



Bolivia: The Price of Tin

Part I: Patiño Mines and Enterprises

by Norman Gall

American Universities Field Staff
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Sentinel without arms, town without spirit, people without grace, land without water, sun without warmth: Each one there—stranger or citizen—should calculate his risks beforehand. An audacious start and a cautious retreat are indispensable. Mines of legendary name—many prosperous and some now empty—climb from slope to slope the length of the cordillera, in constant struggle with the earth. *Adolfo Costa du Rels, "Los Andes No Creen en Díos"* (1973).

The Siglo Veinte ("Twentieth Century") tin mine is cradled among sullen, rusted hills that rise from the *altiplano*—the highland desert of scrub and stone that runs the length of Bolivia—to embrace the swollen hive of penury that the great mine has become.

The road from Cancañiri down to the mine runs past winding, reddish river beds pocked with small excavations that burrow into the alluvial deposits which are, increasingly, the salvation of the dispossessed and the main source of profits for the nationalized Empresa Minera Catavi. The road begins, in switchblade fashion, at abandoned mine shafts such as Dolores, Cerro Azul and Socavón Patiño, dating from the earliest bonanzas of this century, that still scar the mountain at 15,000 feet. It descends past the smaller communities of Calvary and Cancañiri, then through the mining camps themselves: steep, gullied streets threading a mass of decayed adobe warrens with corrugated metal roofs that glisten in the *altiplano* sun and are loaded with stones so the wind won't blow them away. It passes the old concrete movie house that is poised like a Greek temple at the edge of a precipice, overlooking the ramshackle structure of the "Sink-and-Float" preconcentrating plant next to the mountainous gray-green dumps of waste rock that bear witness to 70 years of continuous extraction. The road finally dissolves into the Plaza del Minero, the center of communal life at the mine. All the installations in sight were built before

the mines were nationalized in the Bolivian Revolution of 1952, save for the union headquarters, the only permanent building on the plaza. Its three-story concrete façade is painted with a mayhem of political slogans, its walls pocked with bullet holes and some windows still broken from the army's invasions of the mines in 1965 and 1967.¹ The *sindicato* building stands between the crowded, crumbling mining camps of Siglo XX and the newly prospering town of Llallagua. Farther down the mountain, beyond the cemetery and the barren *pampa* of the María Barsola Field, lies the administrative complex of Catavi, with the concentrating mill and the slatternly office buildings of the Empresa.

The Plaza del Minero at Siglo XX is dominated by an heroic statue, commemorating the 1952 Revolution, of a bare-chested, helmeted miner raising a rifle aloft in his right hand and pressing a pneumatic drill into the ground with his left. The bold, angular lines of the miner's face and figure point to the *sindicato* building, which contains a movie theater, a radio station ("Voz del Minero") and a billiard parlor apart from the union offices of the *sindicato*. It is shelter as well for the organizations of marginal workers who mine the low-grade alluvial deposits, abandoned tunnels, and the liquid wastes from the "Sink-and-Float" plant. A recent addition to the plaza, under the same clump of eucalyptus trees as the miner's monument, is a statue of the dead communist leader, Federico

Escobar, who during the revolutionary period (1952-1964) held the powerful post of *Control Obrero* at the nationalized mine: a kind of worker-ombudsman with broad veto powers over management decisions. A small, muscular man with a booming voice, much-beloved for his defense of the workers, Escobar was portrayed by the sculptor in a characteristic pose, with his mouth open and his finger pointing. He died mysteriously in 1967.

The steps of the *sindicato* building are crowded each afternoon with boys and young men who gather round a huge rack of comic books—Spanish translations of Superman, Batman, and Donald Duck—that they rent for a penny a half-hour, while bowler-hatted Indian women sell ice cream, cotton candy, and glasses of *chicha*² next to the miner's statue. Near the market stalls across the plaza there is a constant flow of *altiplano* Indians in dusty ponchos and floppy sheepskin hats who bring potatoes and firewood on clusters of llamas to sell at the miners' houses. These Indians gradually melt into the mining community—as porters in the marketplace and peons in the marginal workings—greatly swelling the local population.

The story of the Siglo XX mine carries much of the Bolivian experience in this century, embracing one of Latin America's most profound and convulsive social revolutions. That revolution was carried out largely by a small middle class and mining proletariat created by this backward country's sudden incorporation into the world's industrial economy around the turn of the century. What few signs of modernity that exist on the *altiplano* were installed by exporting enclaves such as the Siglo XX mine, which for most of the century was "the richest tin structure and most productive in the world."³ "Since mining began in 1903 it has produced about 30 per cent of all Bolivia's tin and 6 per cent of the world's tin, a total in excess of one-half million tons of tin worth about \$2 billion at early-1966 prices."⁴ In the first three decades of the century this provided the economic base for Latin America's first and only multinational corporation—with interests in the United States, Canada, South America, Europe, Africa, and Southeast Asia—created by Simón I. Patiño, an industrial genius of Indian extraction who has been compared with Rockefeller and Carnegie.⁵ Under the impact of the Great Depression and of Bolivia's humiliating loss to Paraguay in the Chaco War (1932-1935), the mine over the next two decades also became a cauldron



Miner's Statue—Plaza del Minero 1966

Glasses of Chicha.





View of Siglo XX from Caneaniri (1973).

of revolutionary politics, while Patiño—bidden by his doctors to return to Bolivia—tried to run the mine from Europe by remote control through a continuing interchange of detailed reports and instructions with his agents on the scene. By the time the old man died in 1947 in his eighty-seventh year, the mine had become the scene of many uprisings and “massacres” that pushed Bolivia toward its 1952 Revolution, when the major mining groups—Patiño, Hochschild, Aramayo—were nationalized and Indian serfdom was abolished.

Since the Revolution, Siglo XX's production declined by half because of political conflicts and the rapid depletion and decapitalization of the mine. At the same time, even with the exhaustion of its ore, the congestion and human vitality of the great mine has increased dramatically. Although the price of tin has risen in recent months to unprecedented heights (around \$3.00 per lb. New York), this accelerated demographic concentration on declining economic resources could only be accommodated, under present organizational capacity and technology, by a gradual regression from

industrial toward pre-industrial forms of production. A British geographer wrote recently that,

the beds of rivers draining the mineralized area are swarming with people—men, women and children frequently working as family groups, sometimes as cooperatives—turning over the surface washings and burrowing into the deeper alluvium. Work begins at dawn and finishes at dusk. The mineral is handpicked and concentrated in makeshift channels cut out of the stream bed. The only direct outlay, the cost of materials, is small compared with the uncosted input of labor; the return is a proportion of the tin price current at the time of working. Thus, unlike tin mined by other means, total production costs are always below the market price.⁶

Parts I and II in this series of Reports will trace the economic transformations at Siglo XX in this century. These transformations have been extremely dynamic, embracing the creation of an integrated

industrial organization and technology from pre-industrial beginnings within the Patiño empire (Part I), and then a regression to pre-industrial systems of labor under increasing demographic pressures on a diminishing resource base (Part II). This focus must exclude some aspects of the social and political history of the mine, which I hope to cover in another Report. Because the last two Bolivian censuses were made in 1900 and 1950,

there is today an extreme scarcity of meaningful demographic statistics to objectify the personal observations made in my visits to the mine in 1965, 1966, 1970, and 1973. To compensate in part for this paucity of hard data, I carried out a questionnaire sampling of some families at the mine in August-September 1973 that may provide at least some basis for evaluating fertility, infant mortality, literacy, migratory patterns, and income levels.⁷



The mountain and the mining camp (1973).

-I-

The mountain of Llallagua, which Simón Patiño transformed into the world's richest tin mine, is superficially a brown, barren mass with primeval potato patches scratched into its lower slopes. The gray-green mineralized portion of the mountain "is an intrusive body of quartz porphyry which represents an old volcanic vent."⁸ "The ore was formed by hot, ascending solutions circulating upward through channelways in the igneous rock.... Some of the bonanza lodes, among the richest tin veins ever mined, are as much as three meters wide."⁹ In the early years of the mine, these bonanza veins were so rich that the ore taken from them—containing 65 per cent tin—was simply placed in sacks by Indian women called *palliris* and exported without going through the concentrating mill. That was at the beginning of this century.¹⁰

The mountain of Llallagua bears the Quechua name for the benign spirit that brings abundant harvests of potatoes, the staple crop of the Indian peasants of the Andes. The first Spaniard said to have reached the mountain was Juan del Valle, one of the *conquistadores* who accompanied Ñuflo de Chávez on his epic march from Paraguay to Alto Perú (Bolivia). There is little known of Juan del Valle, except the legend that says he went to the top of the mountain and prayed for the power to discover there the silver that his countrymen had found in Porco and Potosí. As part of his invocation he changed the name of the higher of the mountain's twin peaks from the Quechua "Intijaljata" to Espíritu Santo, but this new baptism brought him no luck. In his *Llallagua: Historia de una Montaña*, the Bolivian diplomat-historian Roberto Querejazu

writes that Juan del Valle,

abandoned the place in disillusionment and was lost forever in the darkness of time and distance. Nobody would have known of his existence or his presence in Llallagua if the region's inhabitants, over many generations, had not kept the name of Juan del Valle for the other peak, where his abandoned mine was located.¹¹

Early in the seventeenth century the Spaniards reported a population of 29,621 for the "Provincia y Corregimiento de Chayanta," in which the mountain was located. The population was divided into 5,759 able-bodied men ("tributarios"), 15,417 women, 7,632 children and 813 old men.¹² This imbalanced demographic pyramid can be explained by the *mita*, or forced Indian labor in the mines, which provoked the migratory flight of hundreds of thousands of highland Indians into remote and inaccessible areas. In his classic essay on "The Quechua in the Colonial World," George Kubler wrote that "the entire Colonial epoch in Perú has not incorrectly been designated as a vast religious and political organization for the exploitation of the mines."¹³ Between 1628 and 1754 the population of Chayanta was roughly halved to 15,231.¹⁴ According to the Bolivian historian Luis Peñaloza:

In general, the work in the interior of the mines was uninterrupted. The standard period of continuous work was 36 hours; the shafts were lighted by candles or tallow wicks. The ore was extracted by blows with an iron bar—the use of explosives was very limited—and brought to the surface on the backs of Indian porters ("japiris"), who climbed ladders of rope or leather to the open-air patio ("cancha") of the mine. According to Padre José de Acosta, "each man carries 50 pounds of ore on his back in a cloth tied around his chest; they come to the surface in teams of three. The one in front has a candle tied to his thumb so they can see because, as they say, there is no light in that sky".... Important mines in Upper and Lower Perú, as well as in Mexico, were paralyzed by flooding of the lower levels.... The water was extracted in leather pails that were passed from hand to hand until they reached the surface.... A more costly and complete way of emptying the

mines of water, used only in grave and important cases because of its high cost, was to dig special tunnels at an angle so the water could fall by gravity and exit at the lower levels of the mines.¹⁵

In his treatise entitled *Arte de los Metales* (1637), Padre Alvaro Alonso Barba, curate of the San Bernardo parish in the Villa Imperial de Potosí, reported that "next to Chayanta, in the Audiencia of Charcas, there is another tin deposit from which for some years the mineral has been extracted in abundance,"¹⁶ adding with greater enthusiasm that the district "is full of seams of gold. It has some old tunnels, and in its Río Grande there are nuggets within the sands."¹⁷ The eighteenth century Spanish travelers Jorge Juan and Antonio de Ulloa described the province as being "very famous for its gold and silver mines. The former are indeed at present discontinued, though the ancient subterraneous passages are still open.... The silver mines are still worked to great advantage; but with regard to cattle, this province feeds no more than are barely sufficient for its inhabitants."¹⁸ Peñaloza concludes that tin was found jointly with silver in this region and was "exploited almost by obligation," being used "principally in the lining of tanks or vessels for the distillation and storage of *aguardiente* [a potent sugar-based brew]."¹⁹

The transition from silver to tin came late in the nineteenth century, and assured Bolivia a role in the industrial expansion of Europe and the United States. The rise of the canning industry in these countries coincided with the exhaustion of the ancient tin mines of Cornwall in England—which since Roman times had been Europe's main source of the metal—and with a depression in the silver mines caused both by their exhaustion and by falling world prices.

In the 1880s Patiño himself had worked in the most famous of these silver mines, Huanchaca, which had been in the vanguard of industrialized mining in Bolivia.²⁰ After Huanchaca, he worked for 15 years as a clerk in the mineral-buying and supply firm of Germán Fricke in Oruro, then suddenly left his job at age 37 to dig for tin, with the help of some Indian peons and his wife, at a ten-acre concession called "La Salvadora," on the mountain of Llallagua.²¹ The mine was near the peak of the mountain, and Patiño worked there for three years with great difficulty and little results. In March 1899 he wrote a friend: "Yesterday I had to

escape from where we grind the ore because I didn't have the money to pay the workers."²² Nevertheless, on an afternoon in 1900, one of the peons emerged from the mineshaft to say: "Don Simón, come see what we have found!... It looks like pure silver. It is a very wide vein!" As Patiño disappeared into the mine, his wife Albina—who was helping the Indian women sort out pieces of ore and pulverize them in the crusher—knelt before a crucifix and prayed: "Let it not be silver, my God! Let it be tin!"²³ Tin in Bolivia was to be the metal of the Twentieth Century.

Charles Geddes, former general manager of Patiño's Banco Mercantil in La Paz, explains in his biography of Patiño:

Although he had only lived in mining camps and in small towns, not even in the capital of the republic, in a high and very backward, landlocked country, had never seen the sea or anything but very small factories, Patiño somehow had become convinced that tin was to become one of the great industrial metals of the future. Canning was then only in its infancy and the steadily-growing demand for tin was not yet reflected in its price. But Patiño was sure that demand and price would increase, and for this reason he set his heart on being a tin-miner, not just a miner.²⁴

A photograph exists of Patiño at the age of 33, when he still was a clerk with Fricke in Oruro. In that picture he is a lean, balding young man with small, keen eyes and very tense lips. Some 20 years later, on the eve of World War I, after taking up residence in Europe, he was described by his admiring biographer as "a little less than average height but appeared shorter still owing to his stocky build; he walked with quick, short steps, was broad of shoulder and still muscular. His bright eyes sparkled, often mischievously, his look was darting and penetrating, and he knew how to smile."²⁵ By 1913 Patiño was so important to German interests that he was decorated with the Red Eagle of Prussia and invited to dine with Kaiser Wilhelm. A few years later this half-Indian who was so acutely sensitive about his illegitimate birth would be marrying his children into the European nobility.

