

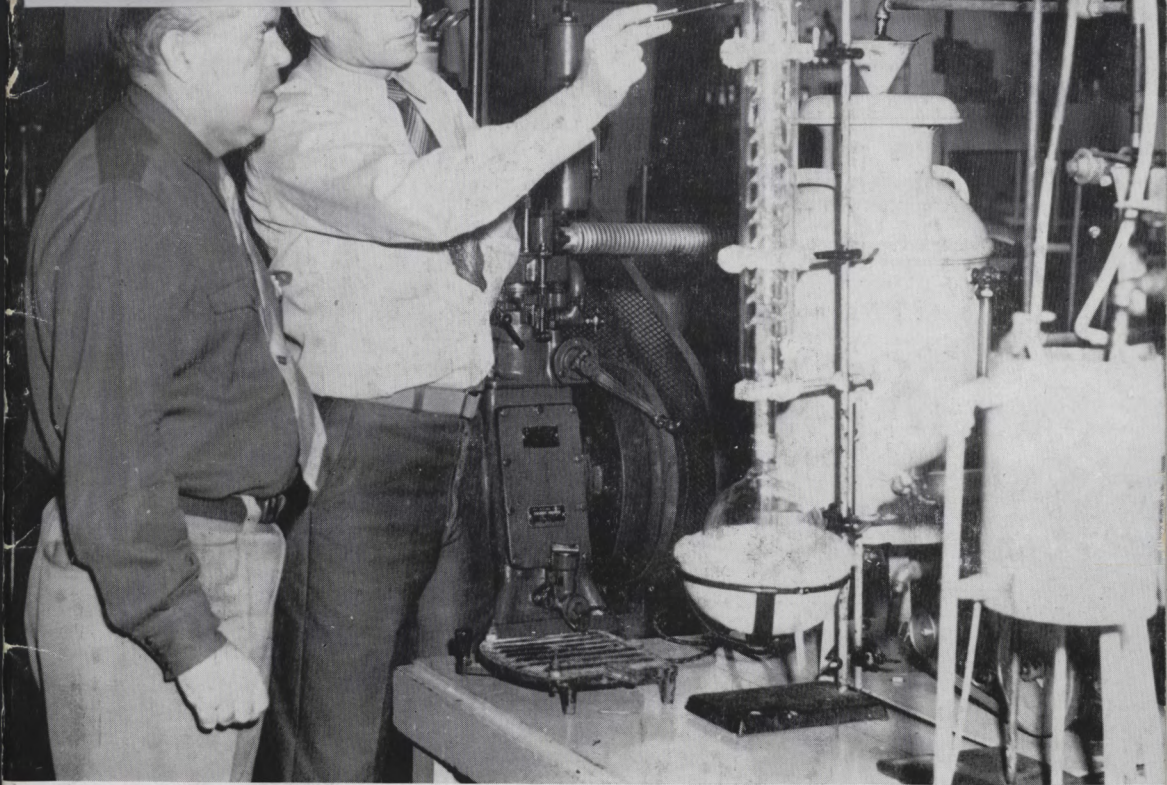
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Second Progress Report

on

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Research for Colorado Industry

BOARD OF INDUSTRIAL DEVELOPMENT RESEARCH
STATE OF COLORADO
JANUARY, 1947

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The Colorado Fuel & Iron Corp., Denver
George H. Rupp.....Manager, Mining Dept.,
The Colorado Fuel & Iron Corp., Denver
A. A. Smith.....Rancher, Sterling
G. Norman Winder.....President, National Wool Growers Assn., Craig

Front Cover photograph—Scientists at Colorado School of Mines using fractionating equipment used in extraction of tars and natural bitumen. For details see page 16.

Second Progress Report

on

**Research for
Colorado Industry**

BOARD OF INDUSTRIAL DEVELOPMENT RESEARCH
STATE OF COLORADO
JANUARY, 1947

Published By
Office of the Secretary
University of Colorado
Boulder



Testing power line insulation with the million-volt lightning generator.

Recognizing that Colorado must become more industrialized if it is to grow both in population and income for its citizens, the State Legislature in April, 1945, appropriated \$100,000 for industrial research. The fund, under the terms of the bill, was to be administered by a Board of Industrial Development Research consisting of the presidents of the three colleges—Colorado A & M College, Colorado School of Mines, and the University of Colorado—with the approval of the Governor.

