was the requisition of rice, clothing, and other domestic necessities for about 10,000 employes and their families.

An example of the confidence shown by the population in the Billiton Co. was the acceptance of paper money issued by the Company. When we started reopening the mines, the Government could supply us only with money in denominations of 50 cents and greater. The

Unloading semiconcentrates at a small concentrator where the material is jigged, tabled, and, if necessary, further cleaned by magnetic separators to remove the associated minerals ilmenite, monazite, and magnetite.



Arriving from Holland this 14-cu ft dredge was towed for three months by a 2000-hp tug from the icy waters of the North Sea, through the Suez Canal, to the warm green waters surrounding the island of Billiton.

useful pennies, nickels, dimes, and quarters were not available. The only way out was to make this kind of money ourselves. Thousands of little slips were stamped by hand and were accepted by the workers and the stores.

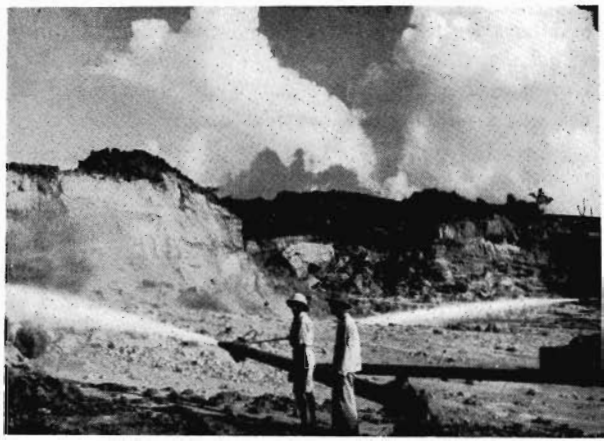
The highly inflated cost of living, one of the main problems, had to be met. This inflation was due to a severe shortage of rice, sugar, and all kinds of materials in a land that had been completely depleted by the invading Japanese. Prices were more than ten times above the prewar figures. Elsewhere in the Indies, however, this figure was still higher, and in the neighboring island of Banka it was over twenty times. To combat the inflation, the Company, as before the war, gave free rice to its workers. Bound by Government restrictions, the quantity had to be somewhat lower than the prewar allotment of 66 lb per month for bachelors and 132 lb for married workers per month, but the caloric value of the rice supplied was adequate and about fifty per cent higher than elsewhere. In addition, about twenty to thirty different articles, such as dried fish, lard, canned milk, coconut oil, cigarettes, salt, sugar, tea, and coffee, were distributed in adequate quantities at prewar prices. There being little to buy on the free market, the miner's take-home pay, with reasonable extras for children and increased expenses, amounted to almost double the prewar figure and was sufficient for his needs. Officials of the department of labor and Chinese authorities, familiar with conditions in other parts of Asia, praised this system as the best seen since the war.

However, the Chinese labor union, guided by some radical intellectuals who had been educated in Singapore and who had never actually worked in the mines, demanded higher wages. Experience with recent increases, which only increased prices on the free market, made the management refuse to give in. A strike was called and lasted for three months. Most of the Chinese workers were against the strike, but fear of severe measures taken against their families and homes made them stay away from their jobs. Because the Chinese—the most experienced in mining—did so, a serious situation arose. However, the Malay labor union, disregarding pressure from the Chinese union, decided to work. After a few weeks' trial, many of the natives turned out to be good winch drivers and were capable of taking over practically all mining jobs previously held by the Chinese. When the union gave in, the Chinese workers returned to their jobs in better spirits than before. Since that date, August 1947, production has steadily increased, and by the end of the 1947 fiscal year the Company reported that the rehabilitation of the alluvial mines was complete. At the time, fourteen bucket dredges, two suction dredges, two large hydraulic mines, and eighteen small hydraulic mines were in operation.

The mine in primary ores at Klappa Kampit—with shafts to a depth of 1000 ft, approximately forty miles of tunnels, and a prewar yearly production capacity of over 2500 long tons of tin—still remained unopened. The whole mine had been flooded before the Japanese arrived. Nevertheless, the invaders had completely dismantled derricks, hoisting equipment, compressor station, work shops, and the 500-ton mill, sending some parts as far as Borneo and Burma. The severe shortage of man power, the great difficulties in obtaining the required equipment, and the tremendous costs involved prohibited the opening of this valuable project.

Production during the first full postwar year was 6000 long tons and in the second year about 8000. The latter included three strike-bound months, so the figure does not give a true picture of the progress made. Production, towards the end of that year, came close to an annual rate of 12,000 long tons which is well over the average prewar output.

