

PREFACE

Many books have been published on the mineral resources of Wyoming. Descriptions of these varied deposits appear in over 200 publications of the United States Geological Survey. Maps and reports on these deposits by former state geologists as well as by other scientists who either resided or visited within the state from time to time during past 105 year period form the titles of 500 additional publications. Manifestly, not all of the valuable data already available on the geology of Wyoming is compressed within the space of present volume.

The chief value of nearly all former reports consists in the wealth of geological information contained therein. In many instances the work has been so thorough that an entire volume is devoted to the geology of a single mineral deposit. On a number of occasions availability of information of this character has vastly accelerated the economic development of our state.

Before starting preparation of present volume, a review of considerable portions of the voluminous literature already accumulated on the geology of Wyoming fell within the purview of prior employment. To correlate and reduce this wide range of information to convenient reference form was one of the original aims of the present compilation.

Many descriptions heretofore prepared on the mineral deposits of Wyoming were written in a phraseology that only the professional geologist could translate. On the other hand, entire reports have been published by specialists that merely covered a local deposition of some simple mineral or chemical salt. For conversion of these lowly raw materials into valuable finished products, industrial reactions sometimes require the consumption of several forms of mineral compounds and potential energizers that occur in huge volumes at different sites within the Wyoming depository.

To connect much of this detached information was also one of the purposes of present commentary. To follow this scheme, the entire mineral depository of Wyoming is, herein, considered simply in the light of a vast storehouse. In succeeding chapters not only do the names of the several ores, non-metallic minerals, raw chemicals, fuels and other sources of basic power appear therein, but also, in this first inventory the total stocks and stores

of the leading products are expressed in whatever weight, volume, heat or energy, simple ultimate unit it was most convenient to use. As most of the Wyoming stores compare extremely favorably to those known to exist elsewhere, the ranking position of Wyoming in comparison to those of other states was, likewise, recorded from the carefully verified facts similarly supplied by the United States Geological Survey.

Moreover, the scope of the present systematic investigation made it frequently necessary to point out what reactions are set-up when two or more of the mineral, chemical and other latent agencies occurring in Wyoming are brought together in a large industrial manner. Abler efforts conducted within these wider fields should produce a broader mental grasp in regard to the general significance of the Wyoming Mineral Empire.

Some professors of geology may take exception to the abrupt and abbreviated definitions that have been coined, here and there, on the origin, identification, character and extent on some of the leading mineral deposits of Wyoming. Already, geologists have access to know the character and magnitude of the colossal mineral wealth still reposing undisturbed within the Wyoming depository. To arouse the interest of the chemist, metallurgist, engineer, technologist, research worker, industrialist, capitalist and ultimate consumer as well as the student and the reasonably intelligent citizen of the state in these wonderful resources largely accounts for the manner in which this treatise is presented. Obviously, but few of the preceding individuals are desirous of reading the insertion of an extra page of jargon peculiar to some special field of foreign science.

In no state is the development and expansion of the mineral industry as important as in Wyoming. Unlike all other states, the major mineral developments are now conducted on public lands that return large royalty payments directly to the state treasury. In the future most operations will be conducted on similar lands, and largely for this reason, discussions on the continuation and expansion of this most unusual form of revenue enter into some of the ensuing chapters.

No claims are made in regard to the absolute accuracy and completeness of the statements appearing herein. The Wyoming Mineral Empire is of so profound magnitude that many geologists have already devoted the best part of their lives in unravelling its potentialities. Advances in fuel technology, industrial chemistry, mineral fertilizer manufacture, ceramics, electro-metallurgy and

other industries typical of Future Wyoming are so complex and all engulfing that scores of specialists could now be occupied in ascertaining the character and number of products that could be fabricated at lower cost directly within the, complete and consummate, Mineral Storehouse that largely composes the State of Wyoming as a whole.

C. S. Dietz

Cheyenne, Wyoming
December 31, 1928

ROAD MATERIALS

In most of the preceding chapters Wyoming was generally found to be a giant and complete storehouse for the several types of geologic deposits reviewed. The same conclusions can be filed on the wealth and variety of its road materials. On completion of the new cement mill at Laramie, Wyoming will be among those two or three highly select states that will produce a super-abundance of every kind of material used in the construction of modern highways. In addition to ordinary binding and surfacing materials the remaining products include bricks, cements, road oils as well as both natural and manufactured asphalts. In the following remarks space will only permit mention of products now being exploited in a vigorous manner.

SAND AND GRAVEL

Every town and city in the state is either underlain or else situated near deposits of sand and gravel. These deposits are of ample magnitude to take care of any possible expansion that may occur in the structural or building trades on all future occasions.

The great consumer of these lowly materials is the 3,023-mile long Federal Aid highway system started in 1917. At the present time about 200,000 yards of sands, gravels and crushed rocks and shales are annually used for surfacing and binding material on this semi-completed modern road system. Much of this material is taken from pits and quarries situated on or directly adjacent to new road construction.

Every mile of the 1922 miles of railroad constructed in the state is ballasted with Wyoming material. A total mileage almost as long situated outside of the state is also constructed of the same material. For ballasting their road bed as far east as Omaha the Union Pacific annually excavates many thousands of tons of disintegrated granite from their Sherman Hill borrow pits. For their lines in Utah, gravel is dug from the Irvine pit located at Green River. During the past year \$50,000.00 was expended in opening up a new pit in that city, that provides an additional shipment of 700 tons daily.

In 1927 the five railways operating in Wyoming reported commercial shipments of 5,060 cars of stone, sands, gravels and clays amounting to no less than 269,372 tons from pits and quarries situated on their lines. No records

are available on cars of ballasting material that the railways transported over their own lines free of cost. To maintain their road beds both in and out of Wyoming, their own non-reported business doubtlessly exceeded the revenue shipments by several times. Most of their long haul shipments were evidently destined to points outside of the state.

As yet no figures are available on the railroad shipments of 1928. At the beginning of the year the railways voluntarily reduced the rates on sand and gravel shipments. This move highly stimulated the export business of the rapidly expanding industry. Domestic non-revenue shipments of railway ballasting material were also vastly augmented by the Union Pacific in constructing their new 52 mile cut-off from Egbert to Creighton. At the peak of the construction period as high as 70 men were employed in their Sherman Hill gravel pits at Buford. Due to the superiority of local deposits, Wyoming can look for a continued healthy growth in an industry largely financed by federal highway funds as well as by out-of-state sales and shipments. At the present time the increasing payrolls derived from these sources contribute their part in making Wyoming a prosperous state.

ASPHALTS

It is not generally known that Wyoming is an important producer of manufactured asphalt. At the present time incomplete statistics indicate that Wyoming ranks ninth among the states in the production of asphalt made wholly from their own sources of petroleum supply. In the East, refineries manufacture large quantities of asphalt solely from oils transported from distant states or else imported from foreign shores. As soon as a larger demand arises for asphalts in the Rocky Mountain area an opportunity will be provided to develop some of the black oil pools of the state from which production has so far been closed.