Paul Walle, an early chronicler of the Bolivian tin industry, wrote in 1914 that in the face of the surging demand for tinplate the ancient Cornwall

mines were so depleted that they could only produce 4,000 or 5,000 tons per year, while those of Saxony and Bohemia were almost completely abandoned. On the other hand, "the Bolivian lodes are of exceptional extent and richness, and their number is so great that it will be long indeed before they can be exhausted."²⁶ Between 1896 and 1902 the world price of tin doubled, and then doubled again by 1917.²⁷ Between 1898 and 1912 Bolivia's tin production increased by nearly tenfold, while the value of those exports multiplied eighteen-fold.²⁸ While production costs in Bolivia rose only slightly (from £75 to £90 per ton) between 1910 and the Great Crash of 1929, tin prices spiraled from £154 in 1910 to over £300 during World War I (1917-1920) and again in the late 1920s, giving Patiño an extraordinary profit margin with which to expand and diversify his empire.²⁹ Llallagua by itself produced roughly 17 per cent of the world's tin supply in 1918, when the average price was a record £329 per ton.³⁰

Three ore samples taken from the rich lode discovered by Patiño's peons in 1900 were brought to the laboratory of an English company operating at the nearby mining town of Huanuni. The chemist told Patiño that the samples contained extraordinarily high-grade ore respectively of 56, 58, and 47 per cent tin. However, Patiño's little Salvador mine was merely one of several operating on the mountain of Llallagua under the pre-industrial technology of the time. According to Geddes,

the exploitation of the mine began in earnest with an increase in the number of workmen, who with hammer and pickaxe extracted the exposed minerals which continued to be crushed in the primitive mill. This was composed of an indented flat stone on which an enormous round boulder, weighing seven tons or more, was rocked to and fro by means of long poles inserted into holes in its sides to give it leverage. Small pieces of ore were slipped under the boulder when the latter was tilted up by the poles, and the whole constituted a very serviceable mineral crusher [*quimbalete*.]³¹

After Patiño's rich strike he had to defend his mine against a plethora of counterclaims, both in the courts and in a famous gunbattle in 1901 between Patiño and his peons and an attacking band led by Armando Artigue, who held a

neighboring concession on the mountain.³² Claim-jumping was a common practice in those days, and both large and small companies were accustomed to running shafts into their neighbors' concessions. Almost from the first, Patifio hired an engineer to run the mine while he concentrated on his lawsuits and on the rapid industrialization of the operation. By 1901 he had ordered the \$1 million Miraflores concentrating mill, containing Bolivia's first diesel engines, enabling him to quadruple the amount of ore processed between 1904 and 1905, the plant's first year of operation. Patifio's voluminous correspondence shows an almost religious zeal for the installation of efficient management and technology, as well as recurrent hectoring of his managers over accounting and costs.³³

The difficulties of creating an industrial infrastructure on the *altiplano* were dramatized in 1918, when Patifio bought a heavy, 600-horsepower Sulzer generator in Switzerland. After being unloaded in the Chilean port of Antofagasta, the motor was divided into five parts to be brought by railroad to the *altiplano* terminal of Machamarca, from which Patifio was building a spur of track to his mine at Uncía. About 30 miles beyond Machamarca the axle of the engine—nearly nine meters long and weighing eight tons—was loaded on a specially built cart drawn by several mules, with the other heavy pieces loaded on other carts. The generator was an important source of energy for the mill in Uncía and the air compressors in the interior mine.³⁴

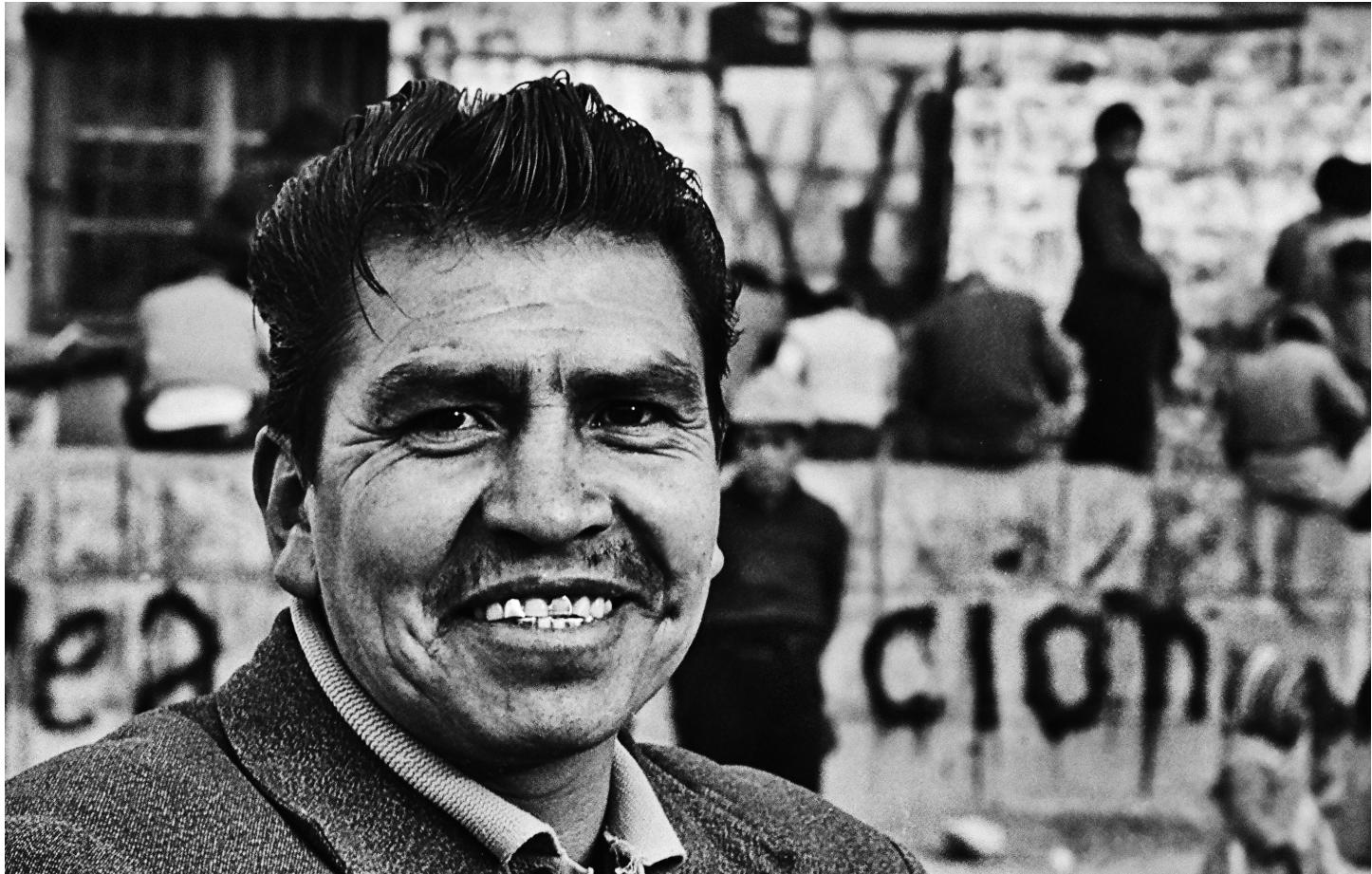
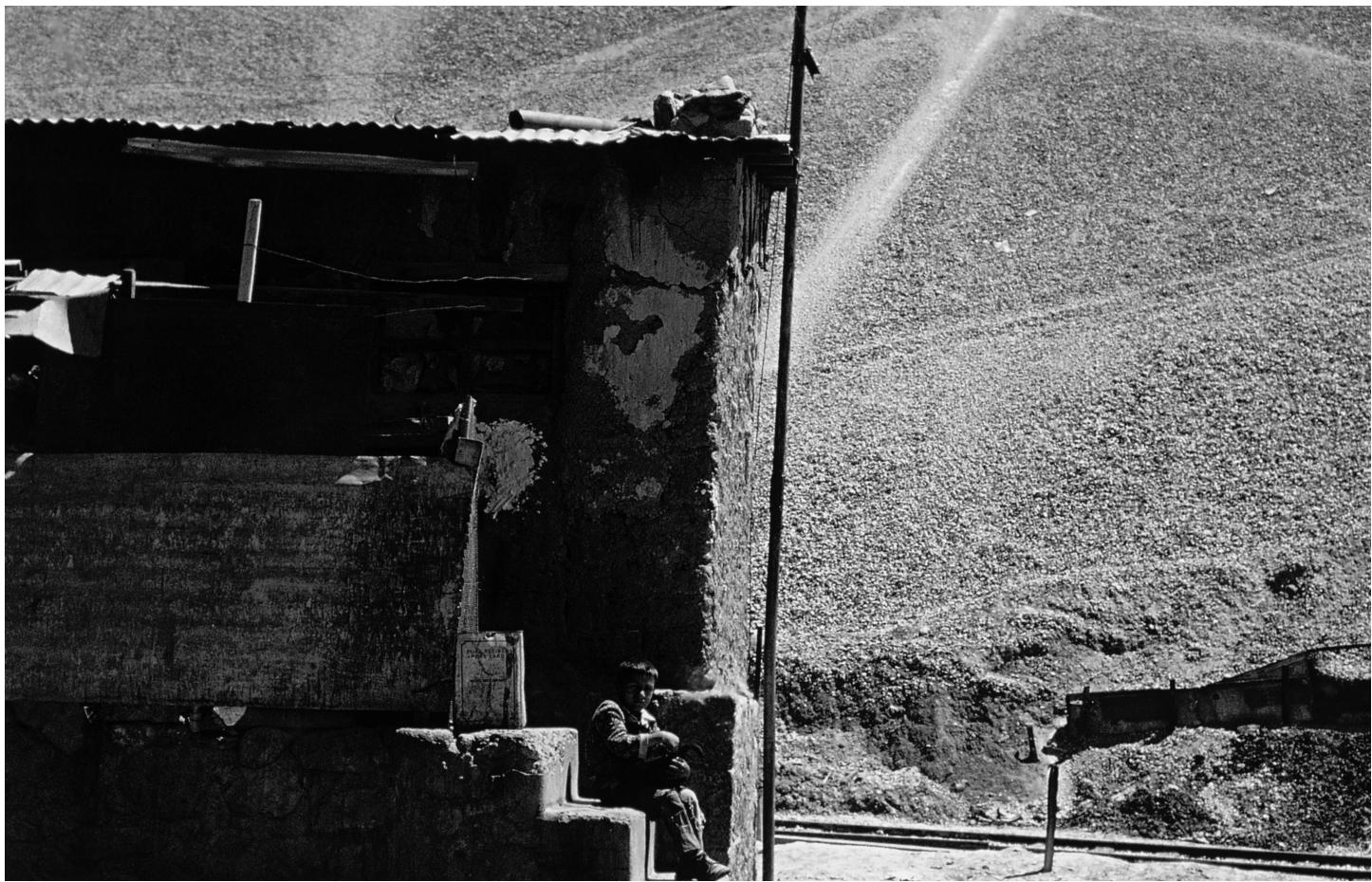
The struggle to emerge from pre-industrial to industrial forms of production would continue for many years. In 1916 the *Engineering and Mining Journal* published an article by two American geologists who visited the mine at the time a second concentrating mill was being built. Here they describe the coexistence of labor- and capital-intensive modes of production:

Aerial trams connect the Salvador and Patifio tunnels with the mills. At the mouth of the tunnels *cholo* [Indian] women sort out some of the richest ore, called *guia*, which is shipped without further concentration.... In the new mill, now in process of construction, the treatment [of ore] will be somewhat modified. The old mill produced about 900 tons of tin *barrilla* a month, while the new mill is expected to produce from 1,200 to 1,500 tons monthly. The *barrilla* is put in

bags and transported to the terminus of the railroad by carts or by llamas. Roughly, about two-thirds is carried by llamas at a cost of \$10 a ton for the distance of 18 miles. Each llama will carry about 100 lb. and will only make from 10 to 12 miles a day, as the llamas get their entire sustenance from the coarse grass along the route and so must be permitted to stop and graze at frequent intervals.... The old mill was making only about 65 percent recovery from three per cent tin ore, but it was hoped to materially improve this in the new mill. At Huanuni the miners in 1915 were paid 75 to 85 cents a day, the boys 45 cents and the women 30 cents. The miners were compelled to furnish the oil for their lamps, at a cost of about six cents a day. These wages are about half what was paid before the European War demoralized the Bolivian tin industry.... Ore taken for samples was carried in rawhide bags by Indian boys to the tunnel level. These boys, some of whom were no more than 10 to 12 years of age, would carry 60 pounds of ore at a time.³⁵

In 1915 the Argentine writer Jaime Molins visited Uncía, "a municipality of 10,000 inhabitants with an irregular topography" covered by the sudden, chaotic growth of most mining towns. Just before World War I bonanza wages were paid: more than \$4 daily for drillers and a general average wage of \$2.20 for a 12-hour shift, several times the real value of wages at the nationalized mines a half-century later.³⁶ These high wages drew an intense migration of workers, mushrooming the town with improvised agglomerations of shacks along twisted alleys on the hillsides near the mine. But by 1915 Molins could write of Uncía: "Today it is a respectable center, dotted with stores in the hands of Syrians, Austrians, Italians, Spaniards, and an occasional Frenchman. It has a subprefect, a city hall, a theater, a public market, schools, hotels and even a weekly newspaper with its own printing press." The general manager of the mine, Máximo Nava, was also president of the Municipal Council.³⁷ Molins went on to describe the degree of industrialization already achieved in Patifio's operations.

Before entering the mine, we take a brief tour of the workshops, the electric power station, the railway terminal for the ore-cars and the warehouse for spare parts. At that



moment a German-made Imperator electric locomotive, drawing 20 ore-cars, emerges from the mine, undulating like a scorpion.... Some recently-arrived machinery, including two large air-compressors and a Borsing water pump, await with suitable dignity their installation in the labyrinth of underground galleries.... At the time of our visit to the mines of Uncía, some 1,500 men worked in the mine and the mill, sometimes reaching 2,500 in peak periods. The workers are distributed in the galleries like bees in a honeycomb. We hear the noise of compressed-air drills, electric drills and the funeral echoes of dynamite explosions. Among the workers are *barreteros*, *carreros* [ore-car pushers], air-drill and locomotive operators, rail-layers, blacksmiths and other artisans. Outside the mine work the *palliris*: Indian women who select fragments of ore rich in mineral. On this mountain the *palliris* do not break or crush the stone as in other mines.... The Uncia mill has the most modern and productive tin-concentrating process in the country, and is even superior to many European mills. The ore enters the mill by cable-car and falls into six crushing mills after its specific gravity is registered on automatic platform scales. After the crushing and pulverizing process it is sent to the cylindrical mills and then to the classifying tables. The low-grade ore goes through a magnetic separation process that is unique to this mill. Llama teams are used to bring the tin concentrates to the end of the railway line, but in the months of November and December this service is interrupted for the lack of pasture grass.³⁸

Both the dramatic enlargement of Patiño's plant capacity at Uncía, needing more and more ore to achieve economies of scale, and the lawsuits that challenged his title to the great Salvadora lode, seemed to drive Patiño to consolidate and expand his properties, first on the mountain of Llallagua, and then elsewhere in Bolivia. In 1910 he took his first big step toward complete control of the whole Uncía-Llallagua tin district by buying the neighboring Compañía Minera de Uncía for £600,000 from the British geologist John B. Minchin. In 1911 he paid £450,000 for several British mines at nearby Huanuni. In 1914 he bought several flooded silver-tin mines in the Colquechaca district of

Potosí. In addition to building the \$5 million, 58-mile Machamarca-Uncía railway, he founded an electric utility company for his hometown, Cochabamba, and, in 1906, the Banco Mercantil, which soon became Bolivia's largest bank, with branches in the major cities and mines.

Patiño's attention was constantly called back to conflicts and rivalries on the mountain. The last of the lawsuits challenging Patiño's ownership of Salvadora was not settled until 1921. Meanwhile, a group of Chilean financiers had bought—in 1907—the other major operation on the mountain, forming the Compañía Estañifera de Llallagua. The two companies were working lodes so close to each other that, in 1911, Llallagua workers accidentally blasted into one of Patiño's galleries. Patiño continued to complain of the Chilean company's "opening up entrances into my workings" until a detailed boundary agreement was reached in 1914 between the two firms. While Patiño's operations continued to be plagued by acute power shortages, however, the Chilean company managed to build an artificial lake and a dam on the Chayanta River, greatly increasing its electricity supply. This enabled the Chileans to double their tin production between 1916 and 1918 and to overtake Patiño as Bolivia's largest producer.³⁹

Nevertheless, by the early 1920s Patiño was said to have a greater annual income than the Bolivian government.⁴⁰ Increasingly he devoted himself to the buying and selling end of the business, spending more and more of his time in Europe until, in 1924, his doctors forbade him to return to Bolivia because of a heart condition. Explaining Patiño's absorption with business dealings in Europe, Geddes writes that,

English, German, French and American traders were struggling to capture the European minerals market. It was indispensable for a large-scale producer to learn the intricacies of the mineral trade as it would have been ingenuous to assume that the stiff competition then existing between British and German smelters would automatically secure for him permanently the best prices. A wise seller had to be wide-awake and know all there was to know about the ramifications of the trade where a whole array of agents, assayers, industrial chemists and managers of smelters waged perpetual war

with the producers about such things as: tariffs for shipping, smelting, railway freight and insurance; amounts of impurities in the minerals; losses of weight through evaporation of moisture in transit; credit facilities, and so on.⁴¹

This involvement in the European mineral and money markets led to a rapid diversification of Patiño's operations. Unlike the principal nineteenth century silver magnates—Aniceto Arce, Gregorio Pacheco, and Severo Fernandez Alonso, each of whom became President of Bolivia—the tin barons tended to avoid open involvement in politics except to promote and defend their business interests, gravitating instead toward the centers of international trade and finance. The growth of the Patiño interests into an important multinational enterprise began with his first trip to Europe in 1908, when he bought half-ownership of the German smelting firm of Zinnwerke-Wilhelmsburg, which was refining nearly all his ore. The other half-ownership of the German smelter was bought by the United States National Lead Company, the world's second largest consumer of refined tin, which then managed the smelter. Thus began Patiño's long association with National Lead, which gave him much of the power he lacked in his drive to dominate the Bolivian and international tin industry. He and his family resided in Oruro from 1903 to 1912, but then took up residence in Hamburg. In those days Patiño relied heavily on Germany for machinery and financing for his new projects, but he soon began to range farther afield. At the start of World War I in 1914, Patiño shifted his base of operations to England. Diverting all his ores to the Liverpool smelter of Williams, Harvey, he began maneuvering to break the British monopoly in tin smelting. In 1916 Patiño and National Lead, acting together, told the family that owned Williams, Harvey that they would build their own smelter if they could not buy into the firm. Faced with this ultimatum from its largest supplier and its largest customer, the Pearce family sold a one-half interest to National Lead, which in turn sold one-third of its share to Patiño.⁴² By 1929 the Patiño interests had taken over whole ownership of Williams, Harvey, and had begun buying large quantities of stock in the principal Malayan tin-mining companies.⁴³