The Board, with the consent of the Governor, selected an Industrial Development Research Committee of men especially qualified to advise the Board. The advisory committee reviews all requests and recommends to the Board the projects that appear feasible. When a project is approved by the Board with the consent of the Governor, funds as available are allocated to a re-

search group at one of the three schools, qualified and willing to conduct the research.

From the many suggestions for research submitted to the advisory committee and the Board, 17 projects were selected for research. Projects were chosen which had the best possibility of commercial use within a reasonable time, and which would produce results of value within the two year period of the appropriation. Many fundamental research problems, whose solution would be of great value to the state, were passed by because of the limited amount of funds available for the work.

It should be pointed out that the research being conducted under the state program is only a portion of the research being done at the schools. Research projects supported by private funds, trade associations, and the federal government are being conducted at these three colleges and the results of these other research programs are in many cases of great value to the state. The amount of money appropriated for the state research program has not been adequate to more than scratch the surface of the many research problems which should be solved for Colorado. Research is a profitable but expensive business. For example, at the University of Colorado, one oil company is spending more each year in support of one research project in water-proofing concrete than the state research program is spending at the University for seven research projects.

It is, therefore, with considerable pride that the Board can report the results of research to date listed on the following pages. We believe the results justify a continuation and expansion of the research program, and that even greater benefits will result from further industrial research for Colorado.

Board of Industrial Development Research

Roy M. Green, President

Robert L. Stearns, Secretary

Ben H. Parker, Treasurer

Results from the Colorado Industrial

- Potato Chips** Certain types of potatoes grown in Colorado have been avoided by this industry because chips from them were too brown or had off-flavors. A new process developed at Colorado A & M College permits use of potatoes from almost any area of the state, and may also eliminate expensive warm-temperature storage now used in potato chip plants.
- Wool Scouring** A study made at the University of Colorado shows that wool scouring could be profitably done in the state if the plant could buck traditional marketing methods in the industry.
- Oil Exploration** The Colorado School of Mines has published a 450-page book of selected well logs of Colorado, of great value to men searching for oil and other minerals.
- Chemicals from Oil Shale** University of Colorado engineers are treating Colorado oil shale with high pressure hydrogen to produce new chemicals from this unused Colorado natural resource.
- Cattle** Colorado A & M scientists are investigating the recovery of male hormones from cow manure. Hormones are used in treating animal sterility in breeding herds which costs Colorado cattle-growers an estimated \$4 million a year. Hormones now are too expensive to be used; recovery from cow manure may provide an inexpensive source.
- Glassware** A survey made at the University of Colorado indicates that it appears practical to establish a handmade glassware plant in the state to supply a portion of the western market.
- Commercial uses for Oil Shale** At Colorado School of Mines, engineers are extracting western Colorado solid and semi-liquid hydrocarbons to find their chemical constituents. Products are being tried in paving materials, asphaltic paints, and protective coatings.

Development Research Program

To aid communities planning to build or expand their airports, University of Colorado engineers made studies of airport soils at Alamosa, Aspen, Boulder, Craig, Delta, Eagle, Gunnison, Longmont, and Montrose. Results have been used in the Aviation Development Survey made by the University for the Colorado Aeronautics Commission.

Airports

In the Colorado A & M laboratories, work is being done on finding uses for blemished and over-ripe peaches not suitable for shipping or canning. The scientists have developed a frozen puree which can be used in ice-cream, sherbets, and ices; bakery goods; and as topping for peach sundaes. They are also developing a frozen fruit pie mix which results in better pies than using fresh fruit.

Fruit

University of Colorado researchers have completed a detailed study of the Pueblo wholesale market, and are now working on similar studies for Grand Junction and Sterling. In these studies, the local chamber of commerce pays half the bill.

Wholesale Merchandising

The reference collections of well samples, well cores, and electric well logs are being expanded at Colorado School of Mines to aid oil companies and geologists looking for further oil deposits in Colorado.

Petroleum Geology

University of Colorado engineers are continuing their study with the million-volt lightning generator of lightning effects on insulation at high altitudes, gathering information useful in improving and making safer electric service in the mountains.

Lightning

More information on these research projects and their results, a financial report, and the future plans for the state research program will be found in the following pages.

PROJECTS IN PROGRESS

Under the direction of the Board, the research has been divided into four classifications. Agricultural research is being done at Colorado A & M College through the facilities of the Colorado Agricultural Experiment Station. Business research is being done in the Bureau of Business Research, School of Business, University of Colorado. Engineering research is being conducted by the University of Colorado's Engineering Experiment Station. Petroleum research is being done at the Colorado School of Mines under the direction of a special advisory committee.