So far but 36 miles of the state highway system has been paved. In the future long mileages of these roads will be paved with modern asphalt and concrete material, all of which will be made in Wyoming, exclusively.

According to report submitted by the Midwest Refining Company, their shipments and deliveries of asphalt from their Wyoming Refineries in 1927

approximated as follows:

<u>Destination</u>	<u>Tons</u>
Rocky Mountain territory (Wyo., Colo., Mont., etc. - - - - -	5,600
East of Rocky Mountain territory, except Neb.) - - - - -	15,600
Nebraska - - - - -	2,425
Canada - - - - -	825
Total - - - - -	24,350

The foregoing figures plainly disclose that before Wyoming can consume the greater portion of her manufactured asphalt production, the population of the state will have to be multiplied at least tenfold. Precisely similar remarks apply to practically all of her mineral products, irrespective of all contrary propoganda current to buy or sell only home-made goods. As a matter of fact, due almost exclusively to our giant oil industry, Wyoming is already one of the big export states of the union in mineral products.

NATURAL ASPHALTS

The extensive deposits of asphaltic sandstones known to occur in central and southwestern Wyoming would provide first class surfacing material in their raw form. Due to the isolation of these deposits, as well as their inability to compete with the pure asphaltic bi-products of our refineries, the natural deposits have so far remained undeveloped. Logically, development of these unusual mineral reserves must await the increased road expansion programs of the future.

Should similar sandstones occur in less favored mineral states, vigorous attempts would be made to liquefy or distill off their 10% bituminous or asphaltic contents. In Wyoming no economic reason exists to undertake such superfluous developments. The pure petroleum asphalts turned out by the Midwest Refineries have an intrinsic value at least twice as great as the natural asphalts ordinarily produced in the United States. So long as the big producers continue to manufacture far more asphalt than the state can possibly consume, it would be folly to take further note of the decidedly inferior natural reserves of Wyoming.

ROAD OILS

The progress that oiled highway construction made in Wyoming during the present year was recently summarized in the Press. In their issue of October 5, 1928, the Eagle concisely reviewed the economics and technology of the oiled highway operations that have so far been conducted in Wyoming. As their condensed

report covers latest findings and developments. It is accordingly inserted below:

"OILED HIGHWAYS IN STATE ARE PROVING SUCCESS EVERYWHERE

With completion yesterday of thirty miles more of oiled surface on the state highway (from Casper to Natrona), highway commissioners here for the meeting of the board are viewing with satisfaction the progress made in oiled highway work during the present season.

At the present time, according to E. E. Sevinson, superintendent of the state highway department, Wyoming will have ninety-two miles of oiled highway at the end of this year. This construction is more or less as an experiment but which is now regarded as having proven the feasibility of using oil on Wyoming roads.

At the present time there are 25 miles of oiled highway adjacent to Laramie on the Lincoln Highway, six miles from Rawlins to Pardo, thirty miles from Casper to Natrona, two miles from Torrington south, nine miles on the Torrington-Lingle road; and twenty-two miles from the end of the pavement of the Casper-Salt Creek road to Midwest.

Highway commissioners point to the success of the oiled highways in California and Oregon and to the successful result of the oil construction in Wyoming as evidence of the advisability of stressing this type of highway whenever and wherever conditions warrant.

Several factors, they say, indicate that the oil highway is to be preferred over other types of construction.

Wyoming black oil, now wanting a market, has been proven to be on the equal with California oil for this use. The oil when prepared for highway work has an asphalt base of from sixty to seventy per cent.

Much of the desirability of concrete or asphalt paving, costing between \$35,000.00 and \$40,000.00 per mile, is also found in the oil surface when laid under similar conditions, costs \$1,500.00 a mile, it is pointed out.

When compared with other surfacing the oiled highways are not costly to keep in repair. The ordinary gravel surfaced road requires \$250.00 per mile to maintain in repair each year, a fact which is attributed largely to the wind. It is stated that the gravel surface loses an inch a year, which amounts cost

from \$700.00 to \$1,000.00 a mile to replace. To completely re-surface a graveled road about once every seven years, the cost amounts to from \$4,000.00 to \$5,000.00 per mile.

Some oiled roads in California, it is said, are in splendid condition after ten years' use without repair.

Although the opinion of both highway commissioners and the highway superintendent appear to favor more oiled roads, the extent to which such construction will be undertaken next year is indefinite, however, until the amount of money available for highway construction and the general needs of the state are taken into consideration."

Many residents have already had occasion to strongly endorse the reported findings of the State Highway Department. Next to asphalt and cement pavements, oiled roads are preferred above all other types of highways that can now be constructed wholly of Wyoming materials. By no means is this general approval confined to the residents of Wyoming. In a late issue of a Nebraska paper its readers were advised to take a trip to Wyoming in order to see what a real road looked like. In this instance specific reference was made to the 9 mile section of oiled highway construction recently laid between Torrington and Lingle.

The time is here for Wyoming to gain leadership in oiled highway construction, not only, throughout the entire Rocky Mountain region, but also, over wide expanses lying directly adjacent thereto. In the future the state itself should serve as a giant research laboratory for the use and application of its high-grade asphaltic oils as a medium for the practical solution of the rapidly increasing traffic problems of the day. For the next several years it would seem advisable to construct the new oiled roadways over stretches that lie directly within the Wyoming boundaries. Already, this new type of construction has appealed to the fancies of at least one of our neighbors. If all surrounding states would have a similar opportunity to contrast the advantages of oiled highways, it would not be difficult to develop a far broader market for the output of our petroleum fields of high asphaltic base. Since

Oregon Basin and later pools have been brought in, it is daily becoming harder to find sizable markets for the black oil production of Wyoming. Any move that the State Highway Department may make to popularize the sale of that commodity in neighboring states is bound to receive the unanimous endorsement and support of the black-oil producers of Wyoming.

In Wyoming nearly all black oil production is from pools located on public lands that belong either entirely to the state or else jointly to the state and the Federal Government. This unique situation makes Wyoming an actual proprietor of the major oil operations conducted within its vast confines. In every sense of the word this proprietorship calls for added responsibilities on the part of the several departments of the State Government. Therefore, whenever an opportunity is presented for any one Department to promote and enlarge the market field for commodities produced directly under state proprietorship, approved business practice demands that the added role of a commercial salesman be also performed by the administration in charge. If sufficient missionary work is done along oiled highway construction, in course of time the public royalties collected from added sales and shipments to neighboring states, barren of petroliferous deposits, should prove sufficient to finance more road building programs directly within Wyoming. Manifestly, no tax-payer would file serious objections to neighborly sales promotion campaigns and other self-supporting movements of the procedure hereinbefore outlined.

In the meanwhile, Wyoming should continue to demonstrate the feasibility and economics of oiled highway construction. If that type of roadway is built on locations that extend to the boundaries of the state, our neighbors would occupy the best possible vantage points to make protracted studies and comparisons of its superior merits.