Ironically, it was these powerful international connections that enabled Patiño to make his greatest claim to being a Bolivian nationalist: the long,

secret process of proxy share-buying that enabled him, in 1924, to displace the Chilean interests that controlled the neighboring Compañía Estañifera de Llallagua. Not only had Chile deprived Bolivia of her seacoast in the War of the Pacific (1879-1884), but also of the world's richest nitrate and copper deposits, which were located in those coastal deserts and mountains. Two decades after the war some of Chile's leading political and financial figures bought the Llallagua mine that was developed by Pastor Sainz, a Bolivian miner-lawyer-politician, and entered promptly into an intense rivalry with the Patiño interests. After the 1914 boundary settlement was signed between the two firms, Patiño secretly went about buying stock in the Chilean company through two intermediaries, the British import-export firm of Duncan Fox in Antofagasta and the Anglo-South American Bank of London, which quietly began accumulating shares on the Santiago stock exchange in behalf of a mysterious "English group."⁴⁴ Again Patiño worked in close collaboration with National Lead President Edward J. Cornish, linking the Llallagua stock purchase with the total takeover of Williams, Harvey, under the economic rationale that the world's largest tin smelter would have as its ensured source of supply the world's largest mine. The moment of truth came in April 1924 when Patiño and National Lead together held two-thirds of the Chilean company's stock and Patiño announced his ownership—along with the merger of the two companies on the mountain—at the annual meeting of Llallagua shareholders in Santiago. A Bolivian at the meeting shouted: "Viva Patiño!" Patiño shouted back: "Viva Bolivia!"⁴⁵

By the time of the Great Depression Patiño had laid the foundations of an extraordinary economic empire. According to Herbert Klein,

his major investments after 1920 came to be greatly diversified, not only in Far Eastern and African tin production and international smelting, but in non-tin related investments as well. Recognizing the declining nature of the high-cost Bolivian tin industry, he carefully diversified his investments into non-tin mining, especially in Canada, and in general business investments in the United States and Europe. Thus by the time of his death in 1947 Patiño had built up a well-integrated fortune which has every appearance of surviving for a long time....Even with the nationalization of his Bolivian tin

properties in 1952, little real difficulty was created for the Patiño family. Forced to give up these increasingly marginal and unproductive resources, they were still able to force an early repayment plan upon the Bolivian government because of U.S. pressure and their control over the crucial Williams, Harvey smelter, the sole Bolivian tin concentrate smelter still operating in the world.⁴⁶

II

The Great Depression had a catastrophic effect on the price of tin. From a high of 71 cents per pound in November 1926 the New York price fell to 19 cents in April 1932.⁴⁷ Bolivia's production of tin-in-concentrates fell from a record 46,338 tons in 1929 to 14,725 tons in 1933.⁴⁸ According to a United States Congressional report,

the high tin prices of 1926-27 caused a boom in the development of tin mines that led to an overproduction of tin as early as 1928.

Stocks began to rise and prices to fall. During the summer of 1928 the Tin Producers' Association was formed to regulate the output of tin mines, but the general industrial depression caused a decline in consumption that nullified all benefits from controlled production. In 1930 a move was started to effect a legally enforceable curtailment program.⁴⁹

Writing on the tin crisis in the Great Depression, Elizabeth S. May observed that the inspiration for these huge investments in tin production capacity,

was the remarkably high price of tin in 1926, and the general belief that at the current rate of exploitation, the existing areas would supply the world demand for no more than 10 years. Fabulous was the amount of capital poured into the tin-mining industry in those years. Investors, evidently, had never heard of such a thing as over-capitalization of a productive area.... The falling off of demand in the United

The early shift (1966).





Entering the mine.

States in 1927 [consuming nearly half the world's tin] soon brought to an end the upward movement of price and by the end of the year those who said there would soon be a tin famine saw stocks accumulating.⁵⁰

This extraordinary flow of investment into tin production capacity in the 1920s produced some major technological advances at Siglo XX, many of them realized by the new American manager, John C. Pickering, hired by Patiño in 1926 at \$50,000 a year. By the end of 1928, the mine had roughly 87 miles of tunnels with rails for ore-cars, 43 lodes with 295 branches under exploitation and 1,098 blocks of ore identified and cubed by geologists.⁵¹ Despite record levels of production, reserves of fine tin increased during the late 1920s by about 15 per cent annually.⁵² The transport of ore by llamas and carts terminated with the completion of the Uncia-Machamarca railroad in

1921. The ore-treating capacity of the Victoria concentrating mill at Catavi had been expanded by half to replace the old Miraflores mill near Patiño's first workings on the other side of the mountain. To meet the chronic power shortage on the *altiplano*, the mine's two artificial lakes were greatly expanded to raise annual hydroelectric generating capacity to 16 million kWh.⁵³ Nevertheless, as a 1928 medical report on silicosis showed, working conditions in the mines remained primitive.

The work consists of blasting rock with dynamite, or with gunpowder if the material is soft. These explosions produce great caving-ins of rock, earth and metallic material that is carried on the backs of peons to the main galleries, where it is loaded on ore-cars. The branch galleries are irregular, narrow and very low, with almost no ventilation, so that only small workers, mainly boys, can make their way through the tortuous caves that cut through the mineralized rock. All these galleries connect more or less directly with a central shaft that serves as a ventilation chimney. Besides this central shaft, there are other ducts that reach the outside and ventilate the deeper galleries. In some mines there are machines that pump in air through hoses. They are used mainly after explosions to reduce the smoke and dust. Lighting is by electricity only in the main galleries, the rest being illuminated by primitive oil lamps.

Two kinds of workers labor in the mines: temporaries and professionals. The first generally are *altiplano* peasants who during the lulls in the farming calendar work for a few months in the mines, while the professional miners see the job as lifetime and even hereditary. The sons of miners begin at an early age, 11 years according to labor legislation, as *aspiris* [porters] who carry the ore on their backs through those strange underground pathways from the dynamite blasts to the main galleries. As they grow up they are promoted to the job of miner, that is if an *ahiza* [cave-in] had not ended their young existences....In such disastrous hygienic conditions—deficiently nourished, intoxicated by alcohol and coca, living eight hours daily inside the mine in an atmosphere saturated with metallic dust and toxic gases, descending to depths of more than

1,500 feet at temperatures of 85F degrees, only to rise suddenly to glacial temperatures at the surface, living in miserable huts in an atmosphere almost as unhealthy as the mine—it is easy to see that the miners' respiratory and circulatory systems cannot withstand such adverse conditions for much time.⁵⁴

In the mid-1920s the managers of Siglo XX began to look toward the time when the mine would have to produce much larger quantities of ore of lower grade. In his history of the mountain, Querejazu writes that "by 1922 the wealth of the famous Salvadoran lode discovered by Patiño in 1900 had been exhausted between the peak and the level 411 meters below, but it had generated the economic base needed for the expansion and mechanization of the whole mine."⁵⁵ In 1927 the intensive geological probing within the mine was rewarded with the discovery of the rich Contact lode, containing 160,000 tons of ore-bearing 7.7 per cent tin.⁵⁶ However, the company continued the systematic inventory of the tin content of old dumps and the rehabilitation of abandoned tunnels that it had begun a few years before to begin exploiting ore-bearing material that was discarded during the bonanza at the beginning of the century, when the ore grade mined averaged between 12 and 15 per cent.⁵⁷

Much of this work of industrialization was stopped by the Great Depression, which by 1932 had reduced the value of Bolivia's tin exports and tax receipts by four-fifths below their 1929 level.⁵⁸ Bolivia's tin industry was especially vulnerable to price reductions because of its high production costs when forced to compete with the more accessible alluvial deposits of Southeast Asia. As a United Nations report explained a generation later:

The costs of tin extraction in Bolivia are higher than in any other producing region. The Bolivian deposits are found in narrow underground veins, and the ore is a complex mixture of oxides and sulfides that is difficult and costly to concentrate and smelt. For this reason, Bolivian concentrates are of a lower grade than those from alluvial deposits and their price is correspondingly lower.... Other factors tending to increase costs are transportation of the concentrates from the *altiplano* to the coast, the relative labor-intensity of underground operations

and the pronounced decline of the ore-grade mined. Underground vein deposits also need large investments in fixed installations and in maintenance. They also require large-scale operations for economic results, making it hard to vary production levels for short periods.⁵⁹

In his 1930 annual report to the stockholders, Pickering wrote that the mine,

because of its magnitude, is of paramount importance to Bolivia. Perhaps a sixth of the revenue of the Republic comes directly or indirectly from the Corporation and, furthermore, between 20,000 and 30,000 people depend on the Corporation for a livelihood. Consequently the Bolivian government requires to be consulted before measures calculated to adequately reduce operating costs may be given effect.... Curtailment of production and reduction in costs was brought about by operating at full capacity during part time only—eventually four days a week.... Unfortunately, men at the mine—influenced by a radical element skilled in the use of communistic catch phrases—misinterpreted the motives of the Corporation and engaged in serious riots in the month of September. Troops were subsequently sent to the district and order reestablished.⁶⁰

During 1930 the payroll was cut by one-third from the 1929 level of 6,688, and by 1933 the work force at the mine had declined to 1,229.⁶¹

During the second half of 1932, the Catavi concentrating mill operated only seven days a month. Pickering reported that, to reduce costs, not only were operations drastically curtailed, but management reverted to cheaper, pre-industrial forms of labor. "About one-half the mine is completely shut down," he wrote, "the remainder being worked one shift daily, five days per week. Hand drilling, which is cheaper, has where possible replaced air drills—a maneuver not feasible in ordinary times since the necessary number of workmen would not be available. To eliminate pumping charges all workings below the Siglo XX haulage level have been allowed to flood; but precautions were taken to permit their being reclaimed when conditions warranted."⁶² The company also leased old dumps and alluvial deposits for primitive workings by unemployed

miners who sold back to the company about 150 tons of tin per month, or one-fourth of its total production.

To prevent his Bolivian operations from being closed down entirely by the Depression, Patiño intensified in Europe the efforts he began in the 1920s to buy into the principal Malayan mines and smelters and to arrange for industry-wide production controls. Geddes explains that Patiño's interest in the Malayan companies was "to get to know exactly why those companies were able to yield much larger returns on capital than was possible in Bolivia; to secure details of their taxes and relations with government;...but, above all, to try to influence those companies to cooperate concerning production and exports."⁶³ The managers of the Malayan companies began sending out circulars to stockholders urging them to pass resolutions restricting foreign ownership and control, while *The Times of Malaya* observed in 1933:

....Mr. Patiño's figures are correct, but what was and is Bolivia's situation as tin producer compared with Malaya? Some very well-informed people believe that without the so-called international tin control project, Bolivia's mining industry would have collapsed and therefore Malaya's chief rival would have suspended production. In other words, we would have obtained an automatic restriction through this suspension of the world's second largest tin producer.... We would add that whilst the mines belonging to the Chinese in Malaya could have continued to produce tin at this very low price [£109 per ton], we doubt very much if Bolivia could have done the same.⁶⁴

An intergovernmental agreement was reached that gave each producing country a quota in 1933 of one-third its 1929 production. By the time world tin prices began to rebound in late 1933, however, Siglo XX found itself with an acute labor shortage. More than 1,600 workers had entered the Bolivian army for the Chaco War with Paraguay in a semi-desert region of the southeast. As a result, Pickering wrote, "experienced drillers are very difficult to obtain and we are forced to accept, and train to that end, such labor as is available. This situation has an obviously adverse effect on the cost of operating the mine."⁶⁵ Because of this labor shortage, the first women workers entered the mine in May 1935, and by September 1936 there were

200 women working underground mainly as ore-car pushers.⁶⁶ Working conditions in the interior mine were described in a 1937 article by the American mill superintendent and chief geologist, who wrote that "almost all work is on a contract basis. Standard wages are guaranteed, and any bonus is divided among the men participating. Prices are based on the hardness of the rock.... Powder is furnished by the company and charged against the contract. Each miner does his own blasting.... Bolivian workmen do not adapt themselves readily to working with mechanical tools."⁶⁷

Because of the Bolivian government's wartime restriction on profit remittances abroad, mine production was curtailed and development work on new shafts and tunnels intensified. To further reduce costs, the company returned to old workings to extract ore. In his 1938 report to the stockholders, Patiño wrote that,

for the last two years, due to the change in the exploitation system, large tonnages have been used from the fills and low grade ores which were previously considered without any commercial value and, therefore, excluded from the reserves. The importance of this fact may be appreciated when considering that...44 per cent of the 1938 production came from this new source.... treatment of said ores will considerably increase the life of the mine. It is considered that under the new system of exploiting low grade ores and old fills not included in the official reserves, an appreciable tonnage containing approximately 2.5 per cent tin may be obtained....⁶⁸

Although the work force at the mine rose to 5,500 in 1938 and 7,700 in 1940, management continued to complain of a labor shortage because of the need to mine ever-greater quantities of ore to compensate for the declining tin content of the veins. In the mid-1930s, the Chaco War recruits were replaced by "Indians without experience, who in the best of cases agreed only to work for a few months" and by Peruvians and Chileans whose presence in large numbers in the mining camps led to a series of strikes and deportation of the "agitators." According to Querejazu,

the system of bringing [Indian] workers into the mines by recruitment proved costly and ineffective. The company had its own *enganchadores* [recruiters], as did other

mining companies, but it had to spend large sums to pay for transport, food and lodging for the recruits to bring them from their places of origin to Llallagua. Normally, they only accepted contracts for 90 days, using the system for tourism in the mining districts at the companies' expense. In 1938, some 6,800 new workers were recruited by Patiño Mines, but of these only 1,900 remained with the company more than three months for work in the interior-mine.⁶⁹

The rapid increase in the work force since the mid-1930s led to serious congestion in the mining camps, which had only 3,740 housing units—each with one room and an outdoor kitchen—for more than 7,000 workers and their families. Until new housing could be built, two families had to share these tiny dwellings, generating quarrels between husbands and wives and between families and, generally, a high level of tension in the camps. Querejazu notes that, in the voluminous Patiño archives in Paris chronicling a half-century of the mine's operations, "there was not a single document analyzing the political and social situation, even though the growing agitation among the workers and repeated errors of government made the future of the mining industry and the nation's economy increasingly insecure."⁷⁰

The final decade before nationalization of the mines in the 1952 Revolution was one of social convulsions and of desperate efforts by the company to compensate for the declining quality of ore. The pouring of peasant migrants into the mines led to a series of strikes, uprisings and "massacres" while Siglo XX's miners became, under Trotskyite influence, the largest and most militant unit of the Federacion Sindical de Trabajadores Mineros de Bolivia (FSTMB), the national union founded in 1944. These miners' revolts hastened the destruction of the Bolivian army in the streets of Oruro and La Paz in April 1952 as the *coup de grace* of a revolutionary uprising begun by students and factory workers and joined by regular units of the National Police (Carabineros).

At the same time, between 1938 and 1952, the average ore grade taken from the mine declined from 2.45 to 1.11 per cent tin.⁷¹ No major ore body had been found inside the mountain since the discovery of the Contact lode in 1927. In his annual report, the mine manager predicted that the mine



The town of Llallagua (1973).

might have to be closed by 1955 if new ways were not found for large-scale mining and treatment of low-grade ores.⁷² The company's response was two technological innovations: (1) the gradual gutting of what was left of the interior-mine by "block-caving" methods of blasting low-grade masses of mineralized rock, permitting the extraction of much larger volumes of material and requiring much less manpower than conventional vein mining; (2) building a "Sink-and-Float" preconcentrating plant, designed to raise the tin content of ore entering the mill by eliminating large quantities of sterile material before hand. Thanks partly to these new methods, the company managed to produce an average of 10,500 tons annually during the 1947-52 period, a level never again reached after the Revolution.

On October 31, 1952, MNR President Victor Paz Estenssoro flew to the Maria Barzola Field on the

barren *pampa* between the Catavi mill and the mining camps of Siglo XX where a decade before army troops had killed scores of people when they fired on a mass of advancing demonstrators. There he decreed the nationalization of the mines before a cheering assembly of miners, peasants, and

politicians, amid speeches, folk dances, and the brassy music of the *altiplano*. Neither the speeches nor the grandiloquent nationalization decree mentioned the fact that they were nationalizing a dying mine.