Most of the production came from the fourteen bucket dredges. All the dredges have their own concentrating plant, consisting of screen and rougher and cleaner alluvial jigs, on board. The most modern are equipped with a tertiary jig and shaking tables, to produce clean concentrates containing from 72 to 76 per cent tin. The older ones produce a middling product, carrying 15 to 40 per cent tin, which is cleaned in a concentrator on shore. The waste consists mainly of quartz sand and such heavier minerals as ilmenite, pyrite, zirconium, and sometimes monazite. Sulphides of basic metals like lead, zinc, bismuth, and copper occur only in traces, ac-



Counterbalanced monitors stripping overburden in an open-cast mine. Loosened overburden is often made to flow in the empty part of the pit; otherwise, it may be pumped behind the dikes that close off the pit.

counting for the high-quality tin produced from the concentrate without processing. As quartz and clay are the bulk of the gangue, the concentration process on the dredges is simple. Lumps of clay are screened off by a huge rotary screen whose openings range from ½ to ¾ in. in diameter. The underflow contains enough water to flow freely over the primary jigs, which make a low-grade concentrate and clean tailing. Most jigs are duplex with four lengthwise cells measuring 3 ft 6 in. square. Various makes are in use. As the Company has always shown an open eye for progress and better recovery, practically all kinds of jigs have been tried. The postwar dredges are all equipped with Pan American balanced placer jigs, built under license in the Netherlands.

The size of buckets in the dredges varies, depending on the size of the ore reserve in the particular valley the dredge has to work. Eight dredges are equipped with 7-cu ft buckets, one with 5-cu ft buckets, and the remaining five, including the two postwar dredges, with standard 14-cu ft buckets. The digging depth varies according to the depth of the valley; nearly all 14-cu ft dredges have a digging depth of 100 ft under water level.

The dredges are now working 24 hours a day. Stoppages, including voluntary ones for changing buckets, cleaning, and other repairs, usually amount to less than ten per cent of the total time. Output varies with the size of buckets and speed of digging, the larger dredges averaging about 500 cu yd per hr or 4,000,000 cu yd per year.

All dredges are electrically driven. Most 7-cu ft dredges are fed from the main power station at Manggar. The two 7-cu ft dredges in Tandjong Pandan district generate the needed electric power on board by wood-fired steam engines. About 700 hp is required for this size.

The larger dredges are, with one exception, equipped with three Diesel generator sets of 600 to 700 hp each, one of which acts as a standby. This setup makes the dredges well suited for sea operations (in some cases the tin-bearing valleys do not stop at the shore line, but extend into the sea). The construction of these particular dredges, all of which have been towed over thousands of miles of ocean, makes operation offshore just as easy as inland. The movement of the dredges is done by winches and cables, the winches being placed in a row and driven by one electric motor.

Tin production of the dredges varies considerably. The all-time high was reached by the Karimata dredge, owned by the Billiton Co., which in one exceptional month in 1941 yielded 750 long tons of tin. However, a production of 500 long tons per year for the smaller dredges is a better approximation of their output.

Following the dredges in importance are the hydraulic mines. There, pumps for water and gravel are mounted on steel pontoons which can be floated from one part of the pit to another. At two of the mines, the pumping plants produce a 70-lb water pressure at depths of approximately 60 to 80 ft. The loosened overburden is often made to flow in the empty part of the pit, or pumped behind the dikes closing the pit. The lower ore-bearing deposits are pumped by a 12-in. gravel pump to sluices, wherein the cassiterite is captured and cleaned to a 20 to 30 per cent concentrate and then transported to a cleaning plant. This process prevents loss of the fine cassiterite. Since the plants have a first cost lower than the dredges, they could, in prewar time, compete with the dredges as far as over-all expenses were concerned. They have the advantage that the bedrock can be inspected at all times, thus preventing the losses which may occur in dredging. Much planning is required and the construction of dikes takes great skill. Extensive knowledge of the overburden is necessary as soft or muddy strata may easily start landslides of enormous proportions, causing great damage to pipe lines and to the station.

The smallest mechanized hydraulic units, which through their large number contribute a large share to the general output, use 6- to 8-in. pressure pumps and 6-in. gravel pumps. Wide valleys are often worked with two or more sets simultaneously, thus decreasing the ratio between total yardage and useful yardage and diminishing the danger of flooding. Electric power is preferred in these mines because of its simplicity. Since war damage decreased the capacity of the main power plant, a large number of Diesel-pump sets were ordered in the United States. These performed well after sufficient experience was obtained with them. Gardner-Denver pressure pumps, directly coupled to General Motors 6-71 Diesel engines, produce about 1500 to 1600 gpm with a pressure of 80 to 100 psi at the nozzle. For exceptionally hard clays, two of those units are sometimes worked in series, increasing the pressure to 160 psi. The gravel pumps widely used before the war were of Billiton's own design, fabricated in the Indies or in the Netherlands. After the war a large number of American pumps were ordered. Those pumps, made by the Ellicott Corp., of Baltimore, are of the 6-in. size and are multiple V-belt driven by Caterpillar D 13000 or General Motors 6-71 Diesel engines. Such units will move from 40 to 80 cu yd per hr—depending largely on the toughness and thickness of the deposit—the tin-bearing deposits being piped to sluices, often arranged in duplex. The depth of those pits ranges from 10 to 50 ft.