SALINE AND ALKALINE DEPOSITS

Within the vast chemical laboratory of Wyoming many salt, sulphur, iron, alkaline earth, mud and hot springs naturally emerge to the surface in nearly every part of the State. In addition to the deposits formed from these mineral springs, there occur in Wyoming valuable and huge deposits of sodium and magnesium largely in the form of soluble sulphate and carbonate compounds. As a rule the latter deposits occur as surficial beds in small drainage areas or beds that have no outlet. Many of these beds are called "lakes", as they form in lowest parts of basins and during the spring and summer months are covered with shallow waters.

GEOLOGY

In Wyoming thick deposits of high-grade sodium and magnesium soluble salts are found in the beds of dry lakes and ponds that vary from those of a few feet in diameter to some that cover several hundred acres in area. As they occur in all parts of the State, most of these alkali deposits appear to have a common origin. According to United States Geological Survey Bulletin No. 430, the alkali deposits occur in all formations above those of the Paleozoic age. They are most abundant in the Triassic beds but appear in all formations from the Paleozoic down to the soils of the present time - the Mesozoic and Cenozoic, containing many times as much alkali as the older formation.

In some localities the amount of alkali stored in clays and shales - the common source of supply for the leaching waters - is enormous. In the Red Desert, the alkali content of the red pulverulent clay is as high as 30 or 40% of the total mass. Obviously, this exceedingly rich original material will never be exploited as long as the chemical pure soluble salts continue concentration and crystallization in the natural evaporation basins of the nearby lake-beds at a rate of accession far in excess of annual marketing demands.

DISTRIBUTION

In a paper of this length it is not possible to record the names and locations of the thousands of mineral springs and alkali lakes that are found in every section of the State. Soda lakes of considerable size and importance are located in Albany, Carbon, Fremont, Johnson, Natrona and Sweetwater Counties. Of the counties mentioned, Albany, Carbon and Natrona contain the most numerous alkali lakes. Until the larger and more favorably situated deposits of these

counties are exhausted, the remaining smaller and more remotely located lakes of the State can offer but little promise for economic development. In the ensuing remarks only the principal deposits of the leading saline and alkali chemicals of the State receive separate descriptions.

SODIUM CHLORIDE

Extensive beds of sodium chloride (common salt) of great purity occur in Crook County, west of the Black Hills and in western Lincoln County along the Salt River mountains. Salt springs and deposits are also found along the western state-line where Lincoln County borders Bannock County, Idaho. In that locality salt has been produced in both states for many years. The principal salt-producing area of Lincoln County lies south of Star valley on the route to Cokeville. In the past, salt developments of magnitude were located on Salt Creek in Sec. 26, Twp. 29 N., Rg. 119 W. In this locality the brine springs were found similar to the workable springs located on the Wyoming-Idaho border. Spring discharges indicate that heavy beds of rock salt underlie the Salt Creek area.

Estimates on the total salt resources of Wyoming are far from complete. In the workable areas along the Wyoming-Idaho border a Government geologist recorded the total for both states at 5,000,000 tons. In the old days, before the advent of railroads in the west, relatively large amounts of salt were boiled from the brine springs of western Wyoming and hauled by ox-team to supply Idaho and Montana mining camps.

As yet, all salt deposits of Wyoming are remotely located from existing railways. Until transportation facilities are provided, only local markets will exist for the salt resources of the State. At the present time most of the salt sold in the State comes from the Great Salt Lake and from the brine beds of Kansas. Until additional railways are built, the supply of the neighboring states will likely remain cheaper than the salt produced in the more remote localities of Wyoming.

SODIUM CARBONATE

Besides the surface alkali deposits or so-called soda lakes, numerous soda springs are scattered throughout Wyoming. These springs and soda deposits are too numerous for further description herein. Like the spring waters, much of the well waters in Wyoming contain a large amount of alkali salts. A notable example is the water in the wells of Green River City. As these wells were drilled along the route of the greatest transcontinental railway system and are located in the heart of a region containing diversified and unrivaled chemical deposits, they alone warrant description in a paper of this length.

Over twenty years ago a dozen wells drilled within the City of Green River disclosed that a bed of almost chemically pure sodium carbonate lies under the city at depths ranging from 125 to 300 feet below the surface. A sample of these well waters sent to the University of Wyoming proved to be a nearly saturated solution of sodium carbonate of greater purity than any found elsewhere in the state. The water contained 8.9% of sodium carbonate, or 24% of crystallized sal soda. These crystals contained only undeterminable traces of sulphates and chlorides, and as such, were much purer than the manufactured product ordinarily sold in commerce. As further reported in United States Geological Survey Bulletin, No. 430, the following typical analysis is recorded for the Green River soda:

Silica	0.51
Iron and Aluminum	0.42
Calcium	0.64
Magnesium	0.27
Insoluble Residue	0.23
Water	22.57
Anhydrous Carbonate of Soda	<u>75.36</u>
	100.00%

Next to salt, sodium carbonate is the most important of all sodium compounds. Few states have deposits of the natural chemical as pure and extensive as Wyoming. A pumping test recorded in Bulletin No. 430 disclosed that 60,000 gallons of water was pumped in a 24 hour interval from a Green River City well. At the end the depth of water was only lowered one inch and no diminution in the strength of the soda solution was noted by the exhaustive pumping test concluded.

UTILIZATION

Outside of Wyoming, only small quantities of sodium carbonate are found in nature. The manufacture of the prepared compound from common salt by the Leblanc and Solvay processes forms one of the most extensive chemical industries.

Besides its general use as a cleansing agent, enormous quantities of sodium carbonate are consumed in the glass and soap industries and in the preparation of other soda compounds of basic importance. By the addition of slaked lime to a solution of sodium carbonate, preferably of the strength directly pumped from the Green River wells, caustic soda (sodium hydroxide) is formed. Immense quantities of this powerful alkali are consumed in making hard soaps, paper and dyestuffs; in bleaching, and in the refining of kerosene oil. In the Green River valley large quantities of both basic ingredients used for making caustic alkali occur in a state of almost chemical purity.

Shortly after the discovery of sodium carbonate the preparation of the refined salt as well as the manufacture of sodium hydroxide therefrom was carried on for a number of years on a small scale at Green River City. Due to great distance from the large consuming markets as well as to other economic factors of a rather premature variety, the industry failed to survive. At the time it was organized no local demand existed for the prepared salts. At this advanced scientific day an entirely different set of economic conditions prevail in the valley. As soon as the Winter Potash Research Bill now pending in Congress passes, it will be highly desirable to have a local supply of sodium carbonate directly on hand. For breaking down the refractory potash-rich silicates of the valley the late patented processes of Henwood, Plausen and others would demand large quantities of cheap sodium carbonate for successful operation. Moreover, for the manufacture of the even more valuable potassium phosphate salts from the exhaustless rock deposits occurring within the valley, liberal applications of sodium carbonate would likewise be required by numerous American, German, English, Japanese, Italian and Scandinavian processes patented within the past few years.

