Mineral Industries

VOLUME 21

NUMBER 3

School of Mineral Industries

The Pennsylvania State College

STATE COLLEGE, PA., DECEMBER, 1951

Forbes to Head U. S. Bureau of Mines

The appointment of John J. V. Forbes, prominent alumnus of the College, as Director, United States Bureau of Mines, Department of the Interior, was announced November 10 by President Truman from the Little White House, Key West, Florida. The appointment to succeed Dr. James Boyd, who resigned recently to enter business, must be confirmed by the Senate when Congress reconvenes in January.

Born in Shamokin, Pa., in the heart of the hard coal region, Mr. Forbes started in mining as a breaker boy when only 10 years old. By working during summer vacations as a laborer, miner, or engineer, he was able to work his way through the Kutztown (Pa.) State Normal School, now a teachers' college, graduating in 1905. After teaching in the Coal Township (near Shamokin) public schools for two years and continuing mining work during vacations, he entered Penn State in 1907, graduating with a B.S. degree in mining engineering in 1911.

For the next 3½ years Mr. Forbes worked in various capacities in coal mines in Pennsylvania and Ohio, then joined the Bureau of Mines as a "first aid" miner at the Pittsburgh Station in 1915. During the next 37 years his service with the Bureau was of such nature as to call forth the White House announcement which described him as "one of the world's foremost mine safety experts and an outstanding career employee in the Government Civil Service." Serving the Bureau successively as foreman miner, junior mining engineer, mining engineer, senior mining engineer, and principal mining engineer, Mr. Forbes was appointed supervising engineer of the Safety Division in July 1927, with headquarters at the Pittsburgh Station.

In 1941 he was appointed Chief Mine Inspector of the Bureau to supervise activities under the newly authorized Federal Coal Mine Inspection and Investigations Act. During World War II he was made Chief Engineer of the Mineral Production Security Division which embraced not only coal mining installations but also metal and nonmetal mineral mining, smelting and metallurgical plants, and mines and quarries. During two work stoppages in the anthracite region in 1943 and 1945, Mr. Forbes was appointed Anthracite Regional Manager for the Solid Fuels Administration to insure uninterrupted production of hard coal. Following the conclusion of the MPSD program in 1945, he was promoted to assistant chief of the Health and Safety Branch, and again assumed supervision of the Coal Mine Inspection Division. Since 1948 he has been chief of the Health and Safety Division.

In the promotion of health and safety activities of the Bureau, Mr. Forbes has visited the principal coal mines in every mining state, as well as metal and nonmetal mines.

Bureau of Mines photograph

JOHN J. V. FORBES

Under his supervision more than 1,000,000 men in the mining industry have been trained in first aid, and over 50,000 have been trained in mine-rescue work. He has participated in recovery and investigational work at more than 100 mine disasters in this country. He has been author and co-author of many Bureau publications on mine health and safety and has contributed many special articles to technical magazines and trade journals on related subjects.

The appointment of Mr. Forbes has been endorsed by both operators and labor in the mining industry. A familiar figure at first aid and mine rescue meets, he has the approval and support of thousands of mining men in his new work.

Mining Officials from India Visit School

Two Government of India mining officials, G. S. Jabbi, deputy chief inspector of mines, and I. J. Badhwar, senior inspector of mines, visited the School November 8-9.

Sponsored under the Point IV program by the U. S. Bureau of Mines, the two officials had made a tour of the Pennsylvania anthracite region prior to visiting Penn State and expected to continue their tour with mine visits in the Pittsburgh area. During their stay at the College, they studied the educational programs of both resident and extension instruction, principally mining. They also accompanied Professor A. W. Asman of the division of mining on a trip to the underground limestone mine of the Warner Co. at Bellefonte.

Dean Steidle Presents Papers At Meetings in Mexico City

Dean Edward Steidle presented a paper entitled *Scientific and Technical Teaching in the Mineral Industries* before the First Inter-American Convention on Mineral Resources, Mexico City, the week of October 28. He also presented a second paper entitled *Some Mineral Aspects of World Peace* before the Third Pan-American Congress of Mining Engineering and Geology which was held in conjunction with the mineral resources convention. Following the meeting Dean Steidle made a tour of three mining districts in Mexico and also visited the School of Mines in Mexico City.

Dean Steidle was an official delegate of the Commonwealth of Pennsylvania at the First Pan-American Congress of Mining Engineering and Geology, Santiago, Chile, in 1942, and an official delegate of the Department of State at the Second Congress, Rio de Janeiro, Brazil, in 1946.

The Royal Academy of Mining, founded in Mexico in 1792 in accordance with the plan presented to the Royal Tribunal by the Director General Don Fausto de Elhuyar in

Mineral Industries

Published monthly by the
SCHOOL OF MINERAL INDUSTRIES
from October to May inclusive

The Pennsylvania State College
Mineral Industries Extension Services
D. C. JONES, *Director*

Pennsylvania's School of Mineral Industries and Experiment Station

Dedicated to education in mineral conservation and research by which the means may be found to make conservation effective. This includes diligent search for mineral truths and the energetic discovery, complete extraction, and maximum utilization of irreplaceable mineral resources.