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NOTES

1. For an account of the first of these battles between the army and the miners, see my "Slow Death in Bolivia," *The New Leader*, June 6, 1966; also my "Bolivia's Mines Yield Tin and Violence," *The Wall Street Journal*, January 12, 1966.
2. The traditional corn brew of the Andean peasantry.
3. Oscar Dávila Michel, "How Empresa Minera Catavi Concentrates Tin Ores," *Engineering and Mining Journal* (EMJ), Vol. 158, No. 11, November 1957, p. 106. The technological history of Siglo XX-Catavi is chronicled in a long series of *EMJ* articles going back to 1914.
4. From David J. Fox, *The Bolivian Tin Mining Industry: Some Geographical and Economic Problems* (London: International Tin Council, 1967), p. 362.
5. The best brief survey in English of Patiño's accomplishments is Herbert S. Klein, "The Creation of the Patiño Tin Empire," *Inter-American Economic Affairs*, Vol. 19, Fall 1965. For a broader history of the times, see Klein's *Parties and Politics in Bolivia, 1880-1952* (Cambridge University Press, 1969). In addition, there are two full-length biographies by former Patiño employees: Manuel Carrasco, *Simón I. Patiño: Un Prócer Industrial* (Paris: Jean Grassin, 1960), and Charles F. Geddes, *Patiño: The Tin King* (London: Robert Hale, 1972).
6. David J. Fox, "Tin Mining in Bolivia," *Mining Magazine*, Vol. 124, No. 1, (London: January 1971), p. 17.
7. This survey was prepared and tabulated under the guidance of Luis Llano Saavedra, director of population studies at CENAFA (*Centro Nacional de Familia*), La Paz. For an overview of current knowledge of Bolivia's population problems, see Llano, *Aspectos Demográficos de Bolivia*. (CENAFA, 1972), and CENAFA, *Condicionamientos Socioculturales de la Fecundidad en Bolivia*, (1967). Also, Richard W. Patch, *Population Review 1970: Bolivia* [RWP-1-'71], Fieldstaff Reports, West Coast South America Series, Vol. XVIII, No. 1, 1971, as well as the same author's *The La Paz Census of 1970 and Attitudes toward Sex, Reproduction and Contraception in Bolivia and Peru* [RWP-3,4-'70], Fieldstaff Reports, West Coast South America Series, Vol. XVII, Nos. 11, 12, 1970.
8. From F.S. Turneaure, "The Tin Deposits of Llallagua, Bolivia," in W.H. Newhouse, ed., *Ore Deposits as Related to Structural Features* (Princeton University Press, 1942), p. 135. Turneaure continues: "The tin ores are found in narrow veins and stringer lodes, more than a thousand of which have been recognized as mapable units averaging from three to six inches in width. Of these, about 40 can be classed as major veins of perhaps double the average width and traceable along the strike for as much as 2,500 feet. The tin-bearing zone is roughly coincident with the porphyry, but several veins extend beyond the contact and one of major importance is entirely within the sediments."
9. From D.C. Deringer and John Payne Jr., "Patiño: Leading Producer of Tin, Part I: The Ore Deposits of Llallagua," *EMJ*, Vol. 138, No. 4, April 1937, p. 173.
10. See Durward Copeland and Scovill E. Hollister, "Tin-Ore Dressing at Llallagua, Bolivia—I," *EMJ*, Vol. 100, No. 12, September 18, 1915, p. 463. About 5 per cent of the mine's production was exported directly from the bonanza veins without being processed in the mill.
11. I am deeply grateful to Dr. Roberto Querejazu for making his manuscript available to me for research in preparation of this Report. This quote is from Querejazu's manuscript, p. 13.
12. Antonio Vázquez de Espinosa, *Compendio y Descripción de las Indias Occidentales* (1628). Transcribed from the original manuscript by Charles U. Clark (Washington: Smithsonian Institution, 1948), p. 669.
13. George Kubler's essay is in *Handbook of the South American Indian*, Vol. 2: *The Andean Civilizations* (Washington: Smithsonian Institution, 1946).
14. *Ibid.*, p. 338.
15. Luis Peñaloza, *Historia Económica de Bolivia*, Vol. 1, (La Paz: 1953), pp. 217-18.

16. Alvaro Alonso Barba, *Arte de los Metales*. Prologue by Armando Alba (Potosí, 1967), p. 54.

17. *Ibid.*, p. 46.

18. George Juan and Antonio de Ulloa, *A Voyage to South America*, Vol. II (Fourth Edition, London: 1806), p. 153.

19. Peñaloza, *op. cit.*, p. 194.

20. Querejazu (ms. p. 34) quotes a letter from Patiño describing the advanced industrial infrastructure created at Huanchaca by President Aniceto Arce, the owner of the mine: "I still remember what don Aniceto Arce had at Huanchaca: 12 big crushers, 18 calcination ovens, 10 furnaces for *piñas* [virgin silver coated with mercury], a British-Coorpound motor, four Root boilers, an amalgamation section, a repair shop, 62 carts, hundreds of mules, horses and burros—and even a railroad!" Arce had built the first railroad into the *altiplano* that connected his mine with the Chilean port of Antofagasta. For a vivid portrait of Huanchaca and the neighboring town of Uyuni, see the novel by Adolfo Costa du Rels, *Los Andes No Creen en Diós*, Barcelona: Editorial Planeta, 1973.

21. *Ibid.*, p. 33.

22. *Ibid.*, p. 47.

23. *Ibid.*, p. 49.

24. Geddes, *op. cit.*, p. 64.

25. *Ibid.*, p. 144.

26. Paul Walle, *Bolivia: Its People and its Resources* (New York: Scribner's, 1914), p. 327ff.

27. Peñaloza, *op. cit.*, Vol. II, p. 209.

28. Walle, *op. cit.*, p. 329.

29. Peñaloza, *op. cit.*, Vol. II, pp. 214 and 309.

30. R.R. Beard, "Property and Operation of Patiño Mines and Enterprises at Llallagua, Bolivia," *EMJ*, Vol. 130, No. 3, August 9, 1930, p. 108; Peñaloza, *op. cit.*, Vol. II, pp. 209 and 235.

31. Geddes, *op. cit.*, p. 65.

32. In this skirmish one of the attackers was killed and two (including Artigue) wounded, while Patiño's band had six wounded, including Patiño himself with a bullet wound in his outer ear. In a newspaper interview published in Oruro at the time, Patiño said: "I armed my peons with a few rifles, shotguns and clubs, and I placed them strategically on the

Juan del Valle hill. From this height, with a long-range telescope, I observed their movements. At 9 A.M. on May 24 Artigue's men moved up from Llallagua, guerrilla-style. When they saw my people on the heights they began to fire crazily. I ordered my men not to fire back so we could save ammunition. Artigue's men advanced faster, firing again when they got closer. They continued advancing while we remained silent. When they got within range of a Remington, I ordered my men to fire. The combat lasted four hours." Quoted in Querejazu, ms. p. 51. Geddes (pp. 66-7) says Patiño's men unnerved the attackers by rolling boulders down the mountain at the outset, then spread the word through a false deserter that they planned to massacre the attackers on their next assault, telling Artigue's men that Patiño had superior arms and manpower defending the hill.

33. Typical of this is his letter to the manager of his Huanuni mine during Patiño's six-month return to Bolivia in 1916: "The cost of production of minerals in the mines under your charge is disastrous when one considers the fine tin contents of the minerals fed into the mill. As I have personally proved to you numerically the firm is losing money every day, and ... drastic measures must be adopted. The payrolls have increased enormously during your administration and production has not increased in the same proportion.... When I went up to the Harrison Adit [mineshift] I noticed that many ore wagons were being brought out of the mine only half-full, which is a grave mistake because the equipment is being worn out needlessly. The ore sorters send a lot of waste into the mill thus destroying machinery, without there being anyone to watch over them. In the ore sorting space there are too many employees but no control...." Quoted in Geddes, p. 143.

34. Querejazu ms., p. 86.

35. Benjamin L. Miller and Joseph T. Singewald, Jr., "The Patiño Tin Mines, Bolivia," *EMJ*, Vol. 102, No. 11, September 9, 1916.

36. Copeland and Hollister, "Tin-Ore Dressing at Llallagua, Bolivia—III," *EMJ*, Vol. 100, No. 14, October 2, 1915, p. 557: "The price paid for labor in Bolivia varies greatly according to the place. In the last two years, because of high tin prices and great labor demand, the wages at Llallagua have constantly risen. A drill man received as high as 10 or even 12 bolivianos [\$3.45 to \$4.15] per 12-hour shift and the average wage at the mine, including a considerable number of women ore-pickers at 1.50 bolivianos and other cheap labor, was 6.30 bolivianos or \$2.20. During the first part of 1914 the price of tin declined and with it the wage of the laborer. Then came the European war and practically no price for tin. Many small mines stopped operations. The nitrate fields of Chile curtailed. Railroad projects were stopped. Labor became

plentiful and the average wage at the mine is now three bolivianos or \$1, while at the mill it is about 1.98 bolivianos (\$0.69) per shift of 12 hours."

37. W. Jaime Molins, *Bolivia* (Buenos Aires: 1916), pp. 128-9. Juan Albarracín Millán, in his *El Poder Minero* (La Paz: 1972), p. 273, gives Uncia's population in 1915 as around 35,000, greater than La Paz, Bolivia's capital. None of these figures can be confirmed in the absence of census data.

38. The *palliris* are Indian women who pick out choice bits of ore from a pile. The term comes from the Quechua *pallar* (meaning pick or select) and was part of the colonial mining lexicon. See Barba, *op. cit.*, p. 66.

39. Querejazu ms., p. 85; Beard, *op. cit.*, p. 108.

40. Alcides Arguedas, *Historia General de Bolivia, 1808-21*, La Paz: 1967, p. 417n.

41. Geddes, *op. cit.*, p. 117.

42. Klein, "The Creation of the Patiño Tin Empire," *op. cit.*, p. 13.

43. Geddes, *op. cit.*, p. 208.

44. *Ibid.*, pp. 181-2.

45. Querejazu ms., p. 135.

46. Herbert S. Klein, "The Creation of the Patiño Tin Empire," *op. cit.*, p. 22. Also see "Patiño of Quebec Discovers a New Metals Deposit: Copper, Zinc Values in Find Are Called Excellent; Gold, Silver Also Encountered," *The Wall Street Journal*, January 3, 1974.

47. Elizabeth S. May, "The International Tin Cartel," in William Y. Elliott et al., *International Control in the Non-Ferrous Metals* (New York: Macmillan, 1937), p. 321.

48. W. Robertson, *Report on the World Tin Position with Projections for 1965-70*, (London: International Tin Council, 1965), p. 110.

49. From the Report of the McReynolds Subcommittee of the House Foreign Affairs Committee, *Tin Investigation* (1934-35), reprinted in May, *op. cit.*, pp. 347-62.

50. May, *op. cit.*, pp. 309 and 315.

51. Querejazu ms., p. 146.

52. D.C. Deringer and John Payne Jr., "Patiño—Leading Producer of Tin, Part II: Mining Practice at Llallagua—Crushing and Sorting the Ore," *EMJ*, Vol. 138, No. 5, May 1937, p. 236.

53. See Annual Reports, 1926 and 1927, of Patiño Mines and Enterprises Consolidated, Inc. (PMECI). In *The Bankers in Bolivia* (Vanguard Press, 1928, p. 39), Margaret A. Marsh

writes: "Lack of fuel is another big handicap in exploiting Bolivia's mineral resources....To the insult of depriving Bolivia of coal, nature has added the injury of setting her treasures at such an altitude that locomotives and diesel engines lose a good share of their efficiency, so that fuel imported at so great a cost does considerably less work than it would at a lower level. The mines placed on the eastern side of the Cordillera, like those at Caracoles and Araca, and even the big Patiño mines on the *altiplano* make use of water power by damming the small streams and conserving the rain and the melting snow from the mountains in artificial lakes, but in the dry season even these plants are forced to resort to the costly oil-burning diesel engines or to reduce the scale of their operations and consequently their output."

54. From F. Veintemillas and A. Valle, *El Mal de Mina y su Legislación Social*, (pamphlet) (La Paz: 1928), pp. 2-5.

55. Querejazu ms., p. 122.

56. PMECI Annual Report, 1928.

57. Fox, *The Bolivian Tin Mining Industry*, p. 364.

58. Querejazu ms., p. 169; Peñaloza, *op. cit.*, Vol. II, p. 234.

59. ECLA (United Nations Economic Commission for Latin America), *El Desarrollo Económico de Bolivia*, (Mexico: 1958), p. 28.

60. PMECI Annual Report, 1930, p. 12.

61. *Ibid.*, p. 16; Deringer and Payne, *op. cit.*, p. 237.

62. PMECI Annual Report, 1932.

63. Geddes, *op. cit.*, p. 226.

64. Quoted in Geddes, *op. cit.*, p. 236.

65. PMECI Annual Report, 1933, p. 15.

66. Deringer and Payne, *op. cit.*, p. 237. This was in violation of an old miners' superstition that forbids women from entering a mine, lest it lead to disaster for the men.

67. *Ibid.*, p. 236.

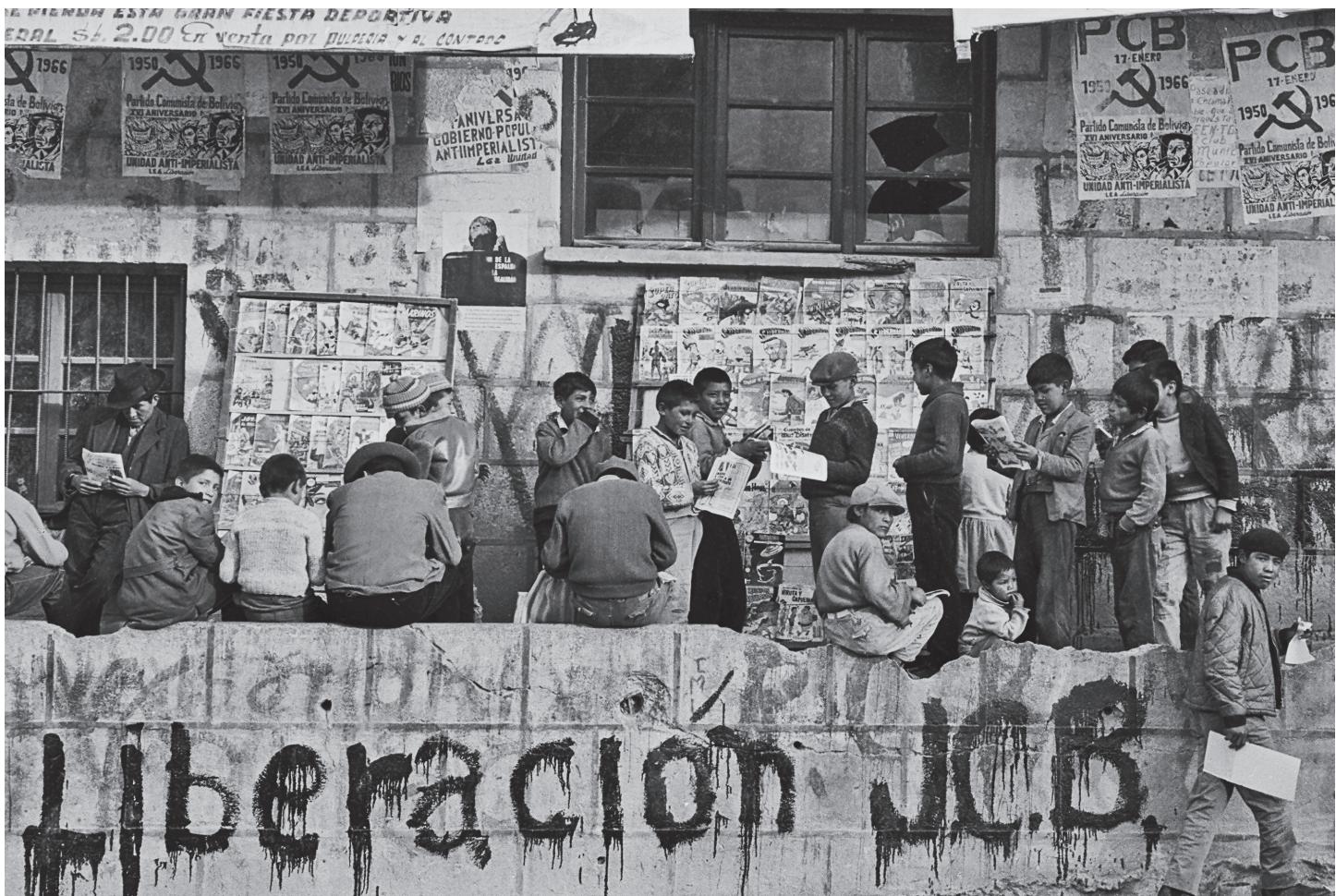
68. PMECI Annual Report, 1938, p. 5.

