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FOURTH ANNUAL MINERAL INDUSTRIES CONFERENCE OF ILLINOIS

"Research on the State's Mineral Resources and Their Utilization"

Urbana, Illinois
April 24-25, 1936

ROCK AND ROCK PRODUCTS SESSIONS

ABSTRACT REPORTS OF

GENERAL SESSION, FORUM ON RESEARCHES IN PROGRESS,

AND SYMPOSIUM ON NEEDED RESEARCHES

Sponsored by
The Illinois State Geological Survey Division of the Department of Registration and Education
The Engineering Experiment Station of the University of Illinois
Illinois Mineral Industries Committee

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Friday Forenoon, April 24, 1936

GENERAL SESSION

The general session was under the chairmanship of Dean M. L. Enger of the Engineering Experiment Station of the University of Illinois. After welcoming the guests he introduced Dr. M. M. Leighton, Chief of the State Geological Survey, who outlined the objectives of the conference.

Dr. Leighton pointed out that prosperity in our early history rested upon the exploration and development of the country's untouched resources, whereas now it rests upon scientific discoveries and technologic developments of new and improved uses of these same basic resources. The new viewpoint given us by science is that we should make a complete inventory of our many types of resources by thoroughgoing investigations and then show that their constitution, composition, and properties are such that they can be transformed in various ways into ever increasingly useful products. The commonwealth that will make available this kind of information will make more profitable use of its resources, will be better able to meet competitive conditions, will create more industrial opportunities, will provide more widespread employment and will lay the soundest of foundations for prosperity and happiness of its people.

He stated that this conference was thus planned to discuss the importance of research as applied to the State's mineral resources and their utilization, to acquaint the industries with the research now in progress and the value of the results, to permit us all to catch a larger vision of the possibilities of well planned comprehensive research, to receive suggestions of additional researches needed from the standpoint of industrial experience, and to develop a joint interest in pursuing a research program with proper facilities and qualified personnel that will make for greater industrial activity and greater public welfare within our commonwealth.

The main address was given by Mr. Fred Wesley Sargent, President of the Chicago and North Western Railway Company, who was introduced by Dr. A. C. Willard, President of the University of Illinois. Mr. Sargent's subject was

"Research and the Immediate Future"

Mr. Sargent set forth the thesis that economic conditions will be improved by the production of new forms of wealth. Intensive research is producing new and improved means of production, and

is creating new industries and enormous demand for changes and improvement in old industries. The chemical industry illustrates the tremendous and rapid advances of scientific research. Many things are being done with chemistry that it was thought, heretofore, could only be done with machinery and muscle. Changes are coming so rapidly that frequently plants become obsolete long before they are worn out.

The intensive developments in science make it imperative that producers of raw materials ever be alert to scientific research. Pure research working in cooperation with honest business are forces that will move us into an era of unprecedented prosperity.

By enlarging the wants of men and women in diverse directions and by the consequent new demands arising for new additional services, scientific discoveries enlarge the field of human activity thereby creating new types of employment.

The Illinois coal industry, which in quantity and total value of product, is Illinois' largest mineral industry, ought also to be one of the greatest in concentrated value. Coal must not be looked upon only as a fuel to be destroyed by burning. Coal as coal only to burn may not long be able to hold its modern place of power, but through the aid of research it has limitless possibilities not only as a source of power but as a basis for vast new industries. Railroads are now burning dyes, medicines, perfumes and innumerable valuable chemicals along with their coal, all of which are wasted, and all of which ought to be captured for the service of mankind. New forms of competition are forcing the railroads to herculean efforts to hold their place in the field of transportation. Since some of these efforts are directed to producing power at lower cost, the coal industry must avail itself of research and more research to meet the competition of other fuels.

The possibilities of coal as a chemical raw material are illustrated by analogy to the rapid modern development in the products obtained from corn. In recent weeks the daily press has reported the discovery whereby a powerful explosive can be extracted from corn.

The railroads stand indicted because of their failure to take full advantage of scientific research possibilities. None of the major contributions to railroad development during the nineteenth century came from the railroads themselves. The telegraph was invented by Wheatstone, an English professor of philosophy, and Morse, an American artist; the Pullman sleeping car by a street contractor; the automatic coupler by Janney, a dry goods clerk; the automatic block signal system by Hall, a retired textile manufacturer; etc.

The railroads recently created the Association of American Railroads, and this organization created a Department of Research. This is a most important branch of this organization for

it should lead to things of permanent value - safety, greater efficiency and lower costs in producing and delivery transportation service.