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Geotechnology

Earth Sciences: Geology, Mineralogy, Geophysics, Geochemistry, Meteorology, and Geography. **Mineral Engineering:** Mineral Economics, Mining, Mineral Preparation, and Petroleum and Natural Gas. **Mineral Technology:** Fuel Technology, Metallurgy, and Ceramics.

DIVISIONS OF SERVICE
Resident Instruction
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Mineral Industries Research

Entered as second-class matter at State College, Pa., November 1, 1938, under the Act of August 24, 1912.

DECEMBER, 1951

1790, was the first mineral industries school in the western hemisphere. Inauguration of the Academy by the Marquis of Revillagigedo, Viceroy of Mexico, marked a new epoch in the development of the mineral resources of the country.

Graduates of the academy became the organizers, engineers, and directors of the rich and vast mining industry of Mexico which is outstanding in the production of petroleum and metals. The tradition is maintained carefully by the School of Mines of the Republic. This magnificent effort has helped in a large measure to give to Mexico its eminent position in the mineral world.

Joint Fuels Meeting Held

Otto de Lorenzi, Director of Education, Combustion Engineering Superheater, Inc., gave an illustrated lecture in the Mineral Industries Art Gallery October 18 at a joint meeting of the Division of Fuel Technology, the Centre County Engineers Society, and the local chapter of the American Society of Mechanical Engineers. The subject of the lecture was *The "Highset" Spreader Stoker for Multiple Fuel Firing.* Carl Miller, Manager of the Stoker Division, and William Stein, Engineer in charge of Single Retort Stoker Division, Combustion Engineering-Superheater, Inc., accompanied Mr. de Lorenzi.

At this meeting, Harold A. Everett, Professor Emeritus of Mechanical Engineering, was made a Fellow of the American Society of Mechanical Engineers.

Mineral Heritage of State Portrayed in Museum

Arthur Jaffe*

Visitors to the campus invariably find their way to the School of Mineral Industries to view the exhibits that make up the Museum and Art Gallery. Attractiveness of the displays undoubtedly accounts for their popularity, but the real values lie in the wealth of information available for those who would seek it. In attempting to portray both the mineral industries and resources of Pennsylvania, certain display features have been developed that are worthy of note.

The Pennsylvania Room, located to the left of the main entrance to the Mineral Industries Building, has been designed to show the mineral heritage of the State. Here are exhibited the mineral fuels, the metallic and the nonmetallic minerals produced in such vast quantities for years. Here, also, are exhibits of some of the numerous mineral products resulting from manufacture by Pennsylvania industries.

One of our most valuable mineral resources, which does not lend itself to display, is our water supply. In the Pennsylvania Room will be found a large geologic relief map of the State on which are clearly indicated the many streams along which towns and cities have grown. Two additional relief maps, 9 by 15 feet in size, show the principal geographic features and all of the known sources of primary wealth in the State.

The School also has the only art gallery in the world devoted exclusively to the mineral industries. The collection of 175 fine paintings features both the mineral resources and the mineral processing industries of Pennsylvania. Practically all of the artists represented are Pennsylvanians. About half of the paintings are of historical significance.

The use of display cases lining the corridors or built into the walls of the Mineral Industries building, and of display cases built into the walls of the Mineral Sciences building, has literally created a two-building museum with adequate space for the many exhibits that are needed to tell the "mineral industries" story. It differs, though, from many other museums in that the pulsations of student life flow past the displays daily, and in nearby laboratories quiet research is continuing to seek the means whereby our meager store of minerals may be used more effectively.

**Curator*

Valuable Porcelain Collection Given to School

A valuable porcelain collection with a personal history has been added to the School's museum through the generosity of Dr. and Mrs. E. H. Dusham. The collection, which Mrs. Dusham has built up over a period of many years, is now on display in case number 217 in the northeast corner of the second floor corridor, Mineral Industries building. Dr. Dusham, who retired last spring as professor emeritus, was formerly head of the Department of Zoology and Entomology in the School of Agriculture.

Among the outstanding ceramic pieces in the collection are a Meissen platter from Dresden, an English silver luster teapot, and a very elaborate Imperial Berlin porcelain chocolate cup with a gold-encrusted interior and a cover. A cream and sugar set from Austria has handpainted decoration that imitates the style of the short-lived Royal Vienna factory which obtained the secret of porcelain manufacture by bribing some ex-workmen of the Meissen plant.

Three large vases with elaborate decoration have been in the possession of Mrs. Dusham's family for many years. They are believed to have been brought to this country by the Huguenots when they escaped from France and are known to have been owned by the family of Mrs. Dobbs whose husband's name is associated with Dobb's Ferry, New York.