69. Querejazu ms., pp. 178-80, 189.

70. *Ibid.*, p. 301-2.

71. Fox, *op. cit.*, p. 364.

72. Quoted in Herbert M. Weisz, "Evolution of Block Caving at Catavi," *EMJ*, Vol. 159, No. 9, September 1958, p. 87.



Bolivia: The Price of Tin

Part II: The Crisis of Nationalization

by Norman Gall

American Universities Field Staff
(1973)

BOLIVIA: THE PRICE OF TIN

Part II: The Crisis of Nationalization

by Norman Gall

January 1974

I

At the time the major Bolivian tin mines were nationalized in 1952, the industry had been sustained for more than 20 years by the efforts and investments made in the first three decades of the century. No important mine had been brought into production since the Depression; little geological exploration had taken place and there were few additional investments. Many mines were becoming exhausted and their equipment was becoming obsolete. After World War II the tense political situation and the high price of tin led the major companies to gut their mines so as to maximize their profits before nationalization, which was widely feared by the industry. In 1958 the United Nations Economic Commission for Latin America reported:

Some of the older and more important mines face adverse conditions of natural origin: the declining grade and increasing complexity of the ore, the narrowing of the veins, the increasing pressure of the rocks as the mines go deeper, and the excessive extension of the underground workings.... Most of these factors cannot be counteracted by new investments in existing mines, and will gradually increase further the costs of ventilation, transport inside the mine, pumping of water from the deepest tunnels, increased maintenance to avoid cave-ins caused by the great pressure of the rocks, etc. In other words, more ore will have to be extracted under worse conditions and transported greater distances to produce the same amount of metal.¹

These adverse conditions in Bolivia were aggravated by the stagnation in the world demand for tin since the Depression. Between 1930 and

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1963 world lead consumption doubled, copper tripled, nickel quadrupled, and aluminum consumption rose 20-fold, while the use of tin increased by only 3 per cent.² Except for one year during World War II (1941), the United States was never again to reach its 1929 level of tin consumption (85,000 tons), and world demand was not to recover its 1929 level (171,000 tons) for another 35 years.³ Because of high production costs and international production controls, the price of tin in recent decades has resembled that of a semiprecious metal, partially because political upheavals in Bolivia, Indonesia, the Congo, Malaya, and Nigeria tended to limit the supply of tin entering the world market. According to one observer, "the shift in supply patterns partly reflects differences in the amounts of reserves and costs of production, but the reduction in total supplies is primarily due to political disturbance in the countries affected or to the policies adopted by their governments as a result of political changes."⁴ Uncertainties both of the price and supply of tin thus have prompted major economizing innovations in its use. In the words of a British geographer:

Tinplate provides an excellent example of the power of modern technology to reduce dependence on the products of the underdeveloped world and their price uncertainties. A rise of £100 a ton in the price of tin is said to increase the cost of producing an average "tin can" by less than one-fiftieth of a new penny. Even so tinplate producers have acted both to economize in tin use and to find alternative materials. Substitutes such as plastic, aluminum or "tinless" tin cans made of steel have made headway, and improved coating techniques have cut down the use of tin even in tinplate, with the replacement of the old "hot dip" tinning by

the electrolytic process and with the production of "thin tinplate" in which the coating is thicker on one side than the other. As a result of these developments, demand for tin from the British tinplate industry fell from 1947 to 1961 even though consumption of preserved foods doubled. In the USA tinplate production went up between 1960 and 1967 from 5.7 to 6.3 million tons, but tin consumption by the tinplate industry fell by 11 per cent.⁵

All these factors must be taken into account when considering what has been widely described as the economic disaster of nationalization of Bolivia's major mines. The sharp declines in production since 1952, commonly ascribed mainly to politicization and disorganization of current operations, can also be viewed primarily in terms of the precipitous drop in the ore grade. While there were many stories of labor anarchy in the mines after nationalization, a United Nations technical assistance mission reported in 1950 that mine labor already was rebellious and worked effectively for only 40-50 per cent of its shifts.⁶ The failure of the three major mining groups to explore and invest in Bolivia, thus allowing their properties to deteriorate, can be understood in view of the uncertain world demand for tin; the Bolivian government's retention of the companies' foreign exchange earnings in the 1930s and 1940s, and the revolutionary effervescence since the Chaco War. All these factors combined to shape the raw and mounting tragedy of the mines and their people.

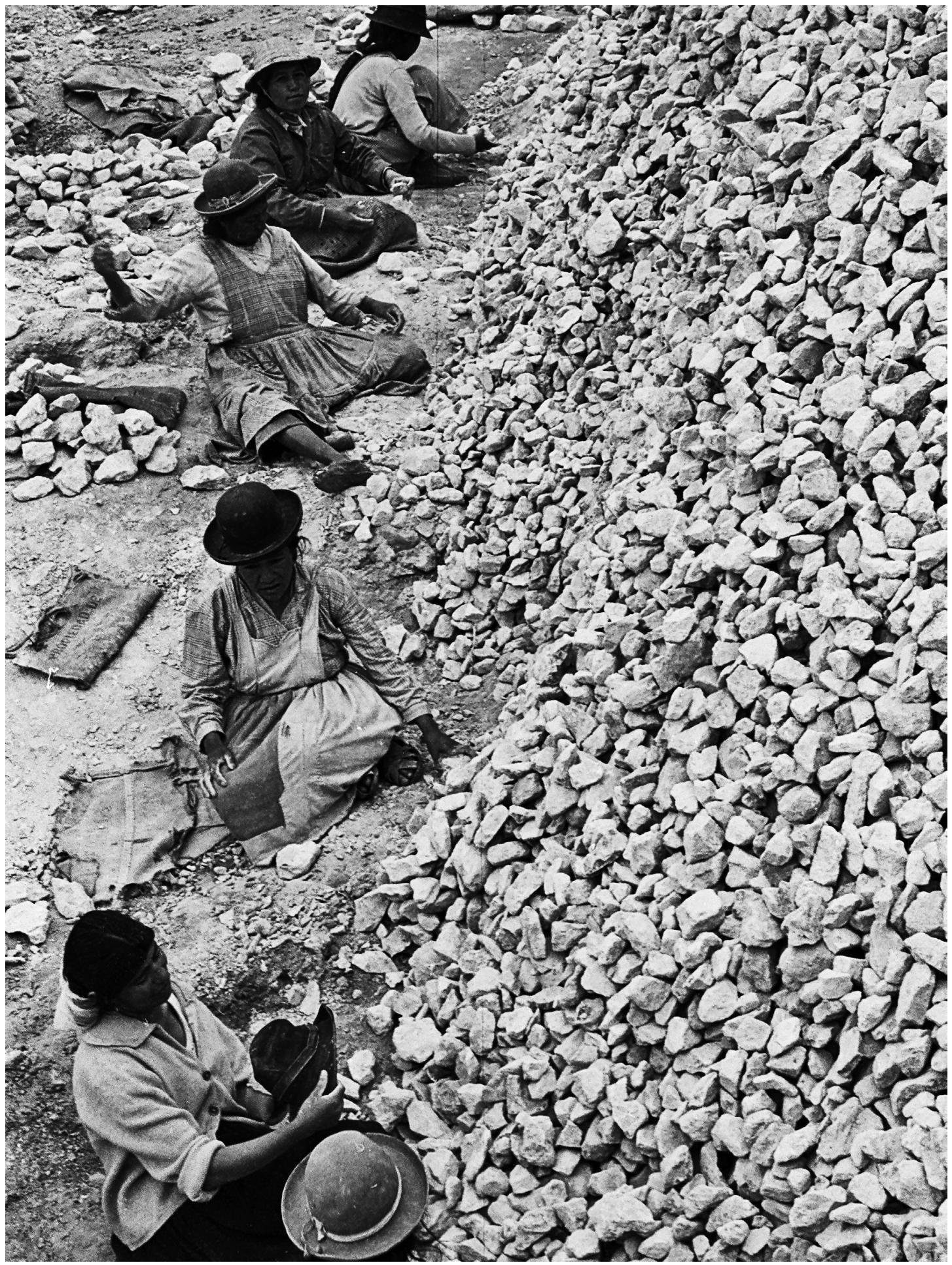
While the mining industry—including the small- and medium-sized private mines that were not nationalized—employed less than 10 per cent of the nonagricultural labor force in 1950 of what was still a heavily peasant society, it was—and remains—the linchpin to the monetary economy in Bolivia. The industry generated 95 per cent of Bolivia's foreign exchange earnings in 1950, with 70 per cent of this coming from tin, and export taxes on minerals provided two-fifths of government revenues. Like oil in Venezuela and copper in Chile, tin in Bolivia was largely an enclave industry where fluctuations in price and production would spell the difference between prosperity and ruin throughout the economy. Unlike sugar in Cuba and beef and wheat in Argentina, Bolivia's monoproduct was extracted by a tiny but volatile minority of the labor force that could create havoc in the economy at any moment.

In his report on the first two years of nationalization to a miners' congress in Siglo XX-Catavi in late 1954, the Secretary-General of the Federación Sindical de Trabajadores Mineros de Bolivia (FSTMB), Mario Torres, attributed the decline in production since 1952 to "depletion of the ore deposits, a lack of trained technicians, lack of spare parts and *pulperia* [company store] supplies...and, finally, the euphoria in the mining camps that comes from feeling free of oligarchic oppression."⁷ When the mines were nationalized, the price of tin was already dropping from the 1951 Korean War high of \$1.28 per pound—an all-time record—to reach a trough of 92 cents in 1954 that lasted through most of the 1950s. In the nationalized mines of COMIBOL (Corporación Minera de Bolivia), the state mining corporation formed in 1952, the work force increased by nearly half between 1951 and 1956, while tin production dropped to half the 1951 level (14,800 tons in 1961).

Because of the inflation that racked Bolivia in the 1952-1956 period and the chaos in COMIBOL's accounting caused by sloppy book-keeping and artificially low exchange rates (14,000 bolivianos to the black market dollar in 1956, against the official rate of 190), it has taken time for economists to determine that COMIBOL actually was making a profit in those years. According to the conservative George Jackson Eder, the American advisor in La Paz in 1956-57 who organized the United States-financed economic stabilization program:

COMIBOL deficits were not the cause of the precipitate depreciation of the currency, as most people in government and in the Central Bank believed. Quite the contrary; if the nation's accounts had been properly kept, without the confusion produced by multiple rates of exchange, and particularly the absurd official exchange rates, it would have been clear that COMIBOL's excess of cash receipts over cash expenditures was the only thing that enabled Bolivia to survive the cash deficits of the petroleum corporation, the Development Corporation and the railways.⁸

A Price Waterhouse accounting of the first 11 years of COMIBOL's operations showed that in 1953-1956 the Central Bank had received from COMIBOL \$138 million more in foreign exchange than it had dispensed to COMIBOL,⁹ with much



of this surplus being diverted into agricultural and petroleum developments in the lowlands east of the Andes. These schemes reflected a view attributed to President Paz Estenssoro that the mines were dying anyway, and that Bolivia's economic future lay in the Oriente.¹⁰ While these policies lay the groundwork for the extraordinary economic development in recent years of the Santa Cruz region,¹¹ it also hastened the decline and decapitalization of the tin industry on which Bolivia still depends.

In his book on the stabilization program, Eder assigns prime importance to miners' wages in fixing the new exchange rate in 1956:

If COMIBOL employed too many miners, and if the miners produced less than they should, which was the case, there would be less for each miner. If the amount available for wages worked out at say \$1 a day per miner, and if the miners demanded a wage of Bs. 6,000 a day, the exchange rate would have to be Bs.6,000 to the dollar; if they demanded Bs. 10,000 a day, the rate would have to Bs. 10,000....On the other hand, the higher the miners' wages and the higher the rate of exchange, the worse off the rest of the population would be, because of higher domestic prices and because of Bolivia's dependence on imports for many articles of prime necessity.¹²

The stabilization program succeeded not only because of the \$25 million initial Stabilization Fund, but it also received \$360 in United States' aid in the 1955-1964 period, nearly half of this in USAID grants directly subsidizing one-third of the Bolivian budget.¹³ The State Department initially asked that even President Paz's Stabilization Decree have Washington's prior approval.¹⁴

Despite its strong bias against state ownership of the mines, one of the most important historic documents of the revolutionary period is the nine-volume study of the mining industry produced in 1956 by the American engineering firm, Ford, Bacon & Davis (FBD). According to FBD, some 65 per cent of the technical staff at the mines left their jobs between 1952 and 1956. Nevertheless, some of the most important technical jobs were filled by foreigners who had worked for the Patiño, Aramayo, and Hochschild organizations and had decided to remain in Bolivia. The report described

some of the nightmarish management problems they faced:

...the frequent lack of materials and supplies, especially the critical ones, at most of the mine operations has been very costly in terms of lost man-hours, strikes, labor disturbances and general decrease in morale. In addition, the general inefficiency of the overall purchasing, handling and distribution of supplies has resulted...in higher costs for such materials.

...in nearly all the Corporation mines one to three or more important staff positions are not even filled, and this does not give a correct measure of the staff and supervisory force deficiency for the reason that many personnel are filling positions above their real capacity.

Labor is frustrated by its inability to cope with inflation, inability to obtain proper working tools, and in some cases lack of adequate supervision, lack of housing, lack of proper medical and camp facilities and most of all lack of essential food, fuel and clothing....Mine doctors have quoted that at some mines as much as 50 per cent of the mine force have some sort of respiratory ailment such as tuberculosis and silicosis.

The *pulperia* [company store] problem has been one of the major sources of trouble and frustration....The *pulperia* grew out of the need of the mining companies to furnish the necessities [food, clothing and fuel] to the miners...at cost, so...the miners and their families had available to them a good diet. [Because of] the increasingly absurd low prices at the *pulperia* in face of the soaring inflation...the mine workers that have the *pulperia* privilege found it lucrative to re-sell items on the black market....It is startling to find that this *pulperia* subsidy in some of the...mines amounts to more than the total direct mining and milling costs at these operations.¹⁵

While there had been serious labor trouble in the mines in the decade preceding nationalization, the most important structural change after 1952 was the control of the industry assumed by the national miners' union. The mine workers' leader, Juan

Lechín, who had played a key role in the revolt that brought the MNR to power, became the MNR's first Minister of Mines (1952-1954), and he was succeeded in this post by the Secretary-General of the FSTMB. The chief instrument of the FSTMB's influence over mine operations was the *Control Obrero*,¹⁶ which also was the most innovative of the institutions spawned by the Bolivian Revolution.

During some recent taped interviews in Caracas, I asked Lechín, now in exile, just how the idea of a *Control Obrero* in the mines originated. "The idea was resisted by Paz and the rest of the MNR leadership, but they gave in because they were afraid of the armed miners' militias that had just defeated the Bolivian army in the streets of Oruro and La Paz," said the tall, white-haired former soccer star whom the miners have adored since he was briefly subprefect in Uncia-Llallagua in 1944. "You know, in those days after the Revolution, people were calling La Paz 'Lechingrad.' The MNR was really a middle-class party, and Paz had voiced opposition to the nationalization of the mines in Buenos Aires on the eve of his return from exile to head the triumphant Revolution. We at the Ministry of Mines were devising a formula for worker participation in the management of the nationalized mines, but we were dissatisfied with merely having minority representation on the board of directors of COMIBOL. Then we heard over the radio that the Russians had just exercised one of their first vetoes in the United Nations Security Council. We thought what a good idea it would be for the workers to have a veto over COMIBOL management decisions to avoid administrative abuses and dirty business deals, especially in the purchasing department. We never intended the *Control Obreros* at each mine to interfere with daily operations, but they did this on their own because they were elected annually by the workers and thus had to respond aggressively to workers' complaints or lose their jobs. Mario Torres, the FSTMB Secretary-General, was *Control Obrero* at the COMIBOL headquarters in La Paz before he was appointed Minister of Mines. When he became *Control Obrero*, Mario asked me what he should do. 'Veto everything,' I told him, 'especially purchases. Then the losing bidders for each contract will come to you with complaints of how they were cheated, and you will learn a great deal!'"¹⁷

One of the most coherent accounts I have heard of the years following nationalization came from

Emigdio Pefaranda, a softspoken, middle-aged Bolivian engineer with a strong rapport with the workers. Pefaranda came to Siglo XX as a young man, around the time of nationalization, and worked in the interior mine for 14 years. We talked at length during my first visit to Siglo XX in 1965-66, and again in 1973. "Before the Revolution," he told me, "about four-fifths of the mine engineers were highly paid foreigners brought in by Patiño, while Bolivian engineers had very little future. There was a caste system with the gringos on top, the miners at the bottom and we Bolivian engineers and office workers somewhere in between. Most of the miners were Indians from distant valleys, and many of them couldn't speak Spanish. When the Revolution came, we all tried very hard. Nationalization made the Bolivian miners and engineers feel they were the owners of the mines. Everyone worked long hours, often seven days a week, and there was great discipline because we wanted to show the world we could do more than Patiño. Production rose at first, even though we lacked rails, timber, and water pipe—the acidity of water inside the mine corroded the pipes very fast. We had to strip some sections of equipment just to keep other sections running. Then the price of tin collapsed after the Korean War. The inflation in Bolivia was aggravated because food production fell after the agrarian reform. People in the cities, who had to form lines at night to get bread and milk in the morning, cursed the miners because the MNR shipped the best food to the *pulperías* at frozen prices because the government was afraid of the miners' militias."