Another sodium compound now used in all kinds of fertilizer extraction processes is sodium sulphate. As previously mentioned, in the Green River valley and other places in Wyoming, exhaustless supplies of this saline material, likewise, abound.

So far, many separate reports have been filed on the divers alkali and mineral fertilizer deposits of Wyoming. In past papers it has been the universal

practice of Government and other geological experts to consider each single chemical deposit wholly as a separate and detached entity. That individualistic policy has already caused financial fiascos of a disastrous order to occur in Wyoming. In the past this office has witnessed costly attempts being made to produce both potash and alkali compounds in the Green River valley wholly in the light of independent, non-related, chemical enterprises. Suffice to state that until someone can demonstrate in a material manner the reactions of wide industrial application that take place when alkaline and fertilizing minerals common to Wyoming are brought together, lethargy, in lieu of logical economical development, will likely continue to rule within the vast chemical laboratory that forms the great State of Wyoming as a whole.

Aside from the Winter Research Bill, this office has not been cognizant of any steps ever being taken towards the practical solution of the greater chemical problems that still confront Wyoming. Should that measure ever cause a concourse of savants to convocate directly within the Green River valley, observant local residents would experience no difficulty in pointing out huge deposits of every chemical element that enters into the manufacture of all kinds of fertilizer and explosive agents. Instead of developing these unrivaled chemical deposits, America still suffers foreign domination for the supply of mineral fertilizers that forms the foundation of its food supply as well as for the cannon powder that would be consumed in event of invasion or attack.

PLATINUM

During the past 30 years a number of important discoveries of platinum ore have been made in the mountain ridge lying due west and south of the old mining village of Centennial. Selected assays made under the supervision of the United States Geological Survey found the highest grade sulphide ores of the district to carry more than one ounce of platinum values to the ton of ore. At the present writing, platinum is quoted at \$80.00 per ounce and during the past 5 year period the metal has sold as high as \$125.00 per ounce, or slightly more than 6 times the value of pure gold.

Developments to date have unmistakably proven the existence of platinum and other associated metals of extremely high value in the Centennial Ridge of mountains. So far the great difficulty has been to locate a sizable ore body of proven platinum content. At the present time, a promotion company is expending large sums of money in the development of a huge local dyke, the chemical composition of which doubtlessly approaches the diorite, norite, and peridotite rocks of South Africa, in which valuable discoveries of platinum metals have been made during the past two or three years. Already, the literature accumulated on the recent African discoveries is of extensive proportions, but inasmuch as the metallurgy of these newest discovered foreign depositions so far remains unsolved, this office must await further advancements in the metallurgical art before being in a position to pass a final opinion on the recoverable platinum values said to be contained in the huge basic dykes that intersect the Centennial mountain ridge in several directions.

S I L V E R

Statistics of the United States Geological Survey disclose that 70,113 ounces of silver has been produced in Wyoming up to the past year. Much of this silver was recovered as a by-product in the mining of copper and other metals. The greatest single producer was doubtlessly the old Silver Cliff mine that now adjoins the present city of Lusk. In recent years, the latter property was worked exclusively as a radium mine, and immediately prior to titular litigation concluded three years ago, extremely profitable shipments of radium ore were shipped therefrom.

To date no extensive deposit of rich silver ore has been uncovered in the State. In the old Cliff property at Lusk, silver in the native form was mined, and at Laramie Peak and other localities, both the sulphide (argentite) and the chloride (cerargyrite) have been found. In the big silver producing countries of the world the latter minerals form the richest ore; but depositions so far examined in Wyoming have invariably proven to be of disappointing magnitude. As all Wyoming copper ores are known to carry silver values, it is probable that the silver recoveries of the future will come from deposits primarily mined for their copper content.

OTHER METALLIC MINERALS

In addition to the commercial ores so far reviewed, discoveries of bismuth, nickel, cobalt, molybdenum, tungsten, palladium, cerium, didymium, lanthanum, thorium, and yttrium minerals have been reported in Wyoming in times past. Investigations made by members of the present staff during the past 10 year period have generally found these depositions to be of extremely disappointing extent. As yet no prospecting operations of magnitude have been conducted for the search of these rarer minerals. Further explorations may, nevertheless, uncover commercial discoveries of the more common of these valuable metals within the Wyoming mineral depository.

Among the tables inserted in the appendix of this volume is the inventory of the United States Geological Survey, entitled, - "Useful Minerals of Wyoming" - For the location of Wyoming depositions of all eleven metals mentioned in the preceding paragraph, the reader is respectfully referred to that official register of the Survey. Since assuming office two years ago, no time has been available to conduct studies of these little known mineral deposits. As matters now stand the brief listings of the Survey must largely supply the extent of information available on minerals of high intrinsic value so far known to occur either in Wyoming or elsewhere in the United States only in extremely limited quantities.

Aside from molybdenum and tungsten, the American production of the eleven comparatively rare chemical elements mentioned may be considered negligible. Our more intensified mining state neighbor, Colorado, always leads in molybdenum and generally ranks second or third in tungsten production. The Colorado deposits are near Leadville, Boulder and other points in the northern portion of the state. It is possible that similar geological conditions may in course of time be observed to prevail in the Encampment, Centennial and other highly mineralized areas that border the southern boundary of Wyoming.

ABRASIVE MATERIALS

The leading natural abrasive materials of Wyoming include deposits of emery, garnet, grindstone, pumice and tripoli. So far this office as well as the Government Survey have only made fragmentary and woefully incomplete investigations of the abrasive resources of the state.

CORUNDUM

In United States Geological Survey Bulletin, No. 624, a deposit of corundum (emery) is listed as occurring in the Wind River range of mountains in Fremont County. As no further mention has been made of the deposit since the listed date of 1917, it is doubtlessly of too small extent to possess commercial possibilities. To date no samples of the mineral have been received by this office.

In recent years the manufacture of artificial corundum has become a tremendously more important industry than the production of the natural mineral, the occurrence of which is no longer adequate for present-day requirements. For making corundum of a quality far superior to that sold today, Wyoming can soon rely on an unique mineral deposition of exhaustless magnitude, the like of which is not found in any other state.

As in present producing localities, the future corundum industry of Wyoming will constantly lean more to the manufacture of the artificial product rather than towards the development of native deposits that are everywhere of limited extent and of a quality far inferior to the manufactured grade. In the final chapter, entitled, "Artificial Abrasives", Wyoming's future in the rapidly expanding corundum industry will be briefly outlined.

GARNET

At times garnet bearing deposits have been reported in areas of the state in which profound metamorphic disturbances occurred in the geologic past. The only garnetiferous properties that received notices in the Press during the present year were those of the Cooney Hills Mining Company. According to recent despatches the present plans of the company call for extensive development of their garnet and talc properties that are situated in the well known

mineralized area that lays southwest of Wheatland. Specimens of the mineral brought to this office disclosed garnet crystals of good color about the size of a pea to occur in a schistose matrix. These crystals are said to be of sufficient hardness for the preparation and manufacture of first-class abrasive materials. Aside from its use as an abrasive, the crystals on further optical and physical tests may prove of value as semi-precious gem stones or at least serviceable for jewel settings for the cheaper grade of watch movements.