A piece of much charm is a delicate figurine of a seated woman holding a dog in her lap. This shows the skill with which lace dipped in a glaze can be used in costuming a porcelain figure. On firing, the lace disappears, but the glaze retains the pattern.

Extension Services

Professor Oscar F. Spencer, in charge of petroleum and natural gas extension, spoke to the Central Section of the Philadelphia Exchange Club at the Sylvania Hotel October 23 on *The Extension Services of The Pennsylvania State College.*

Professor D. C. Jones, director of the extension services, served as a member of the seven-man panel of mine maintenance experts at the November 14 meeting of the Johnstown Branch of The Mining Electro-Mechanical Maintenance Association. Approximately 125 maintenance men participated in the spirited discussion.

Professor R. B. Hewes, in charge of supervisory extension training, is conducting conferences for officials of two West Virginia mines of the Johnstown Coal and Coke Corporation. The program, which started November 5, is on an accelerated basis and will be concluded during the week of January 14.

Division of Geophysics And Geochemistry

Dr. B. F. Howell, Jr., chief, and J. C. Duecker and E. K. Kaukonen, graduate assistants, attended the Eastern Regional Meeting of the Society of Exploration Geophysicists in Pittsburgh October 25-26. The meeting activities included tours of the Gulf Research and Mellon Institute laboratories.

Zirconium---An Old New Metal

By Harold J. Read*

Although zirconium was discovered by Klaproth in 1789 and was isolated by Berzelius as early as 1824, it has not enjoyed any industrial or engineering use until very recent years. The element is rather widely distributed in the earth's crust, usually as the silicate or oxide, and in the scale of abundances it stands well above such common elements as copper, lead, tin, and zinc. When one considers that, in addition to its abundance, the metal has remarkable resistance to corrosion and possesses high mechanical strength, it may appear surprising that it has not been used for structural purposes. The difficulty lies in the trouble which is encountered in extracting the metal from its ore and refining it. As will be seen later, small amounts of certain critical impurities very adversely affect the properties of the metal.

Since the time of Berzelius, many methods have been tried for the extraction of zirconium from its compounds. There is relatively little difficulty in converting zirconium ores to comparatively pure compounds, such as the oxide, sulfate, or chloride. The stability of these compounds, however, is remarkably high, and very strong reducing agents, such as metallic sodium or magnesium, are required to replace the zirconium in its compounds. Moreover, high temperatures are required for these operations. At the necessary temperatures, zirconium metal reacts very readily with nitrogen as well as oxygen, and the metal will be contaminated with one or both of these elements if the reduction is carried out in an ordinary atmosphere.

It is unfortunate that even very small amounts of oxygen or nitrogen cause zirconium to become so hard and brittle that it is rendered virtually useless as a structural material. Not only do the mechanical properties of the metal suffer through contamination by these two constituents of the atmosphere, but the corrosion resistance is markedly decreased. Neither hydrogen nor carbon monoxide, two gases which are commonly employed as protective atmospheres, can be used to protect hot zirconium since the metal reacts with both of them. It is necessary, therefore, to employ inert atmospheres of helium or argon throughout the reduction apparatus, thereby greatly complicating the reduction process. Small amounts of certain metallic elements also adversely affect the properties of zirconium, and their removal has proved to be quite difficult.

There are, of course, two ways to attack the problem of producing pure zirconium: (a) refinement of crude, contaminated metal; (b) production of pure metal by a reduction process which excludes contaminants at the crucial steps. Both methods of attack have been pursued, and the most successful development along each line will now be discussed. The first to be presented is a refining technique.

Some years ago the Foote Mineral Company became interested in the possibilities of using zirconium to replace the noble metals, such as platinum or palladium, in those applications where the corrosion resistance of the noble metals is the property of most importance. As an example, one might consider the spinnerets which are used in the rayon industry. They are exposed to a strong alkaline solution on one side and strong acid on the other—a situation which calls for unusual corrosion resistance of the metals from which the spinnerets are made. In addition to the corrosion resistance, the metal must possess sufficient ductility that it can be drawn into a cup, and it must be sufficiently machinable that it may be pierced by drilling with a large number of small holes. It was found that if zirconium was sufficiently purified, it could be used for this purpose with complete satisfaction and promised to be considerably cheaper than platinum. There are many other possible applications in the chemical industries where severely corrosive conditions are commonly encountered.

It is interesting to note that zirconium is unaffected by body fluids, and can be used by surgeons with civil-engineering inclinations to rebuild damaged human skeletons. It also has many uses in the electronics industry.

In its search for a method of producing zirconium in a state of purity sufficient to attain its remarkable properties, the Foote Mineral Co. acquired rights to an unusual refining process which was developed in Europe.