Agricultural Research

The use of animal wastes as a possible source of certain hormones. Under the direction of Dr. F. X. Gassner, poultry section.

Colorado dairy and beef cattlemen lose an estimated four to five million dollars every year because of sterility in their breeding herds. This loss is especially felt in many pure-bred herds. Sterility in cattle can frequently be remedied by treatment with costly hormones. Hormones now cost from \$3,750 to \$7,500 an ounce. Thus, the cost of the treatment is prohibitive. Hormones are so expensive because they occur only in small quantities in animal glands. Tons of glands are required to obtain a teaspoonful of hormone.

Researchers at Colorado A & M have discovered that manure from pregnant dairy cows contains large amounts of hormone substances. This discovery has opened up the possibility of a cheap source of hormones that might be used economically in treating reproductive disabilities in livestock. A cheap source of hormones would also enable the physician to use hormone treatments more widely in treating humans.

Manure is being collected from pregnant cows and is being chemically fractionated by Dr. B. B. Longwell, University of Colorado Medical School. The extractions are tested for strength by feeding them to chicks and rats. Laboratory figures indicate there is enough hormone substance in cow manure so that hormones could be produced much more cheaply than now. On a biological basis, it appears that eight pounds of dried manure contain one gram of hormones which now costs \$120. If only 25% of the amount present can be extracted, certain cow manure dried properly still would contain \$7,500 worth of hormone per ton. Pilot plant equipment will now be needed to try the process on a larger scale so that enough crude hormone substance can be isolated to permit work on crystallizing the pure compound.

Use of fruit and vegetable surpluses, wastes, and culls in the manufacture of food specialties. Under the direction of Dr. W. E. Pyke, chemistry section.

With the expansion of Colorado's fruit growing industry more diversified outlets for the growers are needed to lengthen the marketing season and to



Testing the frozen puree made from Colorado peaches too ripe for canning.

expand potential outlets. At present, marketing facilities are inadequate to handle more than 10% of the crop and there is an annual loss of about \$300,000 in the Colorado peach industry alone, due to blemishes, over-ripe fruit, and inadequate processing facilities.

Research is being done in the preparation of frozen puree from peaches bruised or too ripe for canning. Techniques have been developed to retain freshness of flavor and to prevent browning. Peach puree can be used in bakery products, as an ice-cream topping, and as a flavor base for ice-cream, sherbet, and ices.

Another frozen fruit product developed is frozen fruit pie mix. The housewife need only partially de-frost the product, place it in the pie shell, and bake it. When properly handled, a pie even superior to that made from fresh unfrozen fruit is possible. The frozen pie mix could be made from peaches, apricots, apples, cherries, plums, and berries, and can be used to great advantage in the preparation of fruit cobblers and puddings as well.



Soaking raw potato chips to improve their quality.

Through research under the state program a method has been developed to prevent or control the degree of color developed in the manufacture of potato chips. In the past the potato chip industry has been highly selective in its purchase of potatoes and has avoided potatoes grown in certain areas and several of the more common varieties, because chips from these were too brown and made undesirable chips. The potatoes that were used often had to be kept in warm, temperature-controlled storage to insure good color. By use of the new process, the ingredients responsible for the browning in the potato are removed sufficiently so that almost any variety of Colorado potato may now be used in potato chip manufacture.

Business Research

Commodity studies on wool scouring, glass tableware, and leather tanning. Under the direction of John W. Bartram, assistant research engineer.

Wool Scouring

Traditionally, Colorado wools have been sent east for further processing. Many growers have wondered why part of the clip might not be processed here. From a recent study for the Board, it does appear that it could be practical to scour some western wools here. It does not now appear economic to scour fine wools which go into worsted manufacture, because worsted manufacturers prefer to buy grease wool. However, adequate amounts of short wools and pulled wools for woolen manufacturing are available in this region and could be scoured locally.

A wool scouring plant here would be an opening wedge into further wool manufacturing in Colorado. In itself, it would be a new small industry for the state. It would provide a local market for the lower priced wools grown in the territory. Data on the establishment of a wool scouring plant can be found in a 28-page report published by the Bureau of Business Research, University of Colorado, Boulder.

Further research into other wool manufacturing industries will be done by the Bureau.

Glass Tableware

At the suggestion of the Colorado Springs Chamber of Commerce, the Board instituted a study to find out whether it would be practical to manufacture handmade glass tableware in Colorado. It appears from the study that it would be practical and profitable. The western market for this type of glassware is calculated to be more than eight million dollars and a new plant would need capture only about 5% of this market to operate profitably. It is sug-

gested that a Colorado glassware plant make a distinctive type of tableware with western styling. This should command a tourist sale as well as sale to residents of the western area. Detailed information on the market, raw materials, plant investment, and operating costs are to be found in a report soon to be available from the Bureau of Business Research, University of Colorado, Boulder.

