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GEOLOGY IN THE PRESENT WAR

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Geology and geologists play an unspectacular but none the less vital part in modern warfare. Modern war is a war of machines and machinery. Geologists are those who probe the earth's crust in the search for ore minerals and fuels. These are the substance of a modern war machine without which a tank or bomber or battleship could not be built, and once built it would be impotent without an adequate supply of fuel. The role of the geologist in modern war is threefold: (1) he locates, investigates, and aids in the development of raw materials; (2) he studies and maps land forms; (3) he serves as a member of the armed forces.

Raw materials.--At the beginning of the war we in America were quite complacent in the conception that we had a controlling interest in the world's mineral resources. And, in fact, the overwhelming majority of the proved reserves of economic minerals was controlled by the United Nations group and by friendly neutrals. This was strikingly true in the case of such resources as petroleum, tin, nickel, and others. Large reserves of fuel occurred in the United States, British and American controlled fields in Iran and Iraq, the Dutch East Indies, and friendly neutrals located to the south of the United States. Abundant tin reserves were under Dutch, French, and British control in the Malay Peninsula and the East Indies. Nickel and cobalt are extensively mined in Canada, molybdenum in the United States, commercial diamonds in South Africa, mica in India and Madagascar. These and a long list of others were virtually controlled by the United Nations group. Such resources as iron

ore and coal occurred abundantly in both camps, and the largest supplies of others, such as the Spanish mercury, were located in unfriendly neutrals. The axis nations themselves had a controlling interest in few mineral resources at the outset of the war.

After Pearl Harbor the strategic mineral situation changed radically and rapidly. Axis nations, particularly Japan, occupied important mineral-producing areas affecting the production of tin, petroleum, and other products. The rapid expansion of war industries in this country caused shortages formerly unsuspected. In some cases, for example, magnesium, an abundant source of raw material lay close at hand in our abundant dolomite deposits and brine, so the shortage was relieved by expanding production and processing facilities. In other cases, such as aluminum, our proved reserves of high-grade ore represent only a few years' supply; therefore, extensive search for new deposits is being carried on. Still other shortages were caused by the technologic advancement of modern warfare. An outstanding example of this type of shortage is quartz crystal, now obtained largely from Brazil and needed in much larger quantities than ever before in radio and electrical equipment for the Army and Navy. Other shortages caused by increased use have occurred in copper, zinc, iron, tungsten, vanadium, manganese, and to a lesser extent in many others.

These shortages are being met in one of four ways: (1) by exploration for new or formerly unknown deposits of ore minerals and extension of known deposits; (2) by substitution of an abundant material for a scarce one; (3) by utilization of low-grade ores; (4) and by development of supplies in neutral countries. Most of these jobs are being carried on by the Federal and State Geological Surveys and the Bureau of Mines, in cooperation with special war agencies, such as the War Production Board and the Board of Economic Warfare. Some typical examples of this work are: the greatly increased production of mica in North Carolina as imports from India and Madagascar decreased;

discovery of new bauxite reserves in Arkansas and development of processes for extracting aluminum from high-alumina clays; development of cinnabar (mercury ore) deposits in Arkansas, California, and elsewhere; development and importation of larger quantities of tin ore from Bolivia and Alaska; utilization of clay products and plastics as substitutes for metal products; substitution of silver for copper in some electrical equipment; extraction of zinc and other metals from lower grade ores than formerly used; and so on.

The mineral fuels -- coal, oil and gas -- are of vital importance in modern warfare; they are food for the industrial machine. We have heard of gas and oil shortages in various parts of the country, and rumors of coal shortages that may appear in the future. These shortages are a different type from those discussed above. With the exception of certain types of motor fuel they are not as yet gross national shortages, but are local shortages caused by increased demands in some areas and inadequate transportation facilities to supply these areas. The task of the geologist in this case is to locate additional supplies near the points of consumption and thus relieve in part the transportation burden. Thus natural gas produced in West Texas or the Hugoton field of Kansas is of little help in relieving a shortage in eastern Kansas once the existing pipe-lines are operating at maximum capacity. This general picture is not likely to change with respect to coal and natural gas. In the case of petroleum, however, with a declining rate of discovery of new reserves it may be that another year of war will bring us into proximity with a gross national shortage. The geologist will then again have the problem of finding oil wherever it occurs within our borders.

Study of our coal resources is largely carried on by the various geological surveys and the bureau of mines. Oil and gas exploration is largely done by the companies themselves, with the public agencies making regional or correlating studies and furnishing general services.

Domestic water supplies represent still another type of shortage because they vary not only from place to place but from time to time. Also an abundant supply of water may not possess the proper chemical characteristics for the intended use. Regardless of other favorable features, a war plant or military base must have an adequate water supply in order to exist. This problem is of particular importance in a state such as Kansas where, over large areas, surface streams are inadequate and water for such establishments must be obtained from wells. The Federal and State Geological Surveys are the primary organizations investigating ground-water problems over the United States for the Army, Navy and other agencies.

Mapping.--The preparation of certain types of maps is largely carried on by geologists. The Alaskan Branch of the Federal Geological Survey has made reconnaissance maps of many thousands of square miles of territory for the Army Air Forces. Geologists are used to interpret aerial photographs for the Air Corps. Topographic engineers and geologists employed by the Federal Surveys and the War Department have made detailed contour maps of coastal and strategic war areas in many parts of the United States. Still other types of maps, including data on topography, mineral resources, and water supplies of foreign areas, have been prepared for the Army. The making of maps is a basic task that must precede most successful military operations.

Service in the armed forces.--Many geologists are serving directly with the armed forces. They are performing a wide variety of tasks depending on the particular theater of operations and the type of action.

Water-supply work has been an important type of geologic service in the armed forces. This includes exploration for water supplies and their development for use both at semi-permanent bases in foreign territory and for temporary bases in arid and semiarid ~~areas.~~ regions) Major Richard Cady, our friend and

former Geological Survey colleague in Nebraska, was killed a few months ago while engaged in this type of work in Eritrea. A number of ground-water geologists who were formerly employees of the United States Geological Survey are now serving in foreign theaters of operation on water-supply work.

Geologists serving with the Army Air Forces study and interpret aerial photographs both from the standpoint of preparing reconnaissance planimetric maps and compiling geologic data that would have some bearing on the effectiveness of bombing fortifications and other land emplacements. Geologists are also used in the preliminary stages of the construction of air bases in foreign territory.

The Engineer Corps of the United States Army utilizes the services of a few geologists in foreign fields, although to a lesser extent than the British, Russian, and German armies. They are useful in the planning of strategy where operations are influenced by topography, boggy terraine, dune sand, or other special land forms that would create an impediment or advantage to a moving army. Conditions of bedrock are important in the planning and construction of permanent fortifications, and in trench warfare, the operation of listening devices, emplacement of mines, and many other operations.

Some geologists with special training or experience in geophysics are being used by the Navy.

Conclusions.--Thus, during wartime the geologist plays a stage hand's role; in the oil fields and mines, industrial plants, planning of strategy, and in actual combat operations.

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