In the early twenties of this century, VanArkel and his co-workers in the Netherlands devised a process for refining zirconium which is known as the *iodide process*. With its aid, metal of very high quality can be produced. In brief, VanArkel's technique consists of enclosing within a glass tube of considerable diameter a quantity of crude zirconium which is supported near the walls of the tube. The vessel is equipped with a wire filament extending along its axis and capable of being raised to a high temperature by electrical resistance heating. The apparatus as a whole can also be heated by a furnace which surrounds the exterior of the glass tube. Arrangements are provided to fill the apparatus with iodine vapor. If the vessel as a whole is now heated to a moderate temperature, the iodine vapor reacts with the zirconium to form gaseous zirconium tetraiodide which is stable at the furnace temperature. But if the filament in the central part of the furnace is heated to a very high temperature, the zirconium tetraiodide will decompose on it to yield zirconium and iodine. The released iodine is available, of course, for further reaction with the crude zirconium in the cooler part of the vessel.

As this process is continued, the filament grows to considerable dimensions and will be composed of relatively pure zirconium, or at least it will be free of impurities which do not form volatile iodides. Hard, brittle, and mechanically worthless crude zirconium can be transformed in this manner to zirconium which is strong but relatively soft, and its ductility is such that it can be drawn into hair-like wires, rolled into thin sheets, or forged to fairly complicated shapes.

Although the process produces metal of excellent properties, it is so expensive that it is not likely to enjoy extensive use in the production of metal for engineering purposes. The price of zirconium produced by this method in 1948 was about $250 a pound. This may appear to be very high, but compared to the price of platinum it is relatively cheap. In the succeeding years the cost of metal produced by the VanArkel method has been considerably reduced, but present prices are not available. Glass equipment is no longer employed, and many mechanical improvements, which cannot be discussed now, have been made.

The Atomic Energy Commission has been interested in the production of zirconium because of a most unusual property which 10 years ago would not even have been considered a significant engineering property; namely, the *neutron cross section*. The ability of neutrons to pass through a material is referred to as its neutron cross section, and in the construction of a nuclear reactor there are many parts which must be made of a material which offers as little resistance as possible to the penetration of neutrons. It also happens that many of these parts must be corrosion resistant. There are relatively few materials which meet both of these criteria, and of them even fewer are suitable for structural purposes. Aluminum, beryllium, magnesium, and zirconium are considered the best possibilities. Of these, zirconium is the leading contender on the basis of the best combination of all the necessary properties. It is, of course, one of the most expensive; but in the applications for which it is used, the initial cost of the metal is a minor item compared to the performance which it will provide.

In spite of the fact that cost is not a matter which would limit the use of zirconium in nuclear reactors, it is still desirable, of course, to reduce the production costs to a minimum. The very nature of the VanArkel process is discouraging with respect to reduction in production costs, and it is probable that little more can be accomplished in this direction than has already been done.

A process for the production of relatively pure zirconium by the second approach referred to above has been worked out by Kroll and his associates in the Bureau of Mines. Briefly their process consists of preparing zirconium carbide which is chlorinated to yield zirconium tetrachloride. This material, after being purified by fractional sublimation, is reduced with magnesium metal in an inert atmosphere to yield a sponge of zirconium metal. The sponge is compacted by powder-metallurgy techniques

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**Associate Professor of Metallurgy*

The above mural extends around three sides of the main lobby of the new Mineral Sciences building. It was painted by Hiram D. Williams as part of a dissertation for a Master of Education degree in Art Education under Dr. Viktor Lowenfeld. The motif was conceived by Dean Steidle to illustrate the program and objectives of the School in the field of the mineral arts and sciences. The mural was photographed by Edward Leos and his staff.

Dean Steidle explains that youth, representing humanity, is inquiring of the parent as to how our mineral civilization can be perpetuated. The parent points to the mineral technologist, symbolic of our program of resident instruction on both the undergraduate and graduate levels, research, and extension training, who explains that man must delve into the innermost secrets of rocks and minerals and excel

geologic forces of nature in processes of concentration. Various modern tools used in studying rocks and minerals, especially optical instruments, are shown diagrammatically in the background. Some of the secrets, such as fossils, petrographic and metallographic texture, and atomic and crystal structure, are revealed.

The central panel is devoted to the extraction of irreplaceable, primary mineral wealth from Mother Earth—the use of the pick, the shovel, the lever—and primary mineral processing to produce the raw materials of industry, together with links of a chain symbolizing fundamental mineral products.

The final panel evolves diagrammatic sketches of primary processing plants and mills, and finally depicts the mineral civilization of the future built on a sound mineral economy—the mineral heritage of each succeeding generation.

Zirconium

(Continued from Page Three)

or cast into ingots and worked into rods, sheets, or wires.