Leather Tanning

More than 600,000 cattle hides and 600,000 sheep skins are produced annually in Colorado, yet there is no leather tannery in the state. It appears from a study by the Bureau of Business Research that a Colorado location should be considered in any expansion of the leather tanning industry because of the adequate hide supplies, good water, and adequate labor supply. Freight rates on hides and leather are such that a Colorado plant could compete very well with mid-western tanning centers in supplying mid-western and eastern consumers of leather. Although Colorado has many advantages for leather tanning, it may be some time before tanning plants could be established here since the study also showed that the tanning industry is somewhat over-built. A detailed report on "Locating a Leather Tannery in Colorado" will soon be published by the Bureau of Business Research, University of Colorado, Boulder.

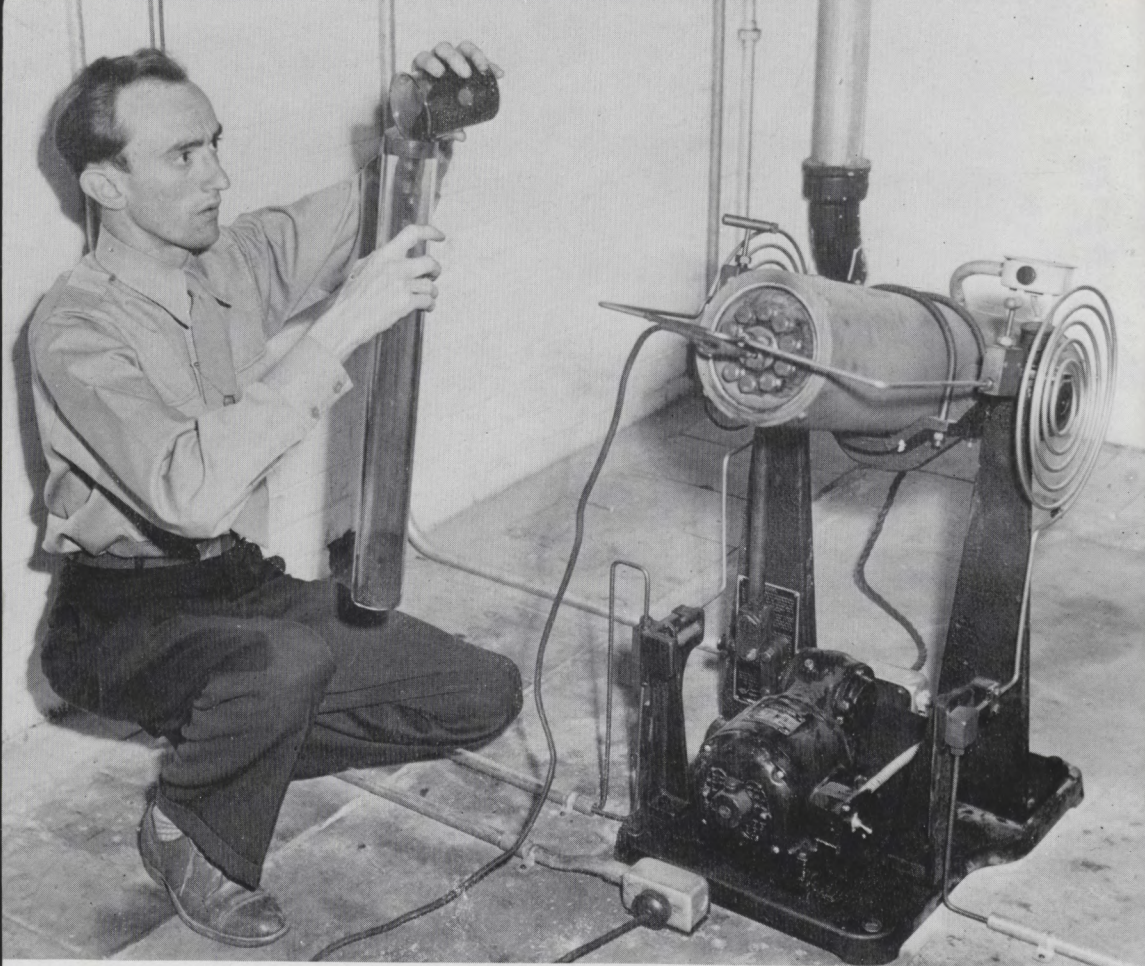
Studies are now being started on leather consuming industries, such as shoe manufacturing.

