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SOME PRACTICAL ASPECTS
OF MINERAL INDUSTRIES EDUCATION
IN THE LATIN AMERICAS

By

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Some Practical Aspects of Mineral Industries Education in the Latin Americas

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TWO years ago the Committee on Latin American Education Relations, Mineral Industries Education Division, started a study of mineral industries education in the Latin Americas. Information was obtainable only with great difficulty. Some information was available piecemeal but no complete résumé had ever been assembled. Initial assistance was gained from the United States Office of Education and the Pan American Union. This, and first-hand knowledge of the writer, provided a list of colleges and universities which were believed to offer work leading to a degree in one or more branches of the mineral industries. Detailed information could be obtained only by direct contact with each university through air mail service. Questionnaire letters were sent to officials of 34 colleges and universities. Twenty-one gracious replies were received.

Fourteen of the colleges and universities concerned offered curricula in mining, five in metallurgy, three in petroleum, seven in geology, one in geophysical engineering, one in topographical engineering, and one in geophysics. Two institutions offer advanced training in petroleum engineering. No institution offers any courses under the caption of ceramics or fuel technology.

The training offered is of three general levels: (1) graduate training (in two instances); (2) degrees corresponding to our Bachelor's degree; and (3) training as "technicians" or "mechanics" who act as assistants to graduate mining, metallurgical, and chemical engineers. In most instances the undergraduate degree is offered after the completion of five or six years of study. As a whole, the curricula are strong on theoretical and classical subjects but short on practical and the application of the sciences to industrial problems. Many institutions require the study of English as a part of the required curriculum. Many offer degrees in civil engineering and these curricula usually include courses in geology, mineralogy, or petrography.

Chile offers a unique program in mineral industries education. Three schools, at Antofagasta, Copiapó, and La Serena, offer six-year courses leading to a degree of "mining technologist." Entrance requirements are lower than at the University of Chile. The mining technologists are trained to act as assistants to mining engineers. In addition, four-year courses are given which lead to a certificate in mining or metallurgical mechanical. These young men are trained in the maintenance, repair, and construction of mining and metallurgical equipment.

Specialists in the field of metallurgy in the United States recently gave three-months' courses in "Metallurgy and Siderurgy" at the Polytechnical School, University of São Paulo, Brazil. The courses were open to qualified engineers, students, and industrial technicians, and were received with great favor.

Complete information concerning higher education in Argentina has been published recently by the Division of Intelectual Co-operation, Pan American Union. This is volume I of a series planned to cover higher education in the Americas.

Pertinent information on college and university work in the field of the mineral industries has been put together in the form of a large chart. Since this chart cannot conveniently be reproduced for inclusion in this report, a résumé is presented here.

Argentina

University of La Plata, La Plata. No degrees in field of mineral industries in the university proper, but the Institute of the Museum offers a four-year course leading to a Doctorate in Natural Sciences, with specialization in geological sciences.

University of Buenos Aires, Buenos Aires. Offers work leading to a degree of Doctorate in Natural Sciences, specializing in geology (five years). The University also contains the Petroleum Institute, which is a graduate school offering advanced work in geophysics, development of petroleum resources, and petroleum industrialization.

University of Tucumán, Tucumán. No degrees in field of mineral industries. The Institute of Mineralogy and Geology is a division of the University, but appears to be a research institution.

University of Cuyo, San Juan. Offers a six-year curriculum leading to degree of Mining Engineer. The University also has the petroleum institute, a graduate school, which offers work leading to the degree of Engineer (Specialist in Petroleum).

University of Córdoba, Córdoba. Offers a three-year course of study leading to a degree of Doctorate in Natural Sciences, with specialization in geology and mineralogy.

Bolivia

Independent University of Tomas Frias, Potosí. Offers a six-year curriculum in mining engineering and a six-year curriculum in chemical and metallurgical engineering. Both lead to the degree of Engineer in the appropriate specialization. Technical University of Oruro, Oruro. Offers a six-year curriculum in mining and in petroleum engineering, leading to degree of Engineer in the appropriate specialization.

Independent University of San Augustín, Oruro. Offers a six-year curriculum in mining and in petroleum engineering.

Brazil

National School of Mines and Metallurgy of the University of Brazil, Ouro Preto, State of Minas Gerais. Offers six-year curriculum leading to degrees of Mining Engineer, Geographical Engineer. Polytechnical School, University of São Paulo, São Paulo. Offers six-year curriculum leading to degrees in mining engineering and metallurgical engineering.