Although this metal is useful for many purposes, the majority of it is not sufficiently pure to meet the exacting specifications required of the metal to be used in nuclear reactors. It may well be, however, that additional work on the Bureau of Mines process will lead to the production of purer metal. It is well to emphasize that the above description of the Bureau of Mines process touches only the high lights and does not really indicate the complexity of the many problems which are involved. There is no doubt, however, but that the Bureau of Mines process is considerably cheaper than the VanArkel process. In June of 1950, the Bureau of Mines reported on the operation of a pilot plant in which 500 pounds of zirconium was produced weekly.

In spite of its present superiority with respect to production costs, it appears unlikely that the Bureau of Mines process can ever be used to produce metal for less than several dollars per pound. The success which has been enjoyed by processes involving the electrolysis of fused salts for the production of such active metals as aluminum, sodium, and calcium would indicate that this technique might well be applied to the extraction of zirconium from one of its cheap compounds. It should be noted, however, that almost all of those metals which have been deposited commercially from fused salts have been recovered in the liquid state. The melting point of zirconium is so high, namely, about 1860 C, that a cell for the production of liquid metal would have to be operated under conditions which have never been achieved in practical processes.

The only material for cell construction which would stand this temperature is graphite, and liquid zirconium reacts fairly rapidly with graphite, thus leading to the contamination of the metal with carbon, an element which cannot be tolerated in any but small amounts. If the fused salt electrolysis is carried out at lower temperatures where the zirconium will not react with the graphite, the product is likely to be a powder, and one is faced with the problem of compacting the powder into dense, solid metal. The result, therefore, is similar to the somewhat unsatisfactory sponge that is obtained in the Bureau of Mines process.

Much work has been done on the electrolysis of aqueous and nonaqueous solutions of zirconium salts. In spite of reports in the literature to the contrary, there have been no successful experiments of this sort, and no processes capable of producing anything other than possibly a very thin film of zirconium have emerged. Even in view of the many failures in this direction, it is an alluring line of investigation, and there are many possibilities which have not yet been explored.

The use of nonaqueous electrolytes for the electrodeposition of metals which are less easily deposited than hydrogen has long been an attractive possibility, and many investigators have demonstrated the feasibility of such processes for several active metals. None of the successful laboratory processes have been used commercially, probably only because cheaper and easier methods have been found for the recovery of the metals. Perhaps zirconium will prove to be one metal in which nonaqueous electrolysis will turn out to be the cheapest of several available processes for its recovery.

Even after one has succeeded in the difficult task of recovering zirconium as a pure metal, two other serious problems still remain. These are the remelting and the hot working of the metal. In both cases the extreme reactivity of zirconium with oxygen and nitrogen are the chief causes of difficulty, and, in addition, one faces a serious crucible problem when one attempts to melt zirconium. Molten zirconium reacts more or less rapidly with all materials which have been suggested for the construction of crucibles. One faces here the same problem that is encountered in the melting of tungsten. It will be recalled, of course, that the tungsten problem was solved by Coolidge through the use of a powder-metallurgy technique. The same solution is available for zirconium, but the requirements are quite different. Many of the applications for which zirconium is desirable involve rather large pieces of metal. The production of these by powder metallurgy is impractical, and it is absolutely necessary, therefore, to find some way of melting zirconium and casting it into ingots which can be subsequently worked to the desired size and shape.

The problem of producing zirconium ingots has been solved, although the solution is not entirely satisfactory from the standpoint of cost. The technique which is used is one which has been gradually developed for dealing with several active metals such as titanium and molybdenum. In essence, the process involves the use of a water-cooled copper crucible which serves as one electrode of an electric arc: the other electrode is a water-cooled tungsten tip which can be moved in every direction within the copper crucible.

The melting operation is started by striking an arc between the crucible and the tungsten electrode. Small chunks of the metal to be melted are then dropped into the crucible and melted by directing the arc on them by means of the movable electrode. When a small puddle of molten metal is obtained, additional chunks of the raw material are added. As the molten pool grows, it gradually solidifies, and at a given time only a very shallow puddle of molten metal exists in the neighborhood of the arc. There is no alloying of the metal with the water-cooled copper crucible, and, surprisingly enough, the ingot which is built up in this fashion is remarkably sound. Rather large ingots have been made in this general manner, although the apparatus is quite complicated. It is necessary, of course, to maintain a pure inert atmosphere within the furnace while the melting process is in progress. One of the noble gases, such as argon which has been highly purified, can be used for this purpose.

One of the prime advantages of the arc process is the relative ease with which the inert atmosphere may be obtained. The method is, however, time consuming and requires a considerable amount of complicated apparatus which must be operated with great skill. It is probable, however, that refinements in furnace design and the accumulation of operating experience will lead to cost reductions for the arc-melting technique. The power costs are not serious, and the development of suitable control apparatus should reduce the necessity for highly skilled operators.