In addition to these studies leading to the possible development of new industries in the state, the Bureau of Business Research has answered questions for local chambers of commerce in such varied fields as wood novelties, pumicite for household abrasives, vitamin D efficiency of Colorado sunshine, and by-products of coal. In cooperation with the Agricultural Experiment Station at Colorado A & M College, a report was prepared advising chambers of commerce of the reasons why it does not now appear practical to consider the establishment of industrial alcohol plants in Colorado using farm surplus crops as raw materials for the plant.

Wholesale market studies for Pueblo, Grand Junction, and Sterling. *Under the direction of Henry B. Moore, director of the Bureau of Business Research.*

Detailed surveys of the wholesale markets served by each of these Colorado wholesale centers are being made by the Bureau in cooperation with the local chambers of commerce. From these surveys, wholesale merchandisers in these centers will have available to them complete information on the potential markets in each county in their trade area. From the surveys the merchants will be able to find out how many people live in each county, the communities in which they do their buying, the amount of sales in each community by type of merchandise, which communities and counties are expanding markets and which are declining markets, the success of local communities in getting out-of-town business, the influences of freight rates on their markets, and competition from other wholesale centers.

The 150-page report on the Pueblo wholesale trade area has been completed and copies are now available from the Pueblo Chamber of Commerce. The studies for the Grand Junction area and the Sterling area will be completed within the next few months. In each of these wholesale trade area studies, the local chambers of commerce are paying half the cost of the project.



Loading the hydrogenation "bomb" used in making chemicals from oil shale.

Engineering Research

Chemicals from oil shale. *Under the direction of C. H. Prien, assistant research engineer.*

One of the long-range research programs being done under the state research fund is that into the production of basic organic chemicals by the hydrogenation of coal and oil shale. During the first year of the work University engineers visited other hydrogenation laboratories, studied the technical literature on the problem, and gathered the complicated equipment for the project. Now, behind barricades of sand and steel they are treating coal and oil shale with hydrogen at very high temperatures and pressures in a stainless steel "bomb" to produce what they expect will be useful chemical products.

In their investigations they have found that the hydrogenation characteristics of Colorado coal are very much similar to those of other coal already being investigated by the Bureau of Mines and other laboratories. In view of the limited funds available for this research, and to avoid duplication of effort, they have turned now to an investigation of the effects of hydrogenation on

Colorado oil shale. Oil shale appears to have tremendous potential values as a source of chemical raw material. It is abundantly available in Colorado but has never been used commercially. From this study it is hoped that methods may be developed for producing chemicals useful in the plastic, pharmaceutical, insecticide, and dyestuff industries. This work could well lead to the development of new chemical processing industries in the state.

Soil studies of municipal airports in Colorado. Project conducted by William H. Thoman, professor of civil engineering.

Airport runways require engineering planning similar to highways, particularly in respect to the soil base on which they are made. With Colorado communities planning to invest millions of dollars in airport facilities, many communities felt the need for a program of soil testing and engineering advice on the type of runway construction required. Invitations to participate in the program were sent to all Colorado towns. Soil studies were made at Alamosa, Aspen, Boulder, Craig, Delta, Eagle, Gunnison, Longmont, and Montrose.

The studies showed that in most of these communities it would be possible to build adequate runways by proper attention to the soil characteristics and drainage of the field. The work has now been taken over as a part of the aviation development survey being made by the University for the Colorado Aeronautics Commission. Copies of the soil studies of these different airport sites have been sent to the interested local officials. Other copies are available on request from the Engineering Experiment Station, University of Colorado, Boulder.

Resin impregnation of native timber. Project conducted by John Corn, junior research engineer.

Recent work by the Forest Products Laboratory of the Department of Agriculture had shown that certain soft woods could be impregnated with synthetic resin to make them harder, more water resistant, and more resistant to fire, insects, and warping. It was hoped that through the use of this method Colorado soft woods might be treated to gain these valuable properties, thus increasing the market for Colorado timber and helping to meet the current shortage of home-building materials. The researchers found that the resin impregnation method worked well on timber from other areas, but most Colorado timbers cannot be suitably impregnated.

Due to the characteristics of the growing season in the mountains, Colorado trees consist largely of heartwood with a very low percentage of sap wood. Heartwood is impregnated only with great difficulty and no commercial practical methods were found for overcoming this.