It is no longer possible to stand by, trusting to luck, that some school teacher, artist, street contractor, or dry goods clerk will save the transportation industry in the future as they have in the past. The tempo of the times will not tolerate it. Progress through research is the order of the day. It is ridiculous to haul a ton and a half of dead weight per ton of freight and several tons of Pullman per passenger; to haul two to three thousand pounds of engine tender with load in order to have coal and water next to the power plant; and to use steam only once and then allow it to escape into the air.

New scientific achievements are eagerly recorded in the daily press. The most promising field of achievement is in the full use of all the riches wrapped up in our mineral resources, the development of transportation to the end that goods and persons will move freely and within the purchasing power of all. The true idols of the future will be the "Microbe Hunters," the "Hunger Fighters," the engineers, and the great students in pure scientific research.

"We are in the midst of a real, practical, scientific revolution that holds promise of a marvelous future for the raw products of our State, providing we have the vision and the courage to organize for research and thereby convert to useful purposes the riches now wasted, and through new and better processes make our minerals more valuable in all uses to which they may be applied to the end of a greater abundance for men and women everywhere."

Friday Afternoon, April 24

FORUM ON ROCK AND ROCK PRODUCTS

RESEARCHES IN PROGRESS

Following are abstracts of the papers presented at this forum which was one of four on Researches in Progress by the State Geological Survey and the Engineering Experiment Station of the University of Illinois, on the mineral resources of the State and their utilization. These forums covered four major fields - Coal, Oil and Gas, Clay and Clay Products, and Rock and Rock Products - and were held separately and concurrently on Friday afternoon.

Illinois Novaculite as a Source for Silica Refractories by C. W. Parmelee, Head of the Department of Ceramic Engineering, and C. G. Harman, Special Research Assistant, Department of Ceramic Engineering, University of Illinois. In all properties examined to date, silica brick made from novaculite compared favorably with the best grade quartzite brick now in use. In some respects they are superior. Much larger novaculite grains may be used than is permissible in the crushed quartzite, and in the novaculite brick there is substantially no quartz that is not inverted to cristobalite. The inversion can be carried out at a lower temperature than is required for quartzite, yet it is accomplished in the same length of time. There is some indication, although this has not been definitely proved, that novaculite brick can be made more resistant to spalling than quartzite brick. The novaculite "gravel," since it is easy to win and needs no preliminary crushing, could probably be washed more cheaply than most quartzite could be quarried and crushed.

Decolorization of Southern Illinois Silica, by C. F. Fryling, Chemist, State Geological Survey. The elimination of off-color silica is the most difficult and outstanding problem of the southern Illinois silica industry. The scientific problem is intimately related to economic considerations, involving the cost of selective mining versus that of decolorization. Information in our own and foreign journals indicates the growing need of an economical decolorizing process. The general methods reported by various investigators can be summarized as follows: (1) Treatment with reducing gases followed by volatilization or solution of iron compounds, (2) simple washing processes with acids or combinations of acids and salts, and (3) treatment with aqueous reducing solutions followed by acid washing. Various degrees of success have attended

the efforts of different investigators employing similar techniques, indicating the necessity of recognizing the peculiar attributes of the actual product to be treated. Preliminary evaluation of different methods of treatment have shown that room temperature reduction and solution by the reaction products of metallic zinc, sodium sulfite, and sulfuric acid, and simple leaching by hot dilute mineral acids are effective methods of removing the iron oxide associated with silica. All things indicate that this project can be brought to a successful conclusion technically. The economics of any technically feasible method will have to be carefully studied.

Inventorying Illinois' Resources of Limestones and Dolomites, by J. E. Lamar, Geologist, and H. B. Willman, Associate Geologist, Illinois State Geological Survey. Inventorying the limestone and dolomite resources of Illinois involves the collection and systematic cataloging of data regarding the distribution, mode of occurrence, availability, and character of these resources. Two such inventories are well under way, in addition to the general program of accumulating and classifying resource data. One deals with the resources along the navigable waterways of Illinois; the other covers in much detail the limestone and dolomite resources of the new Illinois Waterway. Such studies are of value to industry as they indicate where opportunities exist for expansion and the development of new deposits.

A good illustration of how the information resulting from resource inventories has been used is the recently completed work on sources of rock wool making materials in Illinois. On the basis of previously conducted inventories, it was possible to conduct with rapidity the extensive sampling campaign carried out for these studies, whereas if inventory data had not been available an extended and time consuming resource study would have had to accompany sampling.

Demands for more exact and diverse data regarding limestone and dolomite resources has lead to the development of new inventorying methods including very detailed field sampling followed for each sample by laboratory studies of the residues insoluble in acid. The insoluble residue data together with field observations on texture, bedding, etc., are used for selecting combinations of field samples from which composite samples are compounded for chemical analysis. Studies of this nature are in progress for the commercial limestones of southern Illinois and the dolomites of the Chicago area. Where available the results of these studies have proved of much value to the Illinois stone industry.