In spite of the fact that satisfactory ingots with regard to size and purity can be produced by the arc process, it will always remain a relatively expensive step in any over-all production operation. If an electrolytic process could be developed to produce cathodes of dense, pure metal which could be subsequently worked into plates, sheets, or rods, an attractive saving in over-all production costs would be realized.

Although pure zirconium is amenable to cold work by rolling, drawing, and other common cold-working methods, it does work harden and must be annealed rather frequently. It is desirable, therefore, to do most of the working in a hot condition. But here one encounters the problem of reactivity, in that at the hot working temperatures the metal will react with oxygen and nitrogen of the air. Inasmuch as it is not practical, of course, to carry out hot-working operations in an inert atmosphere, it is necessary to enclose the zirconium in a protective sheath such as iron or nickel. The sheathed zirconium can then be handled in the usual way through all of the hot-working operations, after which the sheath is removed either mechanically or by chemical dissolution. This troublesome technique contributes markedly to the cost of using zirconium for structural and engineering purposes. Once again one is attracted to the possibilities of electrolytic recovery in that it might well be possible to electroform the metal into the same rough shapes that are produced by hot working.

In view of the current interest in titanium as a corrosion-resistant, strong metal which is abundantly available as an ore, the question arises as to what zirconium has to recommend it over titanium. The question is particularly pertinent inasmuch as titanium is easier to obtain from its ore, is less sensitive to contamination, and can be more easily worked. The answer is that the corrosion resistance of zirconium is superior to that of titanium, particularly in alkaline media, and its neutron cross-section is much lower. These two points of superiority, aside from others which may exist, are sufficient to encourage metallurgists to continue their attacks on the many problems which must still be solved before this old new metal can take its rightful place among the useful engineering and structural metals.

Mineral Economics

By J. J. Schanz*

During the last 15 years the people of this nation have experienced, in succession, preparation for war, the waging of that war, the reconstruction after the war, and now preparation again in view of the possibility of another world conflict. Modern total war has brought about a need and utilization of mineral commodities unequaled at any previous time in history. Thus, the individual has come to a greater realization of the place mineral products play in his daily existence by being constantly reminded of these matters by shortages, substitutions, newspaper articles on strategic minerals, stockpiling, and so on. Perhaps this unparalleled dissipation of a nation's natural mineral resources will at least bring about some good by creating popular pressure for a long-range national mineral policy for peace as well as war.

The influence of mineral source areas and channels of supply on the strategy of war has grown enormously down through the years. As far back as the Roman Empire we find that both Carthage and Rome were interested in the mines of Spain during the Punic Wars. In the Civil War, the record shows severe suffering by the Confederacy as a result of being cut off from normal supplies of a commodity as common as plain, ordinary salt. The Ruhr has occupied a vital place in the strategy of European wars over the past 40 years. Similar cases can be found in every war that man has fought since he first started using minerals.

The more recent World War II was typified by a greater emphasis on control of raw material sources than ever before. Japan's early moves denied us the antimony and tungsten of China and the oil, rubber, quinine, and tin of southeastern Asia and Oceania; at the same time she provided herself with these commodities as well as with the sorely needed coal and iron of Manchuria.

In the meantime Germany's well-publicized "Drang Nach Osten" was aimed directly at the oil of Rumania and Russia. The Allies, in their strategy against Germany, struck back at this very same oil supply which was the weakest link in the many mineral deficiencies of the Axis nations. The new concept of "strategic bombing," as developed by the Allies during the war, was based on the sound premise that if you knock out the enemy's industrial base, his highly mechanized force will soon grind to a halt and fall apart for lack of fuel, spare parts, and new machines. With this in mind the mineral industries of Germany, such as the Ruhr, the ball-bearing plants, the synthetic fuel plants, and the oil fields ranked high on the bombing priority list.

As a result of the only combat action to take place in the western hemisphere, we learned that such strategy works two ways. When the enemy submarine packs concentrated on our tankers bringing oil from the Gulf coast and the boats bringing minerals from South America, the operations of American forces in Europe were in grave danger of being forced to a halt for lack of fuel. The civilians of the eastern coastal states were the first to be introduced to the privations of war when gasoline was rationed because inland oil transportation facilities were taxed to the limit. The submarines finally became so bold that they would surface in order to shell coastal refinery installations.

Even the so-called "cold war" is not free of the influence of minerals. It seems certain that Russia, as did Japan in earlier days, welcomed the inclusion of Chinese mineral resources within the "iron curtain." Iran has been considered a trouble spot for many months, which term applies also to other areas of the Middle East, for Russia could benefit enormously through gaining access to additional developed oil resources. Although it is not certain, there is a possibility that an important tungsten mine may well be one of the many underlying difficulties in the cease-fire negotiations in Korea.