Other earth-moving equipment such as bulldozers, draglines, and excavators is used on a small scale, mostly for preparing mine roads, constructing small dikes, digging fresh-water canals, and various other jobs. Prewar trials of small units for excavating overburden and ore deposits were not promising enough to warrant their use in a period of rehabilitation when, with few skilled employes left, too much had to be planned and carried out. No doubt, in a later stage, the use of larger draglines for removing overburden and ore deposits will be tried out.

Singkep, a smaller tin island also mined by the Billiton Co., was even worse hit by the war than Billiton. The central power station, transformer stations, and power lines were completely dismantled and the parts shipped elsewhere. Two dredges suffered a similar fate and from two others all equipment and top structure were removed. The opencast mines had been completely drowned and all the equipment sent to Malaya and the Riouw Islands. On Singkep the Company got the same friendly reception on its return. Once a slight disturbance was experienced when republicans from Sumatra tried to interfere, but the job of reconstruction was not halted. By the end of May, 1948, tin production was at an annual rate of better than 3000 tons. This figure is 25 per cent above that of the best prewar year. Most of the increased output was due to the two new dredges built in the Netherlands after the war.

Reconstruction in the Banka tin mines was greatly handicapped by the late return of the Dutch—about five months after the reoccupation of Singkep and Billiton. (Banka tin mines were owned and operated by the Government of N.E.I. until last year, when the Billiton Co. was awarded a management contract.)

Fortunately, through the foresight of the late managing director of the Billiton Co., J. van den Broek, who directly after the war ordered two 14-cu ft bucket dredges ("Roosevelt" and "Stuyvesant") from the United States, and six dredges of the same size from the Netherlands, it was possible to tow four of those potential producers to Banka during 1947. As these dredges are equipped with their own power stations and were nearly complete when leaving the shipyard—the only things that remained to be finished upon arrival were roofing, siding, and attachment of the bucket chain—they began production a few months after their arrival.

Aided by a large Chinese population, numerous steam engines, and electric motors, a great number of hydraulic mines were in operation by May, 1947. By that time four dredges, of a prewar total of eight, had started. Of the suction cutters, one out of three was in operation. The total production during the first five months of 1947 was a little over 3500 long tons, an annual rate of 8400 long tons, less than half of the average of the four prewar years.

The combination of the three major tin islands under the skilled management of the Billiton Co. will soon prove well justified through its output of this much-needed metal.

Research Committee on Comminution Organized

The organization meeting of the Research Committee on Comminution, formed by the AIME Committee on Research, was held Nov. 23, 1948, at Battelle Memorial Institute, Columbus, Ohio. The purpose of the meeting was to outline research that should be undertaken to advance the art and science of crushing and pulverization of coal, ores, and industrial minerals. Primary consideration was given to a plan for collecting operating data on existing mills in industry, including performance factors of the mills and technical data on the strength of the input materials and on the fineness of the product. A subcommittee will be named to undertake the work.

No adequate theory or explanation of the physics of comminution is known. Rittinger's law and Kick's law are believed to be incomplete. Fundamental research will be needed to find the relation of energy consumed in the process versus the new surface produced. A group is being formulated under the committee for this study. Laboratory tests have not been standardized to measure the crushing properties of the raw materials nor to measure the fineness and surface of the product. The graphing of the data is not well understood. New tests are undoubtedly needed to measure the resistence to crushing, even in relative terms. A committee on laboratory technique will be organized.

The final membership of the main committee is to be named by Fred C. Bond, chairman. The next meeting of the committee will be at the San Francisco Annual Meeting, at which time the forms for collecting operating data will be reviewed. The work of the committee is of interest to three Divisions of the Institute: Minerals Beneficiation Division, Industrial Minerals Division, and Coal Division. Members interested in the work are urged to get in touch with Mr. Bond at the earliest opportunity.

At the organization meeting of the Research Committee are: (front row l. to r.) O. F. Tangel; A. C. Richardson; F. C. Bond, chairman; E. R. Kaiser, chairman, AIME Committee on Research; R. M. Hardgrove; (second row) C. F. Clausen; H. R. Spedden; L. A. Rhodes; D. W. Scott; Tom Fraser; H. M. Zoerb; W. O. Hinkley; (third row) C. F. Thompson; T. M. Morris; C. H. Bowen; W. A. Mueller; D. Weston; R. A. Sherman; L. I. Cothern; and W. K. Bock.