GRINDSTONES

In former publications, the United States Geological Survey reported a small production of grindstone from the Rawlins district. In recent years no quarrying activity for that material has been noted in the locality.

During last April, press despatches announced that Mr. H. S. Crispen had started the only grindstone factory in the entire Rocky Mountain region, at Lander. The rock from which the stones are shaped by cutting machinery are obtained from a sandstone deposit on Baldwin Creek. The samples so far produced are reported as flawless and to possess a superior cutting edge. As no other grindstone works are at present operating in the west, a local market of exceptionally wide dimensions should be developed in time for the finished products of the Lander plant. Not receiving samples for testing purposes, this office is still unable to issue a conclusive report on the adaptability of the quarried sandstone as an abrasive agent. At the present time, grindstone rocks are largely graded on chemical tests that ascertain the character and percentage of the cementing material as well as on physical tests that record the size and shape of the component quartz grains.

PUMICE AND PUMICITE

An extensive bed of pumice from 4 to 6 feet in thickness is reported by the Geological Survey to occur in Albany County in the vicinity of Sportsmen Lake. At other places in eastern Wyoming, private geologists have reported the discoveries of huge beds of pumice and pumicite from time to time.

Pumice is a highly vesicular or cellular, glassy volcanic lava, usually rhyolitic in composition. Its cellular structure is due to the expansion, during cooling, of steam and gasses contained in the molten lava.

Pumicite, or what is now erroneously called volcanic ash quite generally, is a more or less finely divided powder or dust made up of small, sharp, angular grains of volcanic glass of about the same composition as pumice. It is formed by the violent and explosive eruption of volcanoes, which throws out this dust in great clouds. Ultimately, the dust settles, often many hundred or thousands of miles from its original source, and forms beds of pumicite.

In Tertiary times the phenomenon of vulcanism thrived in Wyoming on a scale far more colossal than any similar disturbance yet recorded in the written history of the human race. During recent geologic periods, convulsions of confined cataclysmic forces threw up the lava flows that now form the spectacular and bizarre volcanic necks and knobs of the Leucite Hills region; the acid intrusives of Wyoming's sector of the Black Hills; the awe-inspiring phonolite laccolith now known as the Devil's Tower; and last but not least, the rhyolitic and basaltic sheets that make-up the great Pitchstone plateau of the Yellowstone Park region. Accompanying those tremendous displays of terrestrial fireworks were fair-sized volumes of fragmental materials ejected largely in the form of blocks, lapilli, bombs, the so-called volcanic ashes (pumicite), cinders and the like. Apparently, in those days the prevailing wind direction was, likewise, from the northwest. At any rate, instead of remaining here the evil winds of that geologic period succeeded in blowing out of Wyoming an amount of volcanic dust sufficient to blanket half of Kansas and practically all of Nebraska with layers of pumicite that range from a few inches to over 80 feet in thickness. In all fairness to the winds of the pre-historic past, it should be mentioned that the thicker of these pumicite deposits were laid down quite close to the line that now forms the boundary common to Wyoming and Nebraska. However, it must be admitted that the farther the pumicite was blown out of Wyoming, the fineness and quality of the deposition generally improved.

Pure lump pumice similar to Wyoming grades is used as an abrasive for polishing various metals, alloys, woods, painted finishes, stones, porcelains, glasses, pottery and rubber products. In the ground form it is a constituent of ink erasers, tooth powders and other mildly scouring and cleansing preparations. In some foreign countries in which similar volcanic disturbances have occurred,

block pumice in the hewn form is desired as a fancy and easily quarried building stone. A use for pumice of considerable future promise is the cement industry. As a matter of fact, buildings constructed of pumice cement by the Romans at the beginning of the Christian Era are still standing. In recent years patents have been taken out for pumice cements and mixtures of improved qualities. Kansas, which now leads in the production of the mineral as well as in research work relating thereto, has lately had occasion to believe that the cement industry will soon be the largest consumer of their deposits.

As listed by Ladoo, pumicite is used in making abrasive hand soaps, mechanics' paste soaps, silver and other metal polishes, dustless sweeping compounds, paint fillers, oil filtering compounds, and heat insulating materials. By far, most of the pumicite is consumed in the manufacture of cleansing compounds. Old Dutch Cleanser, a product familiar to most housewives, contains no less than 98% of pumicite mineral. Other less widely advertised preparations have a pumicite content almost as high.

As now developed, fully 95% of the total pumicite production of America is mined, milled and marketed in the two nearby states of Kansas and Nebraska. Once upon a time much, if not all, of this air-borne abrasive material was emitted from volcanic vents formerly active within boundaries that now delineate the Sovereign State of Wyoming. On the higher plateaus of the state, windstorms still occur that inflict damages to growing crops as well as to the older and more fragile building structures. However, it may safely be presumed that many years will pass before any other tornado, cyclone or twister will descend with pick-up propensities sufficiently disastrous to transport bodily the basic raw materials of a modern mineral industry from original Wyoming locations to points fully 500 miles more convenient to the great consuming markets of the nation. Today, much is heard of the devious ways in which the water and other resources of Wyoming are constantly enriching the material prosperity of the older and more populous states. Geologically speaking, Wyoming started on that job long before the Indian and the buffalo came to these parts. Indeed, in Wonderful Wyoming more than poetic license exists for paraphrasing the old saw of the prophet to - - "Tis an ill wind that blows no State good".

TRIPOLI

From time to time former state geologists reported the occurrence of comparatively heavy beds of tripoli in the Sunrise and other localities of the state. Lack of inquiry apparently prevented the prior incumbents from making field investigations of those deposits. As soon as some interest is displayed, this office will likely make inspections of the more important discoveries recently reported in Wyoming.

As a matter of fact, visual inspections do not always suffice for the identification of tripoli. Before the qualities and adaptabilities of the Wyoming material for use as an abrasive agent can be finally established, a number of rather costly chemical, microscopic, physical, and industrial efficiency tests of a comparative order will have to be performed. Due to the reasons mentioned, this office is still unable to file conclusive findings on either the character or extent of the tripoli discoveries that have so far been announced in Wyoming.

ARTIFICIAL ABRASIVES

The preparation and manufacture of artificial abrasives is becoming increasingly important. In recent years the industry has been making severe inroads in business formerly controlled by the natural abrasive producers. As a matter of fact, for 1927, the Bureau of Mines recorded the total production of artificial abrasives in the United States as having a value over twice as great as the entire business negotiated by the producers of natural abrasives. For reasons briefly recorded in following lines, one realizes that in lieu of blowing away from Wyoming, gales and trends at last prevailing in the abrasive industry are rapidly pointing in the direction of Wyoming. In short, future Wyoming will doubtlessly esteem the manufacture of artificial abrasives as of vastly more importance than the quarrying of decidedly inferior natural materials that at least originated in Wyoming irrespective of whatever foreign localities they long ago selected for their final resting places.