Although not so highly publicized as other moves, the reconstruction program to put Europe and Asia back on a self-sufficient basis hinges to a great extent on the revival of key mineral producing and processing areas of the world. It is now realized that the seeds of Communism grow best in an environment of unrest created by a lack of economic well-being. The reopening of the war-ravaged mines of Asia, the inclusion of the Ruhr and western Germany in the European Recovery Program, the importance of Middle Eastern oil to oil-starved Europe, the coal shortage in Britain—all of these are critical areas where failure could prove disastrous to the economic structure of a great part of the free world. Losing the peace has become just as great a menace as losing the war.

The people of the United States are again faced with shortages in raw materials, difficulties in purchasing home appliances, no changes in the design of new cars, allocations faced with shortages in raw materials, difficulties brought about by the fact that even our tremendous productive capacity cannot supply both defense requirements and consumer demand at the same time. Under these circumstances we wonder what has been done to assure this nation of adequate supplies in the event of another war. Past experience should have shown the serious consequences if we are cut off from certain foreign mineral sources, such as manganese from Africa and India, and the oil, copper, tin, and iron ore of South America.

Despite the pitifully small stockpile of strategic minerals on hand at the beginning of World War II, the United States was able to emerge from the war with stockpiles in reserve. Although mineral affairs during the war were handled by a complex entanglement of overlapping defense agencies, the mineral industries were able to turn out an overabundance of goods in spite of shortages of both labor and equipment. Congress, apparently realizing both the inadvisability of relying again on such a haphazard mobilization organization and the need for adequate stockpiles, passed the Stockpiling Act of 1946 and the National Security Act of 1947. The three main agencies delegated under these Acts to develop a program for mobilization, to coordinate procurement, and to purchase minerals for the stockpiles were the National Security Resources Board, the Munitions Board, and the Bureau of Federal Supply.

Upon the advent of hostilities in Korea, the mobilization plan for total war was apparently unable to develop action in a limited mobilization while maintaining a peacetime economy. Meanwhile the stockpile, which was to have been completed by June of 1951, had reached only the 38 per cent mark as of June 1950. Lack of appropriations, the large peacetime demand for the same critical minerals, and the scarcity of foreign minerals had constantly harassed the stockpiling agencies since 1946.

In the last year the Petroleum Administration for Defense, the Defense Power Administration, the Defense Solid Fuels Administration, and the Defense Mineral Administration, all of which were formed after the start of the Korean conflict, have attempted to improve our mineral position and to increase mineral production. Two of the most significant steps taken have been the assistance granted for exploration and the accelerated amortization plan. Already 5 million dollars has been allocated to 160 exploration projects, and the DMA alone by June had approved accelerated amortization for tax purposes to certain mineral industries for one billion dollars worth of expansion.

The stockpiling program is still lagging and had accumulated only 59 per cent of the recommended stockpiles by June 1951. In an attempt to bolster this phase of defense activity, the Defense Materials Procurement Agency was formed during the past summer. The DMPA will centralize many of the stockpiling functions handled formerly by several different agencies.

Much is beginning to happen. The big question is whether enough will be accomplished in time. We hope that we won't find ourselves with too little too late.

Instructor in Mineral Economics

Alumnus Named Mining Department Head

Dr. Robert T. Gallagher, Mng. '27, a faculty member of Lehigh University since 1942, was named head of the department of mining at Lehigh recently, succeeding the late Professor A. C. Callen. A native of Johnstown, Dr. Gallagher received an M.S. degree at the University of Missouri in 1938 and a Ph.D. degree at the Colorado School of Mines in 1941.

Earhart Co-Author of Ceramics Abstract Book

The revised edition of *Literature Abstracts of Ceramics Glazes,* co-authored by Dr. W. H. Earhart, assistant professor of ceramics at Penn State, and Dr. J. H. Koenig, director of the School of Ceramics at Rutgers University, was released recently by the College Offset Press of Philadelphia.

The authors, who received their Ph.D. degrees from Ohio State University in 1939, started the initial abstract work as part of their graduate studies. This initial work, published in 1942, covered the period 1900-40. The revised edition brings the abstracts up to January 1951.

The literature covered by the abstract work consists primarily of technical articles in professional magazines published by American, English, Canadian, and Indian ceramic societies. Some abstracts of German, French, and Japanese articles used during the graduate studies of the authors are also included, as well as glaze literature in industrial publications.

A publication of this type fills a need of both manufacturers and researchers for information on both recent and less-recent glaze practice. Considerable interest has been shown by ceramists in the publication.

Division of Geography

Dr. E. Willard Miller participated in the panel discussion on *Physical Geography, Its Place in the Undergraduate College Geography Program* at the meeting of the National Council of Geography Teachers held in Pittsburgh November 23-24.

Division of Petroleum And Natural Gas

Jean Freeland represented the division at the annual Secondary Recovery Conference of the West Virginia Geological Survey held in Morgantown, October 5-6.