Chile

University of Chile, Santiago. Offers a six-year curriculum leading to the degree of Mining Engineer.

Colombia

National School of Mines, Medellín. Branch of National University of Colomb-
Bia, Bogotá. Six-year curriculum in mining engineering with options in metallurgy and petroleum.

Cuba
University of Havana, Havana. Offers no degree in field of mineral industries. The director stated that a committee has been formed to study the need for a curriculum in mining engineering.

Ecuador
University of Cuenca, Cuenca. Offers a five-year curriculum leading to the degree of Mining Engineer. (Closed in 1943.)

Honduras
Central University of Honduras, Tegucigalpa. Offers a program of three years of study in mining leading to a diploma of Mining Expert.

Mexico
National University of Mexico, Mexico City. Offers a curriculum in mining, in metallurgical, and in petroleum engineering, each of five years duration and leading to the appropriate degree. Four-year curricula in geology and geophysics offered, as well as a two-year course in topographical engineering.

National Polytechnical Institute, San Tomas. Offers four-year curricula in mining engineering, mining geology, and metallurgical engineering leading to the appropriate degrees.

University of Guadalajara, Polytechnical Institute, Guadalajara. Offers a three-year course in metallurgical chemistry.

Peru
National School of Engineering, Lima. Offers a six-year course in mining engineering leading to degree of Mining Engineer.

Universidad Nacional Mayor de San Marcos, Lima, oldest university in the Western Hemisphere. Offers a four-year course in geological sciences leading to a degree of Doctor of Geological Sciences.

Venezuela
Central University of Venezuela, School of Geology, Caracas. Four-year course in geology leading to degree of Geologist. Curriculum in mining planned.

No specific courses in mineral industries are given in Guatemala, El Salvador, Nicaragua, Costa Rica, Panama, San Domingo, Haiti, Paraguay, or Uruguay.

Lists of 37 publications dealing with the mineral industries and 36 mining institutes and engineering societies were compiled. In most cases, publications are the official organ of schools, societies, or government bureaus. Information was secured also on organization, operation and function of departments of mines, of geology, of petroleum, and of mineral production in most of the mineral-producing countries.

A recent trip through the Latin America was sponsored by the Inter-American Development Commission. Educators, government officials, and businessmen extended every possible courtesy to me, and were eager to discuss educational and related problems. I was invited to give public lectures at engineers' clubs in Rio de Janeiro and Santiago, and at the University of Buenos Aires, Universidad Nacional Mayor de San Marcos, and the National School of Mines of Colombia.

Some of the other Americas are no longer satisfied to export natural resources. They are industry-conscious and want to share in the increment of value added by manufacture. They must plan new industries on a basis of sound economic principles rather than on expedient political considerations. They understand that home or foreign markets must justify new industries; that industries are dependent on man power; and that technical education has a vital part in man-power problems. They see the miracle performed by our industries during the war, and look with favor upon our system of technical education.

A committee of mineral engineers and technologists has been commissioned to recommend a progressive program of mineral industries education for the National University, Mexico City, including new laboratory facilities. The School of Geology, Central University of Venezuela, has been authorized to introduce curricula in mining and petroleum, and construct a new laboratory building in the vicinity of the geology building. Federal authorities in Brazil are interested in expanding the program of the National School of Mines, Ouro Preto, or in establishing a comprehensive school of mineral industries, Rio de Janeiro, to work hand in hand with the Department of Mines and of Mineral Production. The plans include a new modern building.

A new modern building is now under construction at the University of the Republic of Uruguay, Montevideo, which will include laboratory facilities for instruction in geology, mineralogy, and mining. The College of Exact Sciences, University of Buenos Aires, is planning to expand its program in mineral industries, including a modern laboratory building to work hand in hand with the Federal Department of Mines and Minerals. There was some discussion of the need of a course in coal mine engineering at the University of Concepcion. A new building has been started at the University of San Andres, La Paz, to include work in mineral industries but construction is at a standstill for lack of materials.

A new mineral industries building is under construction outside of Lima. The program of study will embrace the major branches of the mineral industries. The object of locating the school outside of Lima is to keep the students at their work throughout the day. The Central University of Ecuador, Quito, gives instruction in geology and mineralogy, and would like to expand. A first-rate new building has just been completed for the National School of Mines, Medellín, Colombia. The program is being expanded to include the entire field of mineral industries, including meteorology.