The two principal products of the rapidly growing industry are alundum and carborundum. Alundum is merely aluminum oxide, manufactured wholly from the native oxide, bauxite, by an electrothermic treatment. It accordingly resembles

corundum and when prepared from mineral of a high degree of purity, its hardness is even superior to that of ordinary natural emery that oftentimes contains many impurities of a derogatory character. On the mineralogists scale of hardness natural corundum or manufactured alundum, is only exceeded by that of the diamond. As such, it is far more lasting and durable than any natural abrasive material ordinarily found in commerce.

Carborundum is a crystalline compound consisting solely of silicon and carbon. Obviously, this high-power carbide that is slightly harder than corundum does not occur in the form of a natural deposit. It is manufactured by fusing a mixture of sand and coke in an electric furnace of the resistance type. At the present time the manufactured product is quoted at \$100.00 per ton, or a figure slightly in excess of that received for alundum.

To date, Niagara Falls has been the headquarters for all artificial abrasive materials produced in both United States and Canada. In course of time, Wyoming should advance to the forefront in the industry. Successful exploitation of leucite deposits by the Italian process, as described in the potash chapter of this volume, produces huge quantities of aluminum oxide as a chemically pure, by-product precipitate. Due to its purity, alundum of the highest known quality could be directly made from this aluminum precipitate, alone. Pending completion of proposed hydro-electrical developments, the unique Green River valley will provide by itself all of the mineral ingredients as well as the potential electro-thermal forces requisite for the successful manufacture of either artificial corundum or carborundum.

Yesterday, the one item of power development alone sufficed for the establishment of the entire artificial abrasive industry of the nation at the single site of Niagara Falls. Tomorrow, one valley of Wyoming will not only offer a truly colossal potential of hydro-electrical development, but in addition thereto, all of the mineral compounds and fuels that enter into the industry will likewise be produced within direct vision of the power house in unlimited quantities and in unrivaled states of purities. In the parlance of the present day schools of economists, combinations of that degree of consumptiveness, when discovered, are immediately tagged and labeled as completely self-contained lay-outs.

Heretofore, an undue amount of space was devoted to a rather ordinary natural abrasive that pre-historic winds of Wyoming finally succeeded in blowing into quite unappreciative neighboring states. The loss of the dim and distant geologic past should no longer concern the more alert citizens of the state. Today, the Wyoming problem should be exclusively concerned with devising ways and means for the manufacture of abrasives of vastly superior qualities from raw materials and power potentials that at all times remained intact and securely anchored within boundaries that now delimit the Sovereign State of Wyoming.

HYDROELECTRICAL POTENTIALITIES

In this as well as in preceding and subsequent chapters, frequent reference is made to the hydroelectrical possibilities of Wyoming. In the final section of this volume a more extended review of these potentialities appears under the chapter heading - "How Early Development of Wyoming's Hydroelectrical Resources Will Aid the Mineral Industry".

CERAMIC MATERIALS

An unusually wide and complete variety of ceramic materials are deposited throughout Wyoming. For a long time almost all of these deposits remained unexploited, but lately, an increasing interest has been taken in regard to their economic possibilities. In recent years some of these long dormant resources has caused the establishment of large industrial enterprises in different parts of the state. Their further development will go a long way towards making Wyoming a completely self-sustaining state.

A complete description of Wyoming's wealth in ceramic materials would call for the preparation of a separate publication of considerably greater bulk than this entire volume. Accordingly, in this highly condensed chapter attention can only be directed to resources already under active development as well as to a few deposits that promise industrialization at a comparatively early date.

NATURAL CEMENT DEPOSITS

From time to time the occurrence of natural cement deposits are reported from different parts of the state. As yet, the extent and character of only one of these deposits have been ascertained by actual drilling and chemical tests. This deposit comprizes the 2,950 acre outcrop of Niobrara limestone that is situated 10 miles southwest of Laramie. During the present year its owners, The Monolith Portland Midwest Company, constructed a railroad from the deposit to their new cement mill recently completed in Laramie.

Before constructing the new mill, hundreds of chemical tests were made from drill samples systematically taken throughout the deposit. These tests revealed a true cement mix approximating 85% in pure lime composition of an extent sufficient to operate a cement mill of 6,000 barrel daily capacity for a period of more than 250 years.

Before the close of the year, Wyoming will become an important producer of cement for the first time in its history. The first unit completed for the Laramie mill will turn out 2,000 barrels of cement a day. The present plans of the company call for the early completion of the second and third unit to their \$2,000,000.00 plant. Upon completion of the latter additions, the company's daily operations will more than supply all markets that will arise for cement in Wyoming.

The new cement mill at Laramie is the largest ceramic operation that has so far been completed in Wyoming. In recent years most all of our towns and cities paved the streets in their business districts. In every instance the cement used had to be purchased from distant mills located in outside states. The completion at Laramie will not only stop a severe drain that has too long been made on the financial resources of our state, but more than any other factor, it will stimulate the construction of additional mileages of cement highways and streets directly from materials manufactured in Wyoming at the lowest costs.

PORTLAND CEMENT MATERIALS

Close to many towns and cities of the state are important deposits of nearly pure limestones and shales. Portland cement of the highest quality could be made from these materials at a low cost. In course of time additional cement mills will likely be constructed in Wyoming at points most distant from the Laramie region. The city of Sheridan, as well as the more important towns in the Basin, are some of the points that offer advantageous sites for future mills. In their immediate environment are huge deposits of all raw materials and fuels consumed by the industry.

In the potash section of this volume, attention has been directed to the advantages that leucite rock offers for the manufacture of portland cement. At the tremendously high temperatures that cement kilns are operated, an unusually high percent of potash could be directly volatilized from that aluminous silicate. The collection of that valuable by-product would provide a handsome additional income for the mill that first substitutes leucite for the shale ingredient of the mix.

No major industry of the United States offers a more promising field for future expansion than the cement industry. In the past 7 year period, national consumption has increased 77% and as cement is now largely replacing the use of timber, and inasmuch as the less permanent construction of existing highways has proven to be woefully inadequate to handle the steadily increasing flow of modern motor traffic, the United States Geological Survey as well as this office, predict that within the next 10 years the cement industry will enjoy the greatest expansion ever known.

In Wyoming the outlook for the industry is particularly bright. In addition to improved highways, the citizens of Wyoming now demand immediate protection and development of immensely valuable water resources that still remain unappropriated by this and other states. The improvement programs long fought for by our statesmen call for the construction of towering irrigation and power dams along the major river channels of the state. To build these huge engineering structures, unprecedented quantities of cement will have to be supplied.