The annual "Off-the-Record" meeting of the AIME, held in Pittsburgh November 2, was attended by Dr. J. C. Calhoun, Jr., C. M. Davis, J. Freeland, and F. Preston. A paper entitled *Discussion of Calculations for Displacement of Brine by Water,* written jointly by Messrs. Calhoun and Preston, was presented by the former, who also acted as co-chairman of the afternoon session.

Dr. Calhoun attended the Annual Meeting of the American Petroleum Institute in Chicago, November 3-5. He participated in sessions of the Publications and Permeability Code Committees of which he is a member.

Met Senior Receives L. E. Young Award

The 1951 Lewis E. Young Award of $100 was presented to John D. Harrison, a metallurgy senior, at an assembly of metallurgy students, faculty, and others on October 26. The award was presented by Mrs. W. H. Phillips, current chairman of the Western Pennsylvania Section of the Woman's Auxiliary of AIME. Dr. and Mrs. L. E. Young were present, and Dr. Young spoke briefly to the assembly.

The Lewis E. Young Award was established by the Western Pennsylvania Section of the Auxiliary to honor Dr. Young who was AIME president in 1949. It is made to an outstanding student in the mineral sciences at the close of the junior year on the basis of character and high scholarship. The award is presented annually in alphabetical rotation to Carnegie Institute of Technology, The Pennsylvania State College, and the University of Pittsburgh.

Harrison is a resident of Pittsburgh, and the son of Mr. Harold C. Harrison of the Research Division, Westinghouse Electric Corporation.

Former Division Chief Appointed Preparation Engineer

R. E. Zimmerman, Mng. '26, and chief of the division of mineral preparation at the College 1948-50, was recently appointed chief preparation engineer for the Coal Division, U. S. Steel Company. For the past year he has worked in Turkey on mineral preparation for the construction division of the Koppers Company.

Rugh Scholarship Fund Grants Recommended

Grants from the Scholarship Fund provided by E. W. Rugh, Cer. '29, which was announced in the October issue of *Mineral Industries,* have been recommended by the School Committee on Scholarships and Awards to Dean Steidle. The recipient, amount, and purpose of each grant are as follows:

Dr. S. C. Sun—$100—for technical labor to complete work in progress on a project entitled *The Frothing Characteristics of Alcohols and By-products of Chemical Plants.*

Dr. J. D. Ridge—$100—part payment on a Geiger counter to be used primarily by graduate geology students for investigating occurrences of radioactive minerals in Pennsylvania.

Lynn Jacobsen, a graduate student in mineralogy—$100—partial coverage of the cost of having thin sections prepared for a doctoral thesis investigation of *The Petrology of the Ardmore Basin, Oklahoma.*

Melvin A. Rosenfeld, research assistant in mineralogy—$60—partial coverage of the cost of having thin sections prepared for a doctoral thesis investigation of *The Petrography of the Oriskany Orthoquartzite.*

Daniel A. Jacobs, a third semester mining student with a 2.4 average—$100 scholarship.

R. Jay Fries, a seventh semester mineral preparation student with a 2.26 average—$100 scholarship.

The committee has indicated that additional grants and scholarships will be announced in the near future.

Staff Members Attend Joint Ceramics Meeting

The seventh annual "Penn State Night," a joint meeting of the Pittsburgh Section of the American Ceramic Society and the Pennsylvania Ceramics Association, was held in the Mellon Institute auditorium, Pittsburgh, November 13.

Dr. E. C. Henry, chief of the division of ceramics, presented a report on "Ceramic Activities at Penn State" which covered both resident and extension instruction, research, and publications for the period July 1, 1950, to November 1, 1951. Copies of the impressive 13-page report were distributed at the meeting.

James K. Martin of the Posey Iron Works, Lancaster, retiring president of the Pennsylvania Ceramics Association, reported on the activities of the association during his tenure and introduced the newly elected officers: H. A. Heiligman of the E. J. Lavino & Co., Norristown, president; G. H. Aderhold of the Saxonburg Potteries, Saxonburg, vice-president; Professor R. G. Ehman of Penn State, secretary; D. O. Evans of the Corning Glass Works, Charleroi, treasurer; and Dr. Henry, managing director.

R. P. Bell, manager of paint sales, Pittsburgh Plate Glass Co., gave an illustrated talk on "Color Dynamics" and the use of color in both industrial and domestic applications.

Professor D. C. Jones, director of Penn State's Mineral Industries Extension Services, and Irving Dulberg, recently appointed ceramics extension staff member, were introduced at the meeting.

According to *Science and Engineering,* the organ of the India Society of Engineers, there were 843 collieries active in India during April, 1951, with 346,921 persons employed on an average of 24 shifts. The total production of 3,053,723 (long) tons represented a man-shift production of 1.06 tons for miners and loaders, 0.58 tons for all persons employed underground and in open workings, and 0.36 tons for all persons in the industry.

THE CARROLL PRESS—CARROLLTOWN, PA.