The Latin Americans require three functions of service: resident instruction, extension instruction, and research. The introduction of these new educational methods is a slow process requiring a generation.

Urgent need exists for properly qualified young mineral engineers and mineral technologists (future leaders) in several South American countries. No single man can be trained to meet all eventualities; it requires teamwork by specialists to solve the problems of modern industry. Immediate needs can best be met by sending groups of carefully selected students to mineral industries schools in the United States.
Preference always should be given to graduate students.

The principal job ahead of mineral industries educators in the other Americas for the next fifteen years is to serve industry in the education and training of supervisors and skilled workers. Blast-furnace men, steelworkers, overhead crane operators, and the like are needed to turn the wheels at Volta Redonda. Although there are a number of first-rate trade schools in Brazil and Chile, they do not meet the needs.

Although keen interest was shown in my discussion of in-service, up-grading, mineral industries extension instruction in the other Americas, it is difficult to convince responsible authorities that extension training is desirable. Personnel are extremely hidebound, unreceptive to new ideas, and suspicious of the practical application of anything "out of a book."

Handicapped by a high percentage of illiteracy in some countries, even among groups with native intelligence, and by poorly trained labor and supervisors, the industry is low in efficiency and lacking in safety consciousness. With the shortage of trained mining engineers, the role of practical mine bosses becomes doubly important; yet underground bosses are either nonexistent or incompetent.

Naturally, trained graduate mineral engineers and technologists are needed for the future. Meanwhile, however, immediate extension instruction of operative personnel would pay quick dividends of inestimable value. Intelligent young men are interested in operating jobs; but unless they are trained they will grow into the industry under existing conditions and perpetuate present inefficient, unsafe operating practices. Extension instruction is the only way to reach them.

Difficulties include the lack of teachers and men with extension experience in organizing classes, the dearth of suitable training literature in Portuguese and Spanish speaking countries, the danger of purely theoretical rather than practical teaching, and obstacles in demonstrating the proper application of principles taught. Miners will give little credence to what teachers from the company staff may say, for example, if the teachers themselves practice the methods they talk against!

Suggestions for overcoming these difficulties are: Organize extension work on a small scale at first, with one or two classes for trial purposes. Arrange for plant demonstrations with the model operated according to sound practice. Concentrate on training younger men, but include a sprinkling of "old-timers" who can do much to convince the youth to accept the practices taught. Choose teachers carefully for practical knowledge and warn them never to talk "over the heads" of the men. Keep courses as short and simple as possible.

The author is one of the best-known educators in the mining field in the United States. Born in Pennsylvania in 1887, he received his engineering training in the school of which he is now the head, which granted him both a B.S. and an E.M. degree. He worked for private mining companies and for the Bureau of Mines before taking up teaching at Carnegie Tech. immediately following the first World War, in which he was wounded twice. After ten years there he came to Penn. State. He is known for his many progressive ideas, and is especially interested in furthering the solidarity of the Americas.

Training of technicians can be accelerated by sending United States technicians to South American countries to act as key men in the industries and to train native technicians. At the same time prospective technicians can be trained in United States industries. These methods are being used at the moment by several countries. Technicians can lead extension classes.

Overcoming the difficulties involved in giving immediate aid in the industrialization programs of the South American countries, especially Brazil, will require close co-operation between the United States and the country aided. While our technicians are sent to the other Americas to train men locally, for example, South Americans should be sent to the United States for specialized training. A three to six months' special course in orientation and language should be given both to our representatives and to South American exchange professors, students, and trade technicians accepted by the United States.

With a trained, bilingual American technician in each key operation of a South American industrial project, results will be best if he has signed, agreed authority and a trained, bilingual native technician to follow his instructions. Since English-language school problems are insurmountable in most localities, married men without children, or with children of non-school age, should be chosen as United States technicians. Unmarried men should go to such jobs in groups for companionship, but should mingle with the nationals. In either case, a two-year contract should be the minimum, and a bonus in extra pay or vacation with pay should be given to those who work out their contract time.

South Americans eager to learn by doing should be chosen for training here. Unfortunately, South American countries seldom make use of their foreign-trained people unless they are politically entrenched. To prevent waste of such training, I would suggest co-operating only with foundations, institutes, ministries, or departments who have the funds and authority to guar-
the entire cost to the American organization.

There is a tendency to rush advanced instruction and research. A classical approach to research is natural on the part of educators in the other Americas, but this would be starting at the top rather than the bottom, and will not solve the human equation. From another angle there is advanced technical literature in all fields of mineral industries, including metallurgy, to keep educators in the other Americas busy for the next 25 years. These views do not rule out applied research and testing required in scientific control of operations.