Results from this study were made available to a group of men who had intended erecting a commercial plant for this work, and the survey saved them from making an investment in what would have otherwise been an impractical undertaking. The equipment developed for the state research project has since been used for private studies which have indicated that cottonwood trees can be suitably impregnated and a market may be developed for impregnated cottonwood.

Colorado building code service. Under the direction of Casper Hegner, consulting architect.

With house construction in greater demand than at any time in the state's history, many of the communities under 20,000 population feel the need for a modern building code. With the cooperation of the Colorado Municipal League and the University's bureau of state and community service work began in July, 1946 on the preparation of a practical up-to-date building code for use by Colorado communities.

Model codes from all over the country are being collected, and the best features of each will be incorporated in the Colorado code. The finished draft will then be submitted to authoritative institutions and organizations in the building field for their criticisms and suggestions before the code is finally published.

From the work will result a model code which any Colorado community may use to insure that future buildings in that community will be sturdy, safe and attractive with a minimum of added expense.

In addition to the preparation of the model code, a consulting service has been established so that Colorado municipal officials may get impartial data on cinder-blocks, plywood, water and sewer pipe, and other building materials to determine whether they meet community standards. University testing laboratories are available to test materials when necessary.

The effect of altitude on lightning flashover of power line insulation. Under the direction of F. A. Eastom, professor of electrical engineering.

Lightning is the cause of the majority of interruptions on electric power systems. At high altitudes lightning effects are more intense, and equipment must be more heavily insulated.

Using the million-volt lightning generator in the University's electrical engineering laboratories, the study has been under way for several years to determine the correction factors for rating high voltage equipment for high altitude operations.

As a result of these studies, the engineers now have most of the essential data needed for the designing of special insulators for high altitude power transmission. Data from this project is expected to help power engineers reduce the cost of operating power systems in Colorado, and to help them prevent fires that result when lightning follows a power feeder into a house or building.

Petroleum Research

Work being conducted under the direction of Prof. Clark F. Barb, head of the department of petroleum production engineering, and an advisory committee of Dr. F. M. Van Tuyl, head of the department of geology; Prof. Clark B. Carpenter, head of the department of metallurgy, and Prof. James O. Ball, head of the department of petroleum refining.

Selected Well Logs of Colorado

This project involved the selection and publication of significant well logs from the more than 6,000 well logs in the library of the School of Mines. In

addition, scores of logs were obtained from other sources such as the U. S. Geological Survey, oil companies, drillers, and other industries. The 450-page publication "Selected Well Logs of Colorado" contains approximately 500 detailed logs with about the same number of summarized logs from virtually every county in the state. Also included is a large map showing the location and depth of wells and the deepest formations encountered. Known structural axes and oil seeps are also shown. The logs are given by counties and are numbered consecutively, these log numbers being shown on the map. Copies of "Selected Well Logs of Colorado" can be obtained by writing the Director of Publications, Colorado School of Mines, Golden.

Collecting, Indexing, and Study of Colorado Well Samples

The department of geology at the Colorado School of Mines has more than 200,000 samples from many hundreds of wells, and many of them have been classified and indexed.

A list of the wells and the number of samples has been prepared and distributed, and a revised list will be issued within a few months. The oil companies have made constant use of the files and samples, and this project seems to have their approval. Samples are coming in regularly as new wells are drilled.

Collection of Well Cores

This is a continuing project of collecting and storing well cores to make them readily available for reference. The study will show the physical characteristics and fossil content of the formations, important for estimating oil reserves and future rates of recovery. The U. S. Bureau of Mines has agreed to furnish cores of all wells drilled on the Rifle project for the purpose of getting information on the oil shales of that district. The first shale core is now ready for shipment.

Collection of Electric Well Logs

This project is conducted in conjunction with the well-log study and well-sample collection. Through the splendid cooperation of oil companies and geologists, this supplementary aid in evaluating petroleum fields is almost complete to the present time.

Several hundred electric logs have been obtained through donation and purchase and the file is becoming of appreciable value to geologists.

Subsurface Correlation Study

This project would be a continuation of the study and correlation of well cuttings. No work will be done on it until the school is able to obtain personnel properly trained for this research.

Bibliography of All Articles on the Colorado Oil Industry

This project would lead to a better understanding of the production, refining, transportation, and marketing needs of the state. It is still in the planning stage.

Hydrocarbons of Western Colorado

Work is in progress on this project in developing laboratory methods for extracting the various components present in the natural bitumen. The effect of various solvents has been studied and two methods developed involving multi- or combined solvents. This work is still in progress.