"The problems with the mine workers began around 1954-55," Pefaranda continued. "The worst period of union dictatorship was in 1956-1958, when my family and I had to leave the mine under COMIBOL's orders for our own safety. The *Control Obrero* was an invention of the Devil. There was no discipline, no responsibility. After nationalization many people wanted to come to work in Siglo XX, which was then the center of political and economic power in Bolivia. The government pressured management to hire more people, but very few of them wanted to work inside the mine. At the same time there were many more fringe benefits, as well as all kinds of special bonuses. Union leaders rode around in company cars with chauffeurs while the nationalized mines were losing \$1 million a month. The COMIBOL management gave up and tried to get a foreign

company to run the mines, but nobody wanted to do it. So we were left to fight among ourselves."

Surprisingly, nationalization at Siglo XX-Catavi, the largest and most politicized of the COMIBOL operations, caused less economic upheaval in the early years than at the other nationalized mines. Not only did the payroll increase at Siglo XX much more slowly than at the COMIBOL mines as a whole between 1952 and 1956, but a higher ratio of underground mine workers to the total labor force (40 per cent) prevailed at Siglo XX than at all nationalized mines (32 per cent in 1956). While the rate of industrial accidents at the nationalized mines rose sharply between 1953 and 1955, at Siglo XX they declined to about 40 per cent of their 1950 level.¹⁸

In 1955 Siglo XX produced one-third of COMIBOL's tin output, and in 1956 its milling capacity was raised from 5,000 to 6,500 tons of ore per day to help offset a one-third decline in the ore grade between 1950 and 1955. Nevertheless, according to FBD,

the Catavi mine has reached a late stage as regards ore reserves, as the mine is now largely dependent upon "reworking" the previously mined areas to recover some gash veins in the walls, old filling material of economic grade, and sand tailings from the dump.... At present the mine is not quite capable of supplying the full mill load, and it is necessary to supplement the mine output by trucking old sand tailings to the mill.... It is now estimated that the Catavi operation made a profit of \$2.26 per ton milled in 1955.... However, the known wage increases subsequent to the above date would make this operation marginal.¹⁹

At this point the Catavi management embarked on a dramatic expansion of its block-caving program of gutting the interior mine. In a 1959 article in the *Engineering and Mining Journal*, Catavi Manager Herbert M. Weisz wrote:

Without the application of block-caving methods it would not have been possible to mine 13 million tons of pillars ["solid waste"] which contain more than 91,500 tons of fine tin. Block-caving must also be credited with keeping up production which

otherwise would have decreased to a point of preventing continuous operations. It now accounts for about 50 per cent of the ore and 40 per cent of the tin produced and the production program for the Llallagua mine foresees it contributing 80 per cent of the total mine extraction. In addition, by keeping up production while sparing reserves of vein material and by adding new reserves of former sub-grade material, block-caving has permitted raising reserves of mineable ore and prolonging the life of the mine for 10 or 12 years.²⁰

While mining operations held together reasonably well at Siglo XX until 1956 under extremely adverse conditions, they began to fall apart under the political stresses of the Stabilization Program that cut deeply into the purchasing power of the miners and led to splintering of the coalition of forces that formed the MNR. The number of strikes recorded by the Labor Ministry jumped from 310 in 1957 to 1,570 in 1958.²¹ President Hernán Siles (1956-1960) visited Siglo XX in June 1957 as part of a dramatic tour of the mines to prevent a national strike by the miners called to recover the *pulperia* privileges taken away under the Stabilization Program. Around the same time, as a counterpoise to the feared miners' militias, Siles began with United States aid to rebuild the Bolivian army which had been badly crippled in the 1952 Revolution. This strategy reached its logical conclusion with the November 1964 overthrow of the MNR in a military coup, after President Paz Estenssoro peeled away most of his support in the course of his maneuvers for reelection in 1960 and again in 1964.²² After seizing power, the rebuilt army proceeded to crush the armed miners' militias with new weapons supplied in the United States military assistance program.

The political disintegration of the MNR, beginning with the 1957 Stabilization Program, precipitated a rapid deterioration of Siglo XX's capacity to survive as an industrial enterprise. After 1956 the Catavi mill's production of tin-in-concentrates declined at an annual average rate of 9 per cent to 2,810 tons in 1963, or one-third of the 1956 output. The proportion of underground mine workers to the total payroll dropped from 40 to 25 per cent between 1956 and 1964, while worker productivity inside the mine—which in terms of ore extracted rose slightly between 1950 and 1955—declined sharply by 1959.²³ Recording a \$3 million

loss in his 1959 annual report, the mine manager wrote that "we see that we are very near to collapse."

In August 1961 the young president of COMIBOL, Guillermo Bedregal, told the Bolivian Congress that,

...at this moment COMIBOL's debts add up to \$20 million. The major creditors are private manufacturers and state enterprises such as the railroads and the national oil company. The prostration of COMIBOL is one of the causes of the country's economic stagnation; the mines generate between 75 and 80% of Bolivia's foreign exchange earnings, and the failure to mobilize this wealth is causing the bankruptcy of small industries. For example, the Ferrary & Gezzi factory, one of the largest in Oruro, is about to close its doors because COMIBOL owes it \$150,000 and cannot pay. All kinds of industries, from sawmills to shoe factories, depend on COMIBOL for survival. This is not an exaggeration; the statistics are eloquent, and for this reason the mining industry has maximum priority in the government's economic program.²⁴

Bolivia's tin exports declined from \$85 million in 1952 to \$36 million in 1958. Between 1959 and 1963 Siglo XX lost an average of \$365,000 per month, while COMIBOL as a whole was losing \$1 million monthly. The Dutch general manager of COMIBOL, Goosen Broesma, traveled to Europe and the United States to look, unsuccessfully, for a private company to take over management of the nationalized mines. Then the Soviet Union made a dramatic offer to COMIBOL of \$150 million in credits for Soviet mine machinery at the time of Nikita Khrushchev's 1960 visit to the United Nations. Paz Estenssoro told me later that "we used the Russians as leverage against the Americans to overcome their taboo against aiding nationalized industries." This pressure led to the formulation of the so-called Plan Triangular to rehabilitate the investment-starved COMIBOL mines, a three-year, \$38 million package jointly sponsored by USAID, the Inter-American Development Bank (BID) and the West German government. The major elements of the plan were \$4 million for new geological exploration, \$18 million for spare parts and new mining equipment, \$4 million for laying off 4,800 surplus mine workers

and \$2 million for metallurgical research and development.²⁵

While the Plan Triangular assigned \$2 million for new machinery for Siglo XX-Catavi and helped make substantial reductions in the swollen payroll, there occurred around the same time another, more far-reaching response by the growing population of the Llallagua district to the economic crisis of the great mine. This was the large-scale robbery of tin ore by mineral thieves known as *jucos*, a Quechua word meaning "birds of prey that fly at night." The manager of the mine soon found that it was cheaper to have the ore taken from the mine by *jucos*, who would sell it back to the *empresa*, than to have the same amount of ore extracted by miners on the payroll. While *juqueo*, or mineral-stealing, long had been a problem in the Bolivian mining industry, it attained major social and economic significance in the early 1960s. This stolen ore figured on company accounts as mineral obtained from "other sources." While previously an insignificant statistical item, purchased ore rose from 45 tons of tin-in-concentrates in 1957 to 538 tons in 1962 to 1,366 tons in 1964, or nearly half the Catavi mill's 1964 production. Not only did this represent a breakdown of industrial organization, but the growth of *juqueo* was also part of a broader regression toward pre-industrial mining technology.

Hilarion Felipes was one of the Trotskyite organizers of the bands of *jucos* who began entering the mine nightly in the early 1960s. He is a tall, bent man of 31 years with a puffy face and cauliflower ears who lives in a sagging one-room adobe shack on one of the newly settled hills overlooking the town of Llallagua. In the early 1960s Hilarion was "Secretary-General of the Unemployed," an organization of workers fired under the Plan Triangular formed by the Trotskyites—ever-frustrated in their efforts to wrest control of the Siglo XX miners' union from the communists. "I was 19 years old and had just returned from service in the army," he told me. "The Trotskyite leader Cesar Lora found me one night when I was stealing ore and told me I had to organize the *juqueo* on a large scale because there were so many people hungry. It was then that I became a member of the POR [the Trotskyite Revolutionary Workers Party]. Lora and another POR leader, Isaac Camacho, formed a fictitious 'cooperative' at a nearby abandoned mine as a blind for selling stolen ore back to the company. The general manager at Catavi was a young Dutch geologist, Cornelius Bloot, who at first resisted



Hilarion Felipes—former leader of the *jucos* (mineral thieves)—1973.

buying stolen ore. But Bloot was a compassionate man who felt that something must be done to help the unemployed and feared that if the company didn't buy from the *jucos*, they would sell the stolen ore somewhere else.

"At first we entered the mine in groups of ten at a time," Hilarion continued, "including some students who needed money to continue their studies. But soon there were bands of 200 *jucos*, some of them armed, going into the mine at night in different sections, overwhelming the watchmen placed at the tunnel entrances to prevent stealing. When the stealing began on a large scale, peasants came from all the surrounding regions to Llallagua, and the town grew very fast. Most of the ore was stolen from abandoned mineshafts worked long ago by the company, with narrow veinlets that Patiño didn't bother with because the mine was so rich. This was dangerous for inexperienced people because the rock was not solid—the floors and ceilings of these old tunnels were formed by *taqueos* [refills] and abandoned by the company because they were so dangerous. So there were many cave-ins that killed our people. The *jucos* work with iron bars and carbide lamps, and when the lamps flickered out many of our men were trapped forever in these abandoned tunnels because they couldn't find their way out. It's like

burying yourself alive in the pyramids of Egypt. You can crawl on your belly and knees, making your own cave, to find some very good ore, only to fall through an old refill into a shaft below and never be seen again.

"When the MNR was overthrown in 1964," he concluded, "the new military government sent the army into the mines, and the army stopped the *juqueo* awhile. In 1965 Cesar Lora was murdered by an army captain²⁶ and in 1967 Isaac Camacho was arrested and never heard from again. But they have never been able to put an end to the *juqueo*, by both the unemployed and by the miners themselves, because it is the only good business left at Siglo XX and there is so much need."

II

When weighing the heightened population pressure on the depleted economic resources of the Siglo XX mine, one must depend largely on crude statistical and visual evidence that may be no less convincing for its rawness. Because the last two Bolivian censuses were taken in 1900 and 1950 and because vital statistics are mere scratches in the sand, one is left pretty much to one's own devices, which in this case consisted of carrying out a sample demographic survey of 183 families in Siglo XX and the town of Llallagua.²⁷

After mining operations on the mountain of Llallagua were consolidated under Patiño's ownership in the 1920s, population growth in the community was limited initially by a number of factors. Until the Depression, the company hired only single men as miners, because the high incidence of disease and death from silicosis would otherwise oblige Patiño to indemnify large numbers of families attached to the company. The mine population actually shrunk during the Depression, with employment cutbacks reinforced by the recruitment of some 1,300 miners to fight in the Chaco War, to the degree that a labor shortage existed when the price of tin began to recover from the world economic crisis. This labor scarcity forced the company to begin to hire married workers, although housing for families was in extremely short supply and some workers were still living in caves at the edge of the mining camps in the late 1930s. The intense crowding of these camps with new migrants in the 1940s hastened both political revolution and the breakdown of industrial organization.

The 1950 census showed that the mining camps and towns perched on the mountain of Llallagua formed the seventh largest urban complex in Bolivia, with a population of 30,053,²⁸ of which 18,827 lived in the camps of Patiño Mines. While the mine work force increased by 40 per cent between 1950 and 1960, there have been sharp payroll reductions since 1960 that have left the mining camp population in 1973 (20,382) only slightly larger than that reported in 1950. One of the clearer conclusions to be reached from my sample survey is that the mine has ceased to be a melting pot for migrants from other parts of Bolivia as it was earlier in the century. While the community continues to grow from immigration, the newcomers tend to come from the surrounding area and not from the distant Cochabamba Valley, where Patiño was born and which in earlier decades had been the principal supplier of manpower for the mines. This change may be explained simply by the fact that, around the time of nationalization, the company stopped sending recruiters to the Cochabamba Valley. In my 1973 survey about four-fifths of the people interviewed were born on the *altiplano*, with 43 per cent coming from the Province of Bustillos, where Siglo XX is located. Many of the miners now working for the company are the sons of miners. While the death of a miner usually means that his family must move from company housing, causing considerable turnover in the community, it is also true that many an eldest son has inherited his job, by right, from his dead father.

According to company records, the mining camps presently are inhabited by 3,695 workers and 16,687 dependents, yielding the extremely high dependency ratio of 4.5 to one.²⁹ Of the total camp population, 40.5 per cent were under 13 years old and 57 per cent were under 18. This is even a younger population than that of a very young country like Venezuela, with 52 per cent of its people under 18, and younger still than the CELADE national projection for 1970, estimating 52.8 per cent of the Bolivian population to be under 20.³⁰ The 183 women who answered my questionnaire had a median age of 38.2 years and reported a total of 1,315 pregnancies (7.19 per woman). Of these, 1,141 yielded live births, giving a crude reproduction rate of 3.0 daughters per mother, exceeded in Bolivia only by a few rural areas.³¹ Emerging from the company's statistics of age structure and total population of the mining

camps, together with fertility and mortality indicated in responses to my questionnaire, is a typically peasant demographic profile with both high birthrate (50/1,000) and death rate (20/1,000).³² Of the 1,141 live births reported in my survey, 28.5 per cent of the children born had died before this survey was taken. In other words, counting the abortions and stillbirths reported, only three of every five pregnancies produced a presently surviving child. The 21 women in the 45-49 age group, having virtually completed their childbearing years, averaged 9.5 pregnancies and 8.1 live births each, with only 5.3 of these children surviving at the time of the survey. None of these 21 women reported infertility. All but two reported that at least one of their children had died, while eight of the mothers in this age group averaged 4.5 deaths of their children after live delivery. According to Dr. Fernando Querejazu, the chief pediatrician at the company hospital in Catavi, 40 per cent of the children entering the hospital for treatment are badly undernourished, and 15 per cent of all babies born in the hospital die in their first year of life.

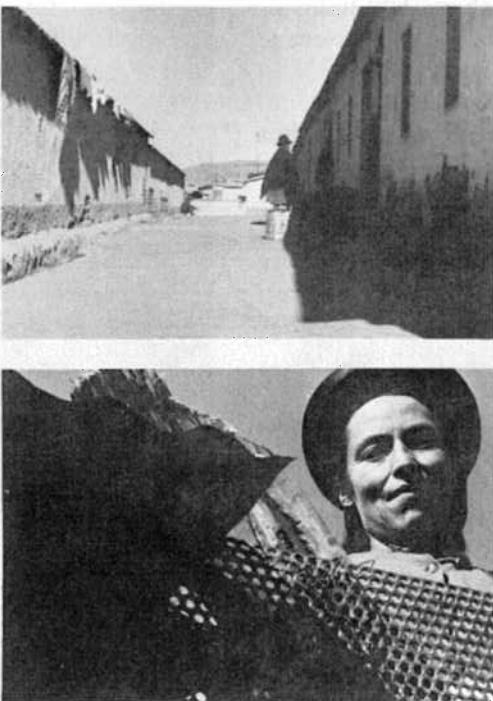
This burden of mortality suffuses the miner's life and repeats itself, like a tale told by an idiot, in the collisions and outbursts of his community. It is ingrained into the rhythm of his work and the dense phalanxes of oblong dwelling compounds in the mining camps. Inside the mine Constantino Apasa's taut, handsome Indian features are distorted at work by a plug of coca leaves in his mouth that smears his lips green and swells his jowls. In the heat of the lower recesses of the mine, his sweating face is powdered by the swarms of dust enveloping the clamor of his pneumatic drill attacking the moist upper reaches of a cavern where he will place an explosive. "The miner doesn't care much about dying," they say again and again. "We face danger daily inside the mine, and will die early of silicosis anyway. This is why we have risked death so readily in revolutions and when the army has invaded the mines."