As mentioned elsewhere, many technical and diplomatic problems involved by the river improvement programs have already been solved by the statesmen. Towards their economical and practical solution, other individuals have, likewise, been doing their share in a less vociferous manner. For construction of these inevitable structures at the lowest possible cost, Wyoming materials, alone, must be consumed. As soon as work is started on these great improvements, Wyoming will have no cause to regret that industrial pioneers of the strength and vision of the Monolith Portland Midwest Company were found to be blazing the trail in a big way at a date as promising and auspicious as the present year.

SHALE AND CLAY DEPOSITS

From time to time, plants for the manufacture of building bricks and other clay products have operated in the larger cities of the state. In recent years, two firms have rapidly advanced to the forefront in the industry. These widely known enterprises are the Parco Brick Company and the Lovell Gas Company, whose works are located in the southern and the northern section of the state, respectively.

In the fall of 1927, the Parco Brick Company completed, at a cost of \$100,000.00, a modern brick works at Parco. At the present time, the plant has a capacity of 250,000 standard and ornamental face bricks per month. Additions to the plant are already contemplated for the manufacture of fire brick as well as tinware in the shape of hollow building tile, roofing and drain tile, and other ceramic products.

For raw material the company located their plant directly on a shale deposit. For operation of the plant natural gas is used exclusively for fuel, and power in the form of electricity is obtained from the refinery of the Producers

and Refiners corporation. Wholly by the aid of delicately controlled thermo-static processes the company has so far been able to produce in commercial quantities ornamental bricks in no less than twelve different shades and colors from one uniform shale deposit. Without natural gas it would be entirely impossible to obtain the highly sensitized temperatures and controls that the complete line of Parco products require for standardized manufacture. The present operation in Parco plainly discloses the absolute necessity of using one of Wyoming's ideal forms of fuel in the modern ceramic industry.

To designate their product the company has recently coined the slogan - "the brick of incomparable pigmentation". Many modern buildings have already been completed in Wyoming of Parco bricks. The pleasing appearance of these bricks already has been widely observed. In the past Wyoming had to import all better grades of bricks from neighboring states but from now on the new plant at Parco will largely eliminate that serious drain upon the state.

During the present year the Cross Gas company excavated and mined approximately 5,000 tons of clays and shales for the manufacture of their well known lines of drain and sewer pipes, floor tiles, face bricks, flue linings, and hollow blocks in their modern plant situated at Lovell. The finished wares of this firm are of the highest known standards and largely for that reason the fame and market for their ceramic products broaden widely in each succeeding year.

In their plant natural gas is used exclusively. Without that ideal form of fuel it would be impossible to obtain the sensitive temperature controls demanded for the manufacture of their products of superior merit..

REFRACTORY MATERIALS

As yet no studies or tests have been made of the relative merits of the huge deposits of fire clays, gannisters and lesser known refractory materials that occur in many parts of the state. Due to the variety of deposits a refractory industry should soon develop in the state. Exploitation of the cheaper and more common materials must naturally await further industrialization and settlement within the state. Beyond making Wyoming a complete industrial empire the more ordinary refractory deposits may be said to have no value at the present time. In the future the availability of the local deposits should do their full share

in attracting steel, hydro-electrical, chemical, fertilizer, metallurgical and other industries that are largely dependent on modern high temperature generation for successful operation.

Among the most valuable refractory minerals found in Wyoming are kyanite, graphite, chromite, titaniferous iron ore, talc, tripoli and some forms of mica. With the exception of kyanite, descriptions of the character and extent of these minerals appear elsewhere in this volume.

The wonderful properties of kyanite as a modern refractory do not appear to have been discovered until the past few years. Accordingly, it has been found out that bricks made of kyanite will withstand two cones of temperature higher than that of any other commercial refractive so far discovered. Its melting temperature of 3,400 degrees Fahrenheit permits the calcined mineral to be used for lining kilns and electric ovens in which the highest temperatures of modern metallurgical practice are produced.

Important discoveries of this rather rare mineral in a relatively high state of purification are frequently reported from both Wheatland and Encampment localities. At present mineral of similar purity appears to be sold at eastern points from \$50.00 to \$65.00 per ton after undergoing mining and preparation costs ranging from \$15.00 to \$20.00 a ton. In event the Wyoming deposits prove to be of commercial extent, plants for the pulverization and calcination of this highly refractory material will certainly be erected in the Wheatland and Encampment localities. But before this office can supply reasonable conclusive information to correspondents on these and similar deposits, constantly reported, the services of one or more research ceramicists would have to be continuously employed first of all. At the present time this department has no funds available to conduct extremely advanced chemical and pyrometrical tests of Wyoming material, the virtues of which so far remain largely undescribed in the latest scientific literature.

Chrome iron ore is another exceedingly valuable refractory material. In the form of fire-brick, chromite now sells for \$45.00 per ton. The United States Geological Survey reports the deposits on Casper Mountain as the fifth largest reserve in the United States. It is possible that these low grade

deposits offer more promise for exploitation as a refractory than for direct reduction to the metallic form. Studies along these lines should be conducted in the future.

So far the huge deposits of high grade titaniferous ores at Iron Mountain have not been exploited for the stated reason that their reduction is not possible by temperatures obtainable in the modern blast furnace. Should some one take the time to conduct tests, their melting point would presumably be found to be on a parity with that of chrome fire bricks. In that event, an incomparable supply of raw material is now available in Wyoming for the establishment of a highly profitable refractory materials industry. At the present time advanced pyrometrical tests of the comparative order described cannot be conducted by the equipment installed in this office.

In quality and magnitude the huge titaniferous deposit at Iron Mountain is in a class by itself. Had a similar deposit occurred elsewhere, it is possible that its economic possibilities would largely be known by this time. As now as in the future, Wyoming must look to itself for the solution of the Iron Mountain problem.

GLASS-MAKING MATERIALS

At two different sites in Wyoming every ingredient that goes into a modern glass furnace charge are found in vast quantities. In addition to pure snow-white quartz sands, these materials include deposits of chemical pure sodium sulphate and limestones as well as the solid or gaseous fuels necessary to fire the glass furnaces aforesaid. These two sites are at or near Laramie and Lovell, Wyoming.

In both of the cities mentioned, glass-works were built in the past. In either case their establishment appeared to be somewhat premature. At the present time the bigger and most successful glass-works of the nation are located in or near large consuming markets. To these points glass-making materials in the crude form can be shipped at far lower freight rates than the exorbitant charges that ordinarily prevail on the bulky containers and other similar fragile products that are shipped from the factories.

For the next ten years or more, Wyoming should be more interested in developing a market for the wonderful deposits of glass-making materials that

abound in the state. In a prior chapter the vast deposits of sodium sulphate in Wyoming have been described. At the present time these deposits remain unprotected by tariff charges. If adequate duties can be provided on this sodium compound the comparatively near deposits of Wyoming would attract more favor with large eastern manufacturers than present sources of supply that reach their plants at the low carriage rates that prevail on goods transported on the High Seas.

If adequate duties are provided, more glass-making works would be established in the large centers of population of the Missouri and Mississippi valleys. At such points the exhaustless raw materials of Wyoming could be shipped at the lowest possible charges.