It is intended that the components recovered by extraction be studied and analyzed for chemical constituents. However, until the work mentioned above has been completed, these materials are being held for further examination.

Work is also in progress in developing a means for testing and classifying natural bitumen in the field.

The effect of the addition of resinous material on the properties of petroleum asphalts, particularly in conjunction with their application to paving materials and asphaltic paints and protective coatings is also under investigation.

List of Wells, Well Sample Collection

This publication is a part of the work being done on well samples, and the list was issued for the benefit of the active oil companies now operating in the state.

The samples in the Colorado School of Mines collection were indexed by state, county, and well. Depths of wells and number of samples available were listed for the convenience of the geologists who commonly use such samples.

The list was issued in March 1946, at which time there were 1,376 wells on record. Many sets of samples have been received since that date and a new list will be issued next year.

The Future of the State Research Program

The results of the industrial research program during the past eighteen months have shown that research in Colorado's colleges and universities is efficient, productive and profitable. Only in state colleges would it be possible to have so much research done for so little money. In the colleges faculty experts are available for consultation without cost. Most of the overhead expenses can be carried by the colleges themselves. Experienced graduate students are available to work on these projects as part of their thesis work.

Much more needs to be done if Colorado is to keep abreast of the industrial development in the western region. Many other western states are actively sponsoring research work leading to industrial development with funds many times larger than those that have been available for the Colorado program.

Industrial research can point the way to uses for the tremendous amounts of power that will be available in Colorado. Industrial research can find uses for many of the state's natural raw materials that are not now being used. Industrial research can help in expanding the markets for Colorado agricultural crops. Industrial research can lead to new manufacturing and commercial enterprises in the state. Research makes jobs, increases employment, and ultimately can raise the living standards of our workers.

Whether the Colorado Industrial Development Research program is continued and expanded in the years to come depends upon the will of the people expressed through their representatives in the Legislature. The colleges are willing to do this industrial research if the funds are available for hiring the necessary research workers and paying the other direct expenses of the projects. The continuation of the program and its extent depend entirely upon the funds available.

INDUSTRIAL DEVELOPMENT RESEARCH FUND
(AS OF NOVEMBER 30, 1946)