Research Studies and the Illinois Mineral Wool Industry, by C. F. Fryling, Chemist, Illinois State Geological Survey. Recent publications indicate a rapidly growing interest in the rock wool industry. The spirit of cooperation within the industry is admirable and augurs well for the future. Methods of fibering can be divided into two classes, (1) the molten silicate is first

broken up into discrete droplets and then subjected to shearing forces, and (2) the fine thread is drawn continuously from a mass of molten silicate. Most mineral wool is applied in the form in which it is produced. The wide variety of uses of mineral wool is responsible for the diverse forms in which it appears on the market. Lack of uniformity in products is a serious problem in the industry at the present time. Apparently there is a need of information on specifications and methods of testing mineral wool. There has been a 35 per cent increase in the number of mineral wool producers in the past year. About 25 per cent of the producers operate plants, or maintain their office in Illinois, indicative of the importance this State is attaining in this industry. From a $65,000 status in 1911, the industry has attained a $3,700,000 value in 1929 and $5,600,000 in 1935, indicating a rapid and accelerated growth. The tendency of retail prices since the termination of the Code price of $50.00 per ton has been slightly downward. Developments reported during the last year have been the successful introduction of blown glass wool, the comparison of heat conductivity of glass and slag wools as a function of temperature, and the production of wool from wollastonite utilizing electrical heating. The trend toward decentralization of the industry is continuing.

Saturday Forenoon, April 25

SYMPOSIUM ON

ROCK AND ROCK PRODUCTS RESEARCHES NEEDED

On Saturday forenoon symposia on Needed Researches from the industrial viewpoint were held separately and concurrently for Coal, Oil and Gas, Clay and Clay Products, and Rock and Rock Products. These meetings were planned in order to provide industries with a special opportunity to offer their suggestions of needed researches. Following are abstracts of the papers presented at the Rock and Rock Products symposium.

Needed Researches in Rock Materials as Related to Highway Construction, by V. L. Glover, Engineer of Materials, Illinois State Division of Highways, Springfield, Illinois. Tests now commonly made on the mineral aggregates used in highway construction concern the specific gravity, absorption of water, abrasion loss, lithological count, and soundness. Modern methods of making these tests are still being improved.

Further research is needed to better correlate the results of the soundness tests, and new research is needed to determine the characteristics of the materials themselves. Data are needed on the structural soundness of the particles as it affects the strength of concrete; on the surface texture of the particles as it affects the bond between the particles and the mortar; on the angularity of the particle as it affects the strength of the concrete; on the surface area of the particle; on the coefficient of expanison of the individual particles; on the effect of gradation of the particles on the composition of the concrete; on the effect of elongated or flat particles on the strength of the concrete; and on the effect of the presence of deleterious substances, such as shale in sand, clay in the fine and coarse aggregate, soft particles in the coarse aggregate, and flint and chert in the coarse aggregate.

Research Problems Involved in the Development of Standards for Mineral Wool, by D. H. Innes, Ludowici-Celadon Company, Chicago. The mineral wool industry is young and many basic data are needed before even tentative standards can be set for its products. The problems include: (1) Nomenclature - definitions of various types of wool, as rock, slag, and glass wools, and of descriptive terms used in the industry; (2) chemical properties - continuing investigation of the two, three, and four-component systems, the standardization of the range of composition suitable for mineral wool, study of chemical reactions and of mixtures of rock in sizes suited to the present cupola design and practice, study of chemical composition and behavior of each type of wool, range or limits of other possible minor constituents or impurities in mineral wool, study of devitrification of mineral wools in service; (3) physical properties - determination of permissible fiber diameters, size and amount of shot, density of wool, thermal conductivity at various densities and temperatures, fusion or softening point, permeability, amount of voids, color, resiliency, and effects of moisture; (4) treatment methods and fabrication procedure - to be worked out separately for individual products according to their intended uses. Examples of the sort of research included are determination of effect of water repellants or binders on the physical properties of the wool, the effect of different sizes of pellets in granular wool, development of acceptable stiffening agents for bats and blankets, and specifications for insulating cements and acoustic tile. It is important that the manufacturers themselves cooperate in the development of these standards.

Research Problems on Stone for Use in Filters of Sewage Disposal Works, by William E. Stanley, Greeley and Hansen, Chicago. Sewage treatment plants comprise two types: (1) Those providing partial treatment by sedimentation or sedimentation with chemicals, and (2) those providing complete treatment including oxidizing elements. Where the local streams that receive the effluent from the sewage plant cannot adequately oxidize it, artificial means must be provided for the oxidation of the organic materials.