Nearly all the workers' houses, like everything else at the mine, date from the Patiño era. The yellow cement surfacing of the exterior walls has been peeled away in most places, and the bare adobe remains. The sudden climatic changes within the daily cycle of life in this mineralized desert are as commonplace as the frequent crossings of the

A street in the mining camp (1973).



A miner's wife washing clothes (1966)



A miner's wife before her house (1966).



Chewing coca.

boundaries of human existence, as shown in the birth- and death rates. Constantino Apasa defends his house against the night wind of the *altiplano* with a sheet of discarded boilerplate propped against the door. Behind the door nine persons sleep in two beds in one room. On one of the walls is an old soccer photo of Constantino with his teammates, and a wedding picture with a finely worked silver frame stands on the only table. A bicycle and a baby carriage hang from the ceiling of the room to economize in floor space. A broken window is stuffed with a burlap ore bag. Above that window outside the house two dried fish heads hang from a wire for good luck. As in most of the miners' houses, the kitchen is outdoors on the small porch that is crowded with wash basins and brushwood brought in from the *altiplano*. At night the small herds of llamas that carry the brushwood often are parked in the streets of the mining camps, while their Indian herdsmen sleep behind the boilerplate in front of the houses. Flowers are planted in old wooden dynamite boxes, whitened by the sun, on the steps approaching Constantino Apasa's house. The sun comes and goes with a sudden intensity. On nice afternoons the miners' wives wearing bowlers of the *altiplano* or the white stovepipe hats of the Cochabamba Valley, bring large tin basins

into the sunshine to wash clothes with water hauled in old lard cans from the communal faucet.

Shortly after the carnage of the Night of San Juan, when during the drunken festival night of June 24, 1967 the army again seized the mines at the time of Che Guevara's guerrilla uprising in Bolivia, the editor of the Catholic newspaper *Presencia*, Alberto Bailey, made a tour of the principal mining districts to describe the living and working conditions. Bailey wrote that "everything has to fit in one small room: clothing, furniture, beds, utensils... and an average of from six to eight persons. All that usually fit are two normal-size beds and at times a third small one. The cold, rain and wind penetrate the roofs and walls, which are almost always covered with old newspapers to improve their appearance. There is no water in the miners' houses, not even in those considered exceptionally good. There is nothing that even resembles hygienic toilet facilities, only communal latrines built between the houses for 40 persons to squat at a time. The excuse for this that we heard in the mines [was that] these houses were built for young, single men. Now miners with large families are occupying these houses and, of course, are crowded."³³

By the mid-1960s there were about 500 miles of tunnels inside the Siglo XX mine, but the average grade of ore had declined from 9 per cent in 1924 to 2.45 per cent in 1938 to 1.11 per cent in 1952 to 0.50 per cent in 1970. While quality of tin ore has declined by half since the Revolution, the population of the Siglo XX-Llallagua mining district has roughly doubled. The most dramatic aspect of this growth has been the almost incongruous prosperity of the town of Llallagua, which in 1950 had an urban population of 6,719 that today may number between 20,000 and 30,000.³⁴ In 1956 Llallagua was separated from Uncia, the provincial capital, and formed its own municipal government. The growing town population has led to serious water shortages because of the competing needs of the municipality and the Empresa Minera Catavi. In the eight years between my first and most recent visit to Llallagua, there has been an impressive proliferation of stores, canteens, tailor shops, and lawyers' offices. Streets have been paved, sewers laid, two new banks opened, a hospital built, and an evening high school for workers created, the Colegio Nocturno 1 de Mayo, which began with the students paying the teachers' salaries. Swirls of people pour into the main street that descends through an old ravine clogged now with appliance stores and outdoor displays of shoes and brightly colored cloth and plastics. The lower mountain slopes beyond the town are being covered rapidly by new settlements of tin-roofed adobe shacks.

We seem to be seeing in postrevolutionary Bolivia what Clifford Geertz saw in postrevolutionary Indonesia: a movement "from industrialization without urbanization toward urbanization without industrialization."³⁵ There are two complementary explanations given locally for the sudden manifestations of wealth and growth in Llallagua. The first is that the return to labor-intensive forms of mining has created a new demand for peasant manpower in these primitive workings, which may have been accentuated by the halving of miners' wages in the 1965-1970 period after the army invaded the mines and crippled the *sindicatos*. The 1965-1970 period saw rapid growth of pre-industrial forms of labor at a time when miners' pay cuts imposed by the military government tended to reduce or eliminate the differential in earnings between those working inside and outside the company organization.

The second explanation given for the surge of prosperity of Llallagua is the trade in stolen ore. A



Main Street, Llallagua (1973).

Marxist labor leader, who himself has built a fine house in Llallagua from his profits as a *rescatire* (ore-buyer), told me that "both rich and poor are in the trade. The Llallagua storekeepers give the *jucos* food in exchange for stolen ore. People in town buy ore for five or six pesos that they can resell for 15 pesos these days. One wealthy family has a soda factory and five or six trucks, which are used to carry stolen ore to sell at the government Mining Bank offices in Oruro and Potosí. Everybody is involved in this. Students go into the mine at night to earn extra money. Miners on the company payroll can steal 50 pounds of ore a day. They either sell it to *rescatires* or to the men in the primitive workings outside the mine, who will turn the ore into concentrates and sell it back to the company."

A third reason for the sudden growth of Llallagua may be its expanded importance as a regional peasant market, both in the stores on the



Sunday market at Siglo XX (1973).

town's busy main street and in the open-air Sunday bazaar that is a theater of intense activity beside the *sindicato* building on the Plaza del Minero. Anthropologists report that, in many localities of the Bolivian *altiplano*, "new towns" have arisen around weekly peasant markets thanks to the new social mobility among rural people created with the abolition of Indian serfdom by the 1952 Revolution.³⁶

The *juqueo*, or ore-stealing, can be characterized as just one of the pre-industrial forms of mining that have reappeared at Siglo XX in recent years. An examination of company records in Catavi showed just how dependent COMIBOL has become on these pre-industrial forms of labor by persons outside the organization. In the first half of 1972 the mine lost \$831,407 with the price of tin averaging \$1.67 per pound and marketing and production costs totaling \$1.82. The mine payroll of 4,932 workers accounted for 36.5 per cent of the costs incurred in the official production of 2,473 tons of tin-in-concentrates.³⁷ Nearly two-fifths of this "production," however, came from sources outside

the company. Its records show that the company had paid \$262,000 for ore and concentrates worth \$812,000. After the Bolivian peso was devalued by 60 per cent in late 1972, greatly reducing COMIBOL's labor costs as tin prices climbed rapidly, the company's profit margin on purchased ore was even greater, fully 400 per cent.

The men and women producing tin from these primitive workings bitterly complain that they are being systematically cheated by company assayers on the weight and tin content of the ore and concentrates delivered, enabling the company to make huge profits on purchased minerals and so reduce its inflated overhead burden. During my 1973 visit to the mine, the cooperatives of *locatarios*—working abandoned mineshafts high on the mountain—were on "strike," refusing to deliver their concentrates to the company until management agreed to return small ore samples with the assayer's report. In a sense, the great mine now seems to be subsidized by cheap Indian labor in much the way that the colonial *mita* drafts of Indians subsidized the *cerro rico* of Potosí after the seventeenth century.



Alluvial diggings (*veneros*) in the riverbed.

"Without this source of cheap labor the *cerro rico*, with all its rich ores long since exhausted, could not have continued to work minerals," D.A. Brading and Harry E. Cross wrote recently in the *Hispanic American Historical Review*. "At Potosí the *mita* both created the first rapid boom and then subsidized continued production."³⁸

Some of the primitive workings at Siglo XX seem almost a revival of ancient mining technology, though there appears to be a tendency to settle at the state of the art that existed around the time gunpowder was introduced into Central European and Spanish colonial silver mining in the seventeenth century. Indeed, some of the mine machinery appearing in German woodcuts of the period are more advanced than much of the apparatus doing the same job at Siglo XX today. The tendency to form cooperatives in the reversion to pre-industrial forms of mining in Bolivia, including COMIBOL's converting its more unprofitable mines into cooperative enterprises to reduce overhead, again resembles an early period in German

mining, when "the lords found it to their interests to turn over the mines to the workmen, with the result that there arose everywhere little autonomous associations of co-laborers, each with a mine of its own, which paid tribute to the lord and divided profits among the members."³⁹

Apart from the *jucos*, there are four kinds of primitive mining now going on at Siglo XX:

(1). *Veneros*: There are about 2,000 men, including peons, who produce about 75 tons monthly of tin-in-concentrates from low-grade alluvial deposits in the streams descending the mountain of Llallagua and in the floodplain of Uncía immediately below. These workings are just as in the ancient mines of Cornwall, where "the stream works were all of limited depth, it being merely a question of digging down to the bedrock through the substratum, a distance that would vary locally but which could not very well be greater than 50 or 60 feet."⁴⁰



Lameros (1973).

On my last visit to Siglo XX I went down into one of these small alluvial mines, which resembled in design the Stone Age flint mines discovered at Grimes Graves in England, with the difference that the vertical shaft, or *cuadro*, descended 34 meters, while the neolithic workings had a maximum depth of ten meters.⁴¹ The *venerista*, or alluvial concessionaire, in this small mine was Apolinar Alvarez Lopez, 41, a native of nearby Chayanta who retired from his job in the interior mine with handsome severance pay under the Plan Triangular. One descends into his *cuadro* by a hand-operated winch cable, which is also used to lower tools and life ore from more than 400 meters of horizontal galleries extending in three directions from the bottom of the *cuadro*. It took Alvarez and six peons two years to excavate these diggings. "We have to find the mineralized layers ourselves. One of our galleries, 190 meters long, is closed now because of a cave-in. Another 100-meter tunnel ended up in the river-



The budle (*lameros*) 1973.

bed. There are many false starts. The company cheats us in the weight and grade of our production, then discounts school tuition for our kids, royalties, truck rental for moving our ore, and a special fee for technical assistance. The engineers who are supposed to give us technical advice come around once in a while, but have never gone inside the mine. All they do is ask me for more production."

(2). *Lameros*: Along the little canal beside the railroad track on which ore is carried from the "Sink-and-Float" preconcentrating plant to the mill, there is a succession of tiny dams and a long line of men waiting their turn to trap the waste that flows in the canal from the noisy machinery that fitfully and inefficiently processes the ore from the mine. The low tin content of ore now coming from the mine is further diminished by inefficient recovery in the concentrating process. Thus one-third of the tin produced by the mine is lost in the waste that pours from the "Sink-and-Float" plant, and gives the *lameros* their livelihood.

There are about 400 *lameros* who, with their peons and families, work the canal at 215 assigned places beside the track. The slime flowing from the plant is picked up on alternate days to allow a sufficient quantity to accumulate at the dams. Because there are so many *lameros* who want to recover the slime bearing 0.20 per cent tin as close as possible to the plant, a system has been devised for taking turns among groups of ten *lameros* so that each will work closer to the plant each month and occupy a place at the head of the line every two or three years.

About one wheelbarrow-load of slime is carried from the canal daily to a gravitational concentrating bath called a buddle, which has been used in England at least since the days of Henry VIII.⁴² The buddle is a cylindrical pool into which water is poured with the tin slime, creating a solution in which the mineral sinks to the center of the pool and the waste material floats to the edges. This laborious process is repeated about 20 times until the grayish material in the center of the buddle turns black. At the end of a good month the *lamero* will produce from six to eight 100-pound bags of concentrates containing 20 per cent tin, receiving for this about \$100 to be shared with his family and his peons.

(3) *Palliris*: In the early 1960s the management in Catavi found that large sections of the mountainous gray-green dumps behind the "Sink-and-Float" plant contained a higher grade of tin than the ore being extracted from the mine. After the MNR was overthrown in November 1964, the widows and orphans of dead miners were given work on the dumps as *palliris*, selecting pieces of high-grade rock from the waste pile and lugging them in 40-pound bags to a mechanical crusher several hundred yards away. Previously, hand-selecting of choice ore, or *guia*, by the *palliris* had been eliminated by the company with the completion of the "Sink-and-Float" plant in 1949. In the 1960s the Catavi management said the *palliris* were being used again as a form of charity to the women. Although the company said the women were their own bosses, it employed an engineer and two foremen to supervise their work. The women were not paid for transporting the bags of ore to the crusher, which sometimes resulted in spinal injuries and internal hemorrhages. They were paid five cents per bag delivered, but were not allowed to produce more than eight bags per day.



Women (*palliris*) on the rock pile (1966).

The leader of the women who work among the knolls and dunes of waste rock is Margarita, a gray-haired Indian woman who wears the white stovepipe hat of the Cochabamba Valley. "On November 11, 1964, a week after the MNR was overthrown, the company broadcast a call on the radio to widows and orphans who wanted work. There were more than 600 of us who showed up. We were promised jobs on the company payroll as vacancies occurred, but none of these jobs ever opened up. Both our numbers and our pay have declined as the tin content of the dumps diminished from 2.20 to 0.78 per cent." Soon this work will be eliminated entirely, since the high grade material is nearly exhausted.

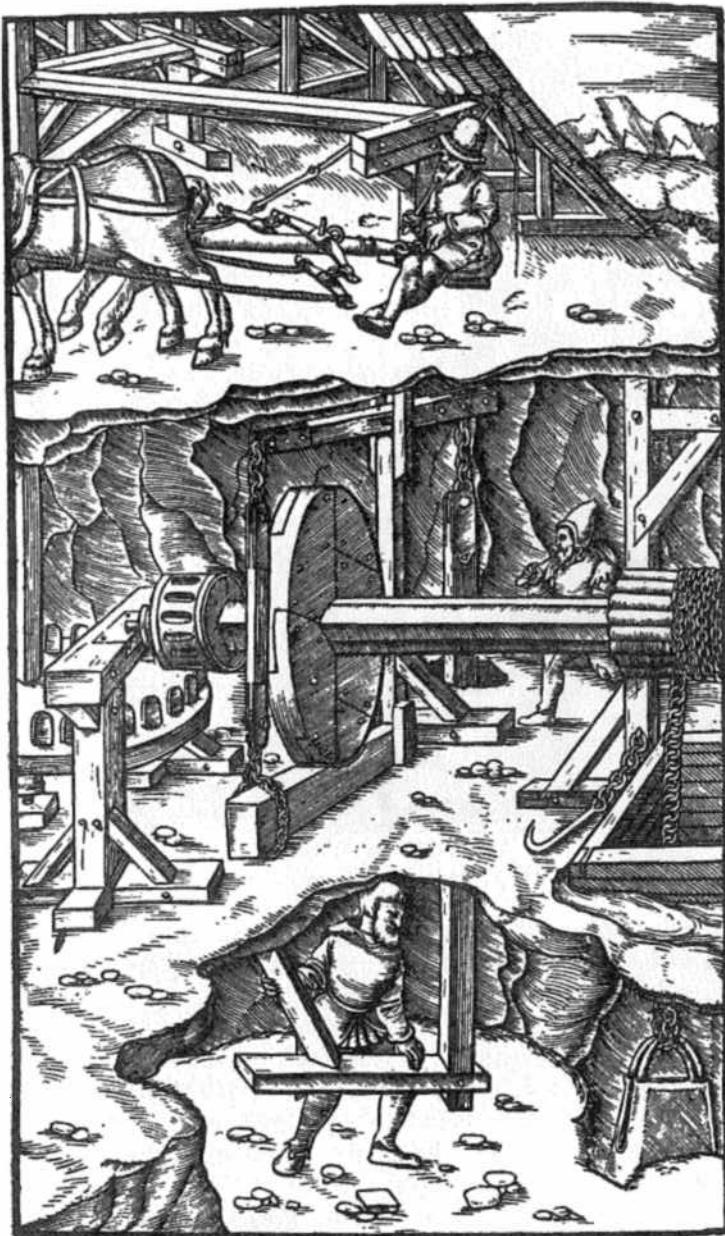
(4) *Locatarios*: These are the roughly 2,000 men who work the abandoned mineshafts at the top of the mountain that date from the beginning of the century. These originally lucrative locations were



Locatario going to work.