RECEIPTS

| | | | |
|--|-------------|-----------|------------|
| University of Colorado | | | |
| 1945-1946 Allotment ----- | \$20,000.00 | \$ | \$ |
| Prien Graduate Research Aid Grant | 200.00 | | |
| 1946-1947 Allotment ----- | 20,000.00 | | |
| Refund on Returned Report----- | 13.50 | 40,213.50 | |
| | | <hr/> | |
| Colorado A & M College | | | |
| 1945-1946 Allotment ----- | 19,000.00 | | |
| 1946-1947 Allotment ----- | 19,000.00 | 38,000.00 | |
| | | <hr/> | |
| Colorado School of Mines | | | |
| 1945-1946 Allotment ----- | 10,000.00 | | |
| Receipts from Sale of Quarterlies-- | 986.75 | | |
| 1946-1947 Allotment ----- | 10,000.00 | | |
| Receipts from Sale of Quartermen | | | |
| to Nov. 30, 1946----- | 121.05 | 21,107.80 | |
| | | <hr/> | |
| Industrial Development Research Fund (Administrative) | | | |
| 1945-1946 Allotment ----- | 1,000.00 | | |
| 1946-1947 Allotment ----- | 1,000.00 | 2,000.00 | 101,321.30 |
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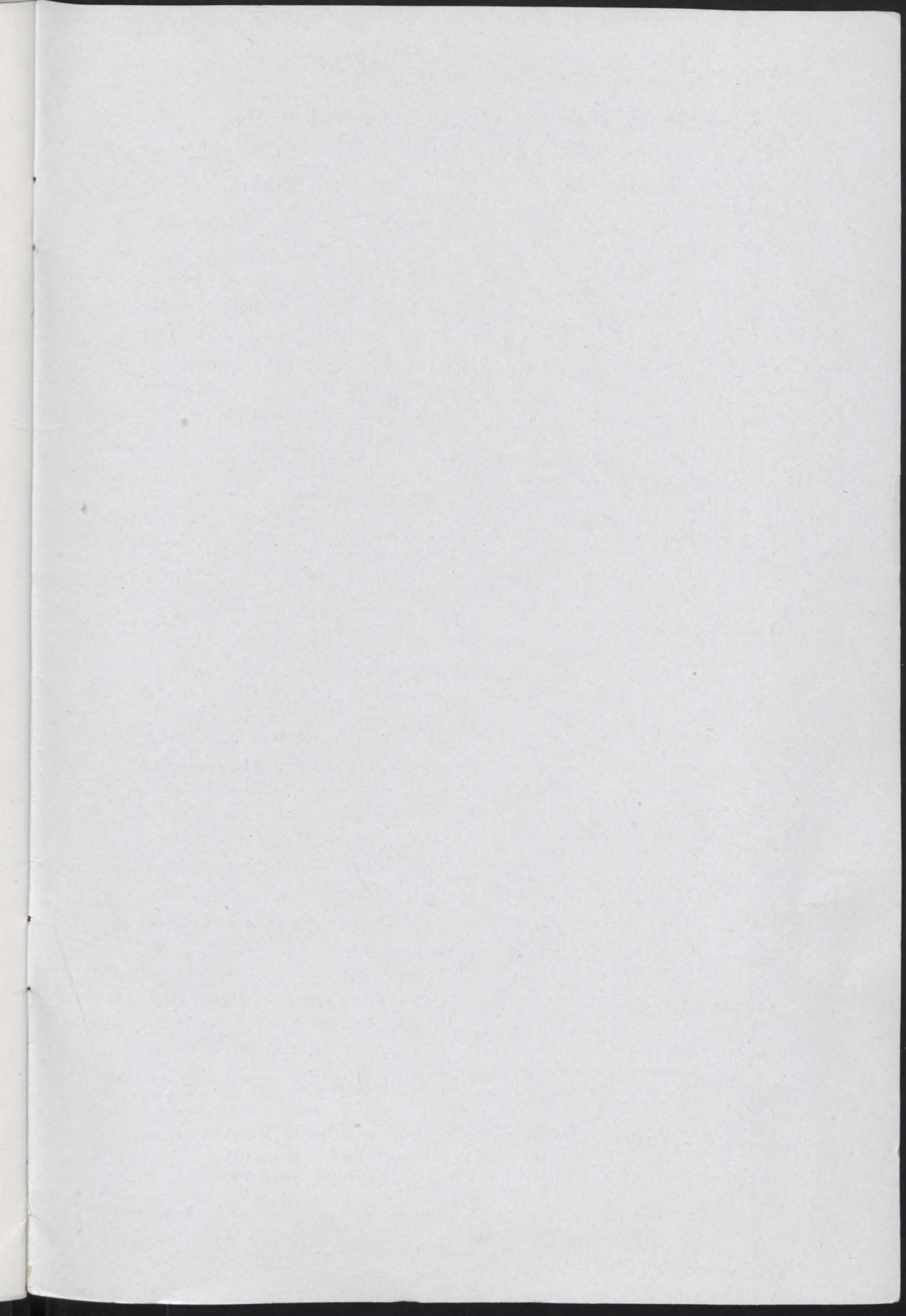
DISBURSEMENTS

| | | | |
|--|-----------|-----------|--------------------|
| University of Colorado | | | |
| July 1, 1945 to June 30, 1946-- | 15,002.82 | | |
| July 1, 1946 to Nov. 30, 1946-- | 11,216.67 | 26,219.49 | |
| | | <hr/> | |
| Colorado A & M College | | | |
| July 1, 1945 to June 30, 1946-- | 16,714.89 | | |
| July 1, 1946 to Nov. 30, 1946-- | 7,251.56 | 23,966.45 | |
| | | <hr/> | |
| Colorado School of Mines | | | |
| July 1, 1945 to June 30, 1946-- | 10,432.90 | | |
| July 1, 1946 to Nov. 30, 1946-- | 2,059.00 | 12,491.90 | |
| | | <hr/> | |
| Industrial Development Research Fund (Administrative) | | | |
| July 1, 1945 to June 30, 1946-- | 134.85 | | |
| July 1, 1946 to Nov. 30, 1946-- | 22.29 | 157.14 | 62,834.98 |
| | | <hr/> | |
| Balance as of November 30, 1946 | | | \$38,486.32 |

BALANCES

| | |
|---|-------------|
| University of Colorado----- | \$13,994.01 |
| Colorado A & M College----- | 14,033.55 |
| Colorado School of Mines----- | 8,615.90 |
| Industrial Development Research Fund (Administrative) | 1,842.86 |
| | <hr/> |
| | \$38,486.32 |

(signed)
BEN H. PARKER, Treasurer.



RECEIVED

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**STATE PUBLICATIONS
Colorado State Library**