POTTERY MATERIALS

In times past, Chambers of Commerce have reported the existence of feldspar and other deposits suitable for the manufacture of pottery and porcelain products within the immediate vicinity of Wheatland, Casper and other Wyoming cities. As yet no plants have been established for the manufacture of these products in Wyoming. Their establishment is surrounded by transportation, marketing, and other economic problems of the character described under the previous heading. In course of time some of these deposits will be developed, but herein, nothing would be gained by a reiteration of remarks appearing in the chapter immediately preceding.

SUMMARY

The preceding fragmentary remarks do not begin to describe all of the important saline and alkaline deposits of the state. To give an account of all the springs, lakes, shale and fuel beds that contain deposits of these soluble salts would require the preparation of a separate volume far too bulky to be of interest to the general reader. However, elsewhere in this volume other soluble chemical salts peculiar to Wyoming are recorded. Perhaps the most important of these is the ammonium alum, Tschermakite, that is described in the nitrogen chapter of this work.

As previously stated, in Wyoming occur natural deposits of salines of profound economic potentialities. In far less favored climes the manufacture of some of these salts form one of the most basic and extensive of all chemical industries. Outside of Wyoming more of these soluble compounds are contained in Germany than any other area already industrialized in a highly intensified manner. For many years Germany has been the chemical giant among the nations of the world. That leadership began when peasants first started to develop her saline deposits in a small way about 150 years ago. Those humble operations proved sufficient to explode many of the hoary myths and dreams formerly held by the old alchemists. Also, on these original foundations now rests the entire structure of industrial chemistry as known today.

As yet the wonderfully complete line of saline and alkali deposits of Wyoming carry about the same degree of esteem as her classical and unmistakably visible oil structures received as late as 15 years ago. For both forms of deposits Government and private geologists completed careful studies long before extensive exploitation actually started. As yet exploitation of the chemical deposits has failed to materialize, but before being rescued from their unduly prolonged state of dormancy it, however, happens that a host of problems remain to be solved. For the solution of the most pressing problems more reliance must be placed on the minds of the political economists and the technological experts rather than on findings of geologists that are already a matter of documentary record.

Of course in Europe the recovery and manufacture of saline and alkali compounds has long been an old and firmly entrenched industry. In America the new infant industry has a long way to travel before it will be entirely freed of

foreign domination for even the source of its basic raw materials. One of the leading Wyoming salts that received description in preceding chapters was magnesium sulphate. From 1922 to 1925 the amount of magnesium sulphate imported for consumption in the United States varied from 8,211,228 to 25,390,734 pounds annually. It is extremely doubtful if the purity of the prepared imported salt could equal the almost chemical pure lake deposits that are found in Wyoming close to the railroads in the Medicine Bow and Douglas localities. As recorded, the foregoing import figures plausibly disclose that before America can establish a complete magnesium industry of its own, some far-sighted pathfinder will have to start the exploitation of the wonder Wyoming deposits even if fair and adequate protection is unprocurable at this particular time.

Prior to preparation of this paper a conversation entered into with Mr. Dan W. Gill, the pioneer producer and shipper of sodium sulphate in this state also disclosed that increasing foreign importations has within the past year or two restricted the highly profitable market that he, single-handed, developed for that alkali chemical of Wyoming. Had it been possible to conduct similar enquiries on the remaining chemical salts, almost exclusively found in the Wyoming depository, equally elucidating replies would have doubtlessly been received.

In the economic history of America there were periods when the steel, motor and other giant industrial enterprises of the present day had to receive full and complete protection from low cost products fabricated abroad. For the birth and creation of an alkali industry of similar national magnitude, the present American wage scale must demand an equal degree of protection first of all. As now developed, most of the larger chemical works established locations near the Atlantic sea-board. Even with present tariffs it is cheaper for those manufacturers to pay the duties on basic chemicals purchased abroad rather than pay the long-haul freight rates that would prevail if these salts would be shipped from their nearest domestic depositories out here in Wyoming. Had these lowly alkali salts always received the degree of protection due them the great chemical manufacturers would have doubtlessly sought sites not far distant from the Wyoming raw materials for the location of their original plants. At the present time no one will blame existing manufacturers for hesitating to move their well organized

businesses direct to the great natural depositories that are situated in Wyoming. However, to prevent similar economic dislocations in the future, the critical time has arrived for the broader-gauged statesmen of Wyoming to be strictly on the job. All told, the problem of cutting down the increasing influx of raw chemicals prepared by low cost foreign labor must concern Wyoming far more so than any other state. Instead of spreading farther inland, tariff differentials should restrict the future importations of chemical salts, peculiar to Wyoming, to points that merely fringe the Atlantic seaboard. In this connection it may be surprising to mention that the pioneer shipper of sodium sulphate in Wyoming was unable to extend his market east of the Missouri River during the past year. Economically and geographically speaking, the entire Mississippi valley should be rightfully included within his immediate trade territory for the exhaustless chemical deposits that are now under his proprietorship.

Technologically speaking, much missionary work remains to be done before a complete chemical industry worthy of its name can be organized in Wyoming. As conducted today, a fair sized operation would require an initial expenditure of one hundred million dollars. Merely to catalog all of the varieties of chemicals that abound within the natural laboratory of Wyoming will hardly suffice to attract the amount of capital mentioned. To expedite matters it may pay to add an alkali expert to the payroll of this office. If a gentleman can be procured who has contributed a laborious life to that highly specialized field of endeavor, it would be possible to list at least a 101 different finished chemical compounds of high intrinsic worth that could be completely made in Wyoming cheaper than in any other state. Obviously, my technical staff has neither the time nor training to undertake such an arduous task at the present writing.

Important inter-related situations largely of a geographical and political order now call loudly for the establishment of a chemical industry directly within Wyoming. Other states of the arid west contain some chemical deposits similar to those found in Wyoming. But it happens that none of these deposits are situated as close to the Great Industrial Empire of the East as those of Wyoming. Some of these deposits occur in states barren of fuel reserves. In Wyoming many alkali and saline lakes occur either on top or directly adjacent to huge gas structures. For the direct separation of their one or more contained chemical solubles by

exactly controlled, fractional or repeated crystallization processes, no conceivable fuel would be more efficient than those tremendous reserves of low cost, directly applicable, supplies of natural gas that possess the highest of known calorific values.

At the present time many foreign chemicals are hauled to Niagara Falls for reduction to the metallic form. The advantages of locally reducing our soluble magnesium salts to the extremely valuable metallic form has already been discussed in this paper. For the early establishment of a chemical industry from the grass roots to the final finished products the long battles that our present statesmen have fought for the immediate hydro-electricalization of the Green, North Platte and other major river courses of the state now promise the most seasonable rewards.

Potentially speaking, for the future welfare of the Wyoming Chemical and Industrial Empire, no single force will prove as potent as the immediate development and utilization of the vast hydroelectrical resources still remaining intact in our incomparable, high-gradient river channels.