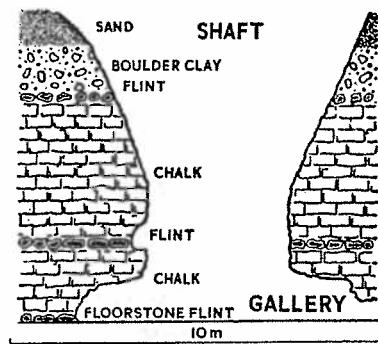


Locatarios

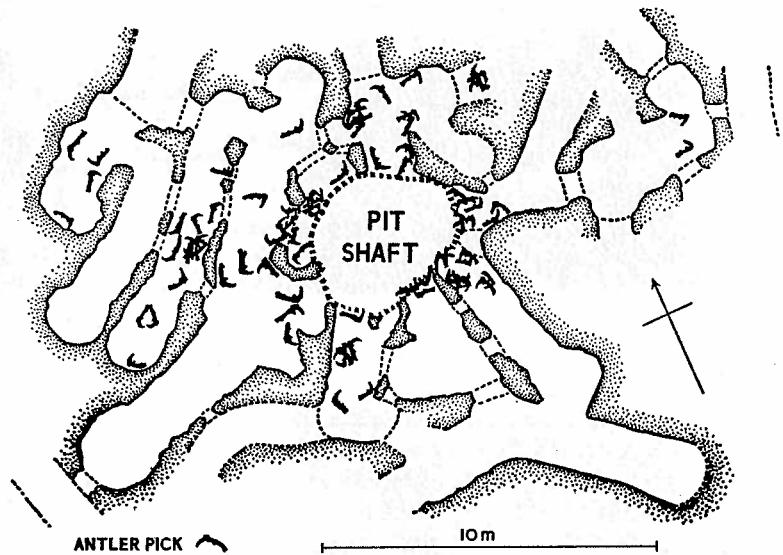


Horse-whim for raising large loads. The man below operates a brake consisting of a beam that can be lifted to bear on a drum fixed to the driving shaft. The load may be held stationary by catching the chain on a suspended hook. 1556. (Charles Singer, et al. A History of Technology, Vol. II, p. 18).

Some of the mine machinery appearing in German woodcuts of the seventeenth century are more advanced than much of the apparatus doing the same job at Siglo XX today.



Section through pit no. 1, Grimes Graves flint mines, East Anglia. (Charles Singer, et al., A History of Technology, Vol. I, p. 559).



Galleries radiating from pit no. 2, Grimes Graves. The floor of the shaft is about 9 m. below ground-level. (Charles Singer, et al., A History of Technology, Vol. I, p. 559).

given out in 1967 to political insiders and friends of the company manager, who were then ousted in a revolt of their peons in October 1969 when a leftist military regime seized power in La Paz. The peons then formed cooperatives to work the locations themselves.

Were it not for their high productivity (97 tons of tin-in-concentrates delivered monthly to the company), the *locatarios* might be described as a composite of the excess population of this swollen community: former company workers, peasants, unemployed army veterans, students and miners' sons. Save for the very rare use of pneumatic drills bought by individual teams of *locatarios*, this work resembles the technology employed in mine extraction in colonial times.

The *locatarios* work in teams of two to eight men, depending on the size of the shaft and the width of the vein, working *a pulso* (by hand) with an iron bar to the light of a carbide lamp, advancing the work-front of the tunnel between 10 and 15 inches daily. They buy timber, helmets, boots, and explosives from the company, which also rents them trucks to transport ore to their concentrating area farther down the mountain.

I have been down to these workings several times. In the warmer parts of the mine the men work in their underwear, or sometimes naked, taking turns at the workface when they have to dig in pockets of gas. They carry away the ore and waste material on their backs along the narrow tunnels to primitive lifts, where it is raised in buckets to the extraction level. They can spend months digging fruitlessly trying to find a new vein, at their own cost and risk. They say much of their luck depends on the *Tio*, an idol that is a semblance of the Devil. *Tio* figures are kept in

several mineshafts in the mountain of Llallagua, and are worshiped with coca leaves and cigarettes, receiving on special occasions a sacrifice of a baby llama. "The *Tio* is everywhere," one *locatario* told me. "We had a *Tio* of our own, but the idol was stolen. The *Tio* has eaten four men here: two have died from gas-poisoning and two in cave-ins."⁴³

The *locatarios* bring their extracted ore further down the mountainside to a riverbed beside one of the mining camps, where it is crushed and concentrated by primitive methods used by Patiño when he was processing ore by hand at the beginning of the century. There is the *quimbalate*, which crushes the ore beneath heavy rocks, and the *maricate*, a kind of straining box with metal screening at the bottom that filters the ore as it is washed. Each afternoon the *locatarios* bring their ore to this "*ingenio*," or mill, and around the twentieth of each month the entire work force is engaged in concentrating the ore for delivery to the company. The quality of this ore, here as elsewhere at Siglo XX, however, is declining and the men feel that the old mineshafts will soon be empty.

In this way the Bolivian tin industry seems to be returning to its earliest beginnings. This probably could have been avoided with adequate geological exploration and investment in development of new methods of recovering low-grade ore. Since the Great Depression, however, these possibilities have been blocked by political and population pressures on the resources already developed, even though much of this wealth already had been transferred out of the country before 1952. Consequently, the exhaustion of ore reserves and the decline of industrial organization has forced COMIBOL to turn several of the nationalized mines into cooperatives worked entirely by pre-industrial technology.

NOTES

1. United Nations Economic Commission for Latin America (ECLA), *El Desarrollo Económico de Bolivia* (Mexico: 1958), pp. 44-45.
2. W. Robertson, *Report on the World Tin Position with Projections for 1965-70* (London: International Tin Council, 1965), p. 10.
3. *Ibid.*, p. 115.
4. From Joseph Grunwald and Philip Musgrove, *Natural Resources in Latin American Development* (Johns Hopkins, 1970), p. 232.
5. From Kenneth Warren, *Mineral Resources* (Penguin, 1973), p. 156.
6. George Jackson Eder, *Inflation and Development in Latin America: A Case History of Inflation and Stabilization in Bolivia* (Ann Arbor: Michigan International Business Studies No. 8, 1968), p. 49.
7. Mario Torres Calleja, *A Dos Años de la Nacionalización de las Minas* (La Paz: 1955), p. 34.
8. Eder, *op. cit.*, p. 54.
9. Price Waterhouse Peat & Co., *Corporación Minera de Bolivia: Informe sobre el Estudio Contable de las Operaciones entre la Empresa y el Supremo Gobierno al 31 Diciembre de 1963* (mimeographed).
10. Interviews with Goosen Broesma, former general manager of COMIBOL, and other COMIBOL officials in the MNR period.
11. See my "Go east, young man," *The Economist*, November 13, 1965: "Since 1956, the U.S. has ploughed some \$80 million into the Santa Cruz area. This has gone on such things as roads, land clearance, sugar mills, schools and providing the new farms with livestock, machinery and experimental stations. Some of the money has been stolen, much of it wasted or misused. But the overall result has been to give a desolate area some kind of economic foundation. Oil and natural gas were discovered in the area after Gulf Oil obtained a concession in 1956. Rice and sugar production doubled between 1960 and 1964, converting Bolivia from an importer of these products to an anxious searcher for export markets." Since this article was written, the Santa Cruz area has continued to grow so rapidly that secessionist tendencies have developed that would bring the Bolivian Oriente and its prized natural resources into the orbit of Brazil and Argentina.
12. Eder, *op. cit.*, p. 132-3.
13. Richard S. Thorn, "The Economic Transformation," in Thorn and James M. Malloy, ed., *Beyond the Revolution: Bolivia since 1952* (University of Pittsburgh Press, 1971), p. 390; and United Nations, "La Política Económica de Bolivia en el Período 1952-64," *Boletín Económico de América Latina*, Vol. XII, No. 2 (1967), pp. 197-203. See also Richard W. Patch, "Bolivia: U.S. Assistance in a Revolutionary Setting," in Council on Foreign Relations, *Social Change in Latin America Today* (Random House, 1960).
14. Eder, *op. cit.*, p. 89.
15. The following are excerpts from Ford, Bacon & Davis, *The Mining Industry of Bolivia*, Vol. 3, *The Nationalized Mines* (La Paz, December 1956), mimeographed.
16. According to FBD, the *Control Obrero* "has the right of veto over all of management's actions, except—in theory—in technical matters. In practice...he interferes also in technical matters. In case management were to object to the exercise of a particular veto of a *Control Obrero* the matter is referred to the Corporation and the FSTMB. If these two cannot agree, the Minister of Mines is supposed to decide. Based on the actual records in most cases decisions have been in favor of the *Control Obrero*, as the Minister of Mines has always been a leading member of the union." *Ibid.*, p. 74.
17. In his letter of resignation as *Control Obrero* at COMIBOL headquarters in La Paz, Sinforo Cabrera shrewdly observed in 1960 that "the technical and administrative personnel in the new revolutionary period have not freed themselves of their bourgeois prejudices and continued ties to their mistaken superiority complex. For this reason they have resisted the *Control Obrero* from the beginning, underestimating his value in the corporation management and trying systematically to prevent him from understanding the grave problems of the industry. A grave error, because the *Control Obrero*, feeling himself isolated from participating in management policymaking, and needing to justify the existence of his job and to maintain his prestige, has been obliged to become just another union leader and a competitor of the Secretary-General. From Cabrera, *La Burocracia Estrangula a la COMIBOL* (La Paz, 1960), p. 121.

18. *Ibid.*, pp. 45-6.
19. *Ibid.*, pp. 44-6.
20. Quoted in Herbert M. Weisz, "Evolution of Block Caving at Catavi," *Engineering and Mining Journal (EMJ)*, Vol. 159, No. 9, September 1958, pp. 86-7.
21. Thorn, *op. cit.*, p. 187.
22. A superb account of this process is given in Patch, *The Last of Bolivia's MNR?* [RWP-4-'64], Fieldstaff Reports, West Coast South America Series, Vol. XI, No. 5, 1964.
23. According to company records examined in Catavi this year, it took 209 *mitas* (man-days) in 1952 to produce a ton of tin-in-concentrates, then rising to an average of 355 *mitas* per ton in the 1954-1958 period and then skyrocketing to 690 *mitas* per ton in 1961, an all-time productivity low.
24. From Guillermo Bedregal, *Recuperación de la Minería Nacionalizada* (La Paz: COMIBOL, 1961), p. 24.
25. According to Thorn (*op. cit.*, p. 195), "the disbursements proceeded more slowly than planned, and the initial effect of Operation Triangular was only to slow down the rise in costs. The plan was saved from disaster only by the precipitous rise in the price of tin from \$1.17, the plan price, to \$1.70 a pound, which actually permitted some reduction in the operating losses. By far the most important result of Operation Triangular was to stop COMIBOL from absorbing all the available financial resources of the government. Public finances were regularized to an unprecedented extent, both salaries and merchants were paid on time, and COMIBOL's large floating debt was greatly reduced." The collaboration between Bolivian officials and foreign experts was punctuated by mutual recriminations. American officials privately complained to me that USAID money was being used by COMIBOL to pay accumulated social benefits to fired surplus miners, who were then rehired. COMIBOL executives complained that a Canadian consultant to the Inter-American Development Bank, C.C. Huston, was sent to Bolivia to organize the Plan Triangular. He appointed his friends to the Advisory Group that ran the plan and who then gave Huston's company, Prospection Ltd., contracts for a large portion of the \$6 million budgeted for geological and metallurgical research.
26. See Alberto Sainz, *Así Asesinaron a César Lora* (Ediciones "Masas," 1966).
27. Because of the suspicions generated by the army invasions and political repression of recent years at Siglo XX, this survey could not have been carried out without the help of the Oblate Fathers who attend the parishes of the mining community, as well as of the schoolteachers, social workers, and leaders of the League of Miners Wives who conducted the interviews. A simple questionnaire was designed that would be easy to administer and would provide an elementary statistical picture in view of the almost total absence of hard demographic data on communities of this type. Needless to say, the theme deserves much more extensive research.
28. The six more populous cities in 1950 were La Paz (267,000), Cochabamba (72,000), Oruro (58,000), Potosí (43,000), Santa Cruz (41,000), and Sucre (38,000). Since then, according to urban censuses taken in these cities in 1966-1972 period, the population of Santa Cruz has tripled and those of La Paz and Cochabamba have more than doubled, while Sucre, Potosí, and Oruro registered much more modest increases. See Llano Saavedra, *Aspectos Demográficos de Bolivia*, (CENAFA, 1972), p. 42. For an account of how one of these urban censuses are taken, see Richard W. Patch, *The La Paz Census of 1970* [RWP-4-'70], Fieldstaff Reports, West Coast South America Series, Vol. XVII, No. 12, 1970.
29. The highest national dependency ratio in Latin America is 2.5-to-one for the Dominican Republic. It is in the workers' overriding interest to fully report all dependents to maximize eligibility for *pulperia* and company medical benefits. Company records would not necessarily show the departure of dependents from the community, nor the presence of non-nuclear relatives living in the miners' homes. The "dependent" category may also include some miners' sons and daughters working in the private sector in the town of Llallagua. However, in a subsample of 85 Siglo XX women included in my survey, only six said they were working outside their homes.
30. See Jorge Somoza and Luis Llano, *Proyección de la Población de Bolivia* (Santiago, Chile: CELADE [Centro Latinoamericano de Demografía], 1963), p. 26. I am very grateful to Dr. Julio Paez Celis, statistical director of the Venezuelan Census Bureau, for his help in tabulating demographic data from company records and my questionnaire-survey.
31. According to Llano (*op. cit.*, p. 29), the highest crude reproduction rate recorded in Bolivia is in the *altiplano* outside La Paz (3.08). The highest fertility rate reported by Llano is 6.88 live births per woman in the 45-49 age group in the rural area of Santa Cruz Department, compared with 6.1 live births per woman in my Siglo XX-Llallagua sample.

32. Dr. Paez Celis tells me he tabulated the birth- and death rates for the mining camps by using standard tables provided by CELADE, following the Theory of Standard Populations (Lotka's Law).
33. Bailey's articles, published under the penname "Xavier," appeared in *Presencia*, La Paz, on September 7, 10, 14, 17, 21, 24 and October 1 and 5, 1967. Another description of these conditions is in Jack Brown, Rafael Baldvieso, and Manuel Sanginés Uriarte, *Informe Cornell: El Minero Boliviano de Colquiri* (La Paz: Universidad de San Andrés, 1968). Since these accounts were written, COMIBOL has tried to alleviate these conditions by painting the miners' houses and converting the porches into enclosed kitchen-dining rooms, but the above description still fits most of mining camps.
34. A national census has been scheduled in Bolivia for 1974.
35. Clifford Geertz, *Agricultural Involution: The Processes of Ecological Change in Indonesia* (California, 1963), p. 146.
36. See, for example, David A. Preston, "New Towns—A Major Change in the Rural Settlement Pattern in Highland Bolivia," in *Journal of Latin American Studies*, Vol. 2, No. 1 (Cambridge, England: 1970). Also Hans C. Buechler, "The Reorganization of Counties in the Bolivian Highlands: An Analysis of Rural-Urban Networks and Hierarchies," in Elizabeth M. Eddy, ed., *Urban Anthropology: Research Perspectives and Strategies* (Athens, Georgia: Southern Anthropological Society Proceedings, No. 2, 1968), pp. 48-56.
37. That is, the tin content of exported concentrates, which currently contain about 50 per cent tin. In other words, the total weight of concentrates containing 2,473 tons of tin would be 4,946 tons.
38. D.A. Brading and Harry E. Cross, "Colonial Silver Mining: Mexico and Peru," *Hispanic-American Historical Review*, November 1972, p. 560.
39. George Randall Lewis, *The Stannaries: A Study of the English Tin Miner* (Harvard, 1924), p. 177.
40. *Ibid.*, p. 9.
41. C.N. Bromehead, "Mining and Quarrying," in Charles Singer et al., ed., *A History of Technology*, Vol. I: *From Early Times to Fall of Ancient Empires*, Oxford, 1954, p. 559.
42. Lewis, *op. cit.*, p. 15n.
43. A marvelous description of the miners' cult of the Tío is given in June Nash, "Devils, Witches and Sudden Death," *Natural History*, March 1972. Nash writes that the Tío is an embodiment of Huari, "the powerful ogre who owns the treasure of the hills" and who "persuaded the simple farmers of the Uru Uru tribe to leave their work in the fields and enter the caves to find the riches he had in store."