Our interest in mineral industries education in the other Americas goes further than education itself. Graduates favor equipment used in the laboratories, irrespective of manufacturer. Whether the graduate knows it or not, it is surprising how long this holds true. Manufacturers know this and should be interested in having mineral industries schools in the Latin Americas equipped with equipment made in the United States.

The mineral industries schools in the other Americas must raise salaries in order that the majority of the faculty can give full time to school duties. At the moment, practically all members of the faculties, including the dean, hold positions with private companies, or do consulting work and give far too little of their time to teaching, student counseling and research. Professional engineers holding part-time teaching jobs restrict teaching to diffusion of knowledge. Some retain their positions at the university merely for prestige.

Consulting work in Chile is restricted to persons holding professional degrees in Chile. A University Club open to degree men has been organized in Santiago.

Two women teach mineral industries subjects in South America: one paleontology at the School of Geology, University of Venezuela; the other petrography, in the Division of Geology, University of Buenos Aires. The first South American woman mining engineer was graduated by the University of Chile in December 1944. The University of Cuyo, Argentina, graduated its first mining engineer in November 1944.

South American travel to North America should be encouraged by the establishment of a tourist dollar which could be purchased at a substantial discount from the current exchange. In one year of experience and study in a foreign country, young people can learn more about political, social, and economic developments than they could acquire in an equal amount of time spent in any other manner. A mutual acceptance of responsibility for the support of our ideals will result from better acquaintance with the arts, literature, history, and culture of our neighbors. Greater attention to the teaching of Spanish and Portuguese in the public schools of the United States must be encouraged.

Nothing would do more for solidarity than making American technical books available to South American countries, and offering membership in our professional societies to them at reduced rates. Unfortunately, Latin American college students and instructors cannot afford $6 or $7 textbooks at the current rate of exchange. German textbooks are used largely in some countries because the German Government foresaw the need, had the books translated, had them printed locally with cheap labor on cheap paper, and sold them for prices the people could afford to pay. As a result, the Germans built up good will. South American professional men would greatly like to join our technical societies but membership dues of $15 to $25 a year are too much of a handicap at the present rate of exchange.

The Pan American Institute of Mining Engineering and Geology was conceived at the First Pan American Congress of Mining Engineering and Geology, called by our Chilean neighbors in January 1942, as an autonomous private institution, independent of any political affiliations, to bind together the mineral industries profession in the Western Hemisphere. Its statutes provide that the new Institute shall cooperate with all the mineral industries societies of the Americas, support all activities that will benefit the mineral industries, expand fundamental knowledge regarding the earth sciences, mineral engineering, and mineral technology, and encourage the standardization of technical terminology and systems of weights and measures. The Institute wishes to facilitate the interchange of publications, students, professional men, and industrialists connected with the mineral industries, and to sponsor additional Pan American Congresses of Mining Engineering and Geology. PAIMEG has been recognized formally by the Pan American Union.

Above all, we desire a friendship based on such sound and honorable fundamentals that it will endure and thrive in times of peace. Undeniably, we become more concerned about cooperation when our national security is threatened than we do in the more nearly normal times of peace. In part, this is a perfectly natural reaction. In war years we see our commerce interfered with, our domestic economy disrupted, and national existence in jeopardy. As a matter of course we turn to our neighbors for support and assistance, particularly because we know that they have much to contribute, and because they have faced similar problems.

The Western Hemisphere is reasonably self-sufficient mineralically with the exception of certain strategic minerals, notably graphite, perhaps Mineral X; consequently, we have a definite and even selfish interest in hemisphere solidarity. On the other hand, nothing could be more harmful than the wishful thinking which conceives of the Latin American republics as permanently alienated from Europe and no longer dependent upon European markets.

Every country has as much to lose as the next. But if in these times of stress we can forget some of our selfish interests and learn to appreciate the particular capacities and skills of others, then we can create a common ground of understanding and mutual appreciation which can be extended and expanded in the future.

These remarks narrow down to fundamental in human relations. First and foremost, we must see ourselves with the eyes of the others. Let us raise our sights to broader horizons in mineral industries education. The future belongs to the rising generation and I know of no better inheritance to leave them than a better acquaintance with their fellow men and a better knowledge of how to use our remaining mineral resources for the good of all the people. This is a function of education. The future of the Americas depends upon how successfully we carry out this trust.