The sewage filter provides one such method, serving as a supporting medium for bacterial growths. In the second or activated sludge method, air is forced up through the tank of wastes, or the waste is agitated mechanically in the presence of sludge particles which have been activated with bacteria. The use of pre-aeration plants ahead of the filters have made it possible in some installations to increase considerably the volume of sewage which might be placed through the filters.

Possible researches should include: Improvement in quarrying and preparation of crushed stone for use in sewage filters with reference to cleanness of the stone, uniformity of size, and durability; and the problem of the fundamental basis of design of sewage filters in economic competition with other methods of producing the same treatment of sewage. Any research which will show ways of increasing the amounts of sewage that can be safely handled by a given volume of stone would increase the possibilities of the use of stone for this purpose.

Needed Researches in the Field of Domestic Whiting, by H. C. Krause, Sales Manager, Columbia Quarry Company, St. Louis, Missouri. Three materials, frequently confused, are whiting, more accurately referred to as "English chalk whiting"; domestic whiting; and ground limestone. The production of the first two involves chemical processes, whereas the production of ground limestone involves only grinding, sizing, and drying.

At present ground limestone is used principally as a filler or for its chemical qualities, but in some uses both qualities have value. In general there is a lack of information regarding the various properties of ground limestone and of the relation and inter-relation of these properties to uses. Of much value to the ground limestone industry and those it serves would be a complete study of the following properties of ground limestone: Chemical analysis, color, fineness, particle size distribution, structure, density, resistance to impact, oil absorption and plasticity.

It is believed that intensive research holds the key to the solution of many of the ground limestone industry's problems.

Soil Conservation Service Program in Illinois, by F. A. Fisher, State Coordinator, Soil Conservation Service, U. S. Department of Agriculture. The Soil Conservation Service was begun in November 1933 as an emergency organization under the Department of the Interior. The erosion demonstration area comprised 150,000 acres of corn belt land in McLean and Ford counties, chosen because of the importance of conserving good land. In 1935 the old S.E.S. became a permanent bureau in the Department of Agriculture and the State CCC camps were placed under the technical direction of the new Soil Conservation Service.

Its functions include: (1) Research and demonstration to determine the best and most economical erosion control methods; (2) operation of three demonstration projects (McLean and Ford, Madison, and Stephenson counties); (3) carrying on of erosion control work on certain public lands (Dixon Springs); (4) management of 28 CCC camps; (5) cooperation with State Extension Service to make practical erosion information available to all interested farmers.

Demonstration projects under way include pasture improvement, farm woods improvement, establishment of plant species on sandy soils, survey of farm management and land use, and silt measurement.

The erosion control work on private lands must be carried on in cooperation with legally constituted Soil Conservation Associations, 33 of which have been organized in Illinois. Recommended practices include: Increased use of legumes and grasses; the return of lands unsuited for cultivation to pasture and woodlot; contour farming, terracing, contour farming and the construction of dams and earth fills. Planting of trees, shrubs, vines, and grasses aid not only in erosion control but also provide winter food and cover for wild life, contributing to game conservation. The use of agricultural limestone contributes to erosion control by encouraging the growth of the best types of vegetation. Demonstration projects are using lime in improvement of pastures and woodlots as well as on cropped soil.

Chemical Research for New Products from Illinois Rocks, by C. F. Fryling, Chemist, Illinois State Geological Survey. The possibilities of chemical utilization of minerals are rigidly delimited by certain restrictions in the form of availability and location, energy requirements for effecting desirable chemical reactions, and limits of chemical composition afforded by the different deposits. A consideration of sedimentary rocks from this viewpoint indicates the most profitable direction for research on the utilization of these materials to be the interaction of silica, alumina, lime and magnesia effected by the application of heat. The production of lime, Portland cement, rock wool, various ceramic wares, and the utilization of limestone and dolomite for metallurgical fluxes and refractories are the present outstanding examples of processes depending on the action of heat on various combinations of these oxides. Composition-temperature phase relationships are fairly well known for fourteen of the possible fifteen systems derivable from the silica, alumina, lime and magnesia. The four component system has been studied but to a greatly limited extent. With a clear recognition of the limits within which we are restricted by nature relative to the composition of Illinois rocks, and an appreciation of the state of our knowledge concerning the effect of heat on various rocks and rock mixtures, it is safe to say that the sponge of Illinois non fuel mineral resources has by no means been squeezed dry of new products. But a short time ago rock wool from Illinois mineral deposits was but an idea. Shortly after this time it was the subject of a research. Today the idea, rationalized and given definite form by research has become an industry in our State.