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BUREAU OF STANDARDS
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THE ORGANIZATION AND WORK OF THE UNITED STATES BUREAU OF STANDARDS

General Description of the Bureau

The Bureau of Standards was created by an act of Congress, March 3, 1901, in response to an insistent demand from American industries that the United States be made independent of foreign countries in precise measurements. While it is obvious from its title that the Bureau has something to do with "Standards", the very wide field now covered by this term is usually not appreciated even by those accustomed to the use of exact measurements in their own particular work. Standards are divided into five classes as follows: (1) Standards of measurement; (2) standard constants; (3) standards of quality; (4) standards of performance; and (5) standards of practice. As an example of the first class, we may take the familiar measurements of length, mass, and time; while the second kind of standard is well illustrated by such a constant as the mechanical equivalent of heat, the constant of gravitation, etc.; a standard of quality takes the form, usually, of a specification for materials so drawn up as to insure that a substance made according to the specification will fulfill certain requirements; standards of performance may be applied to all sorts of machines and devices, from photographic lenses to airplane engines; while standards of practice include various codes for the regulation of the construction, installation, and operation of buildings, machines, and appliances of all descriptions.

Any single institution covering the whole field of standardization must, indeed, be one of extremely varied activities; in fact, it must concern itself with every branch of industry and science. In order to deal with such a variety of work, it has been found expedient to organize the Bureau of Standards into eleven scientific and technical divisions, besides the office and operation and construction divisions. The staff of each division is made up of experts in some particular line of work, the divisional organization being dependent upon the character of the work rather than upon the kinds of standards. The names of the technical divisions are as follows: Weights and Measures; Electricity; Heat and Power; Optics; Chemistry; Mechanics and Sound; Structural, Engineering and Miscellaneous Materials; Metallurgy; Ceramics; Simplified Practice; and Building and Housing.

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The employees engaged in clerical work form the Office Division, while those employed in the operation of the mechanical plant, the various shops, and the care of the buildings and grounds make up the Operation and Construction Divisions.

The location of such an institution as the Bureau, devoted to accurate scientific work, is of considerable importance, and it is particularly fortunate in this respect. The buildings are all designed for the special class of work for which they are used, and stand on a tract of 35 acres on the outskirts of Washington, where there is much greater freedom from mechanical and electrical disturbances than would be found in a site nearer the center of the city.

The Bureau's Relations to the Government and the Public

While the importance of exact standards was recognized by the founders of our country, and although the constitution gives to Congress the power to "fix the Standard of Weights and Measures," it was not until March 3, 1901, as before mentioned, that the present national bureau was established. Prior to that time the limited amount of standardization work carried out by the Government was taken care of by the Coast and Geodetic Survey.

In accordance with the law creating the Bureau, its services are given free to other departments of the National Government and to State governments, while in general when tests are carried out for private individuals or organizations, a nominal fee is charged. The relations of the Bureau to the other Government departments, to the public, and the industries are extremely varied and interesting.

It may be well to consider these relations somewhat more at length at this point, in order better to understand the work of the different divisions of the Bureau. One of the Bureau's most important functions is that of a testing laboratory for the other Government departments. It is obvious that it is to the interest of all concerned to place government purchases on a sound basis of merit and it is with this end in view that the Bureau undertakes to make tests of the materials used in governmental work. The Government differs in no way, except in size, from a private industry. It is, however, larger than any single industrial organization, and its activities cover a far larger field. Therefore, by performing tests for the Government, the Bureau is able to keep in close touch with all the latest manufacturing methods. In addition to this routine testing work, it also acts in an advisory capacity and is frequently called into consultation by other organizations, such as the Federal Specifications Board, to aid in the drafting of specifications, rules, and regulations.

At the present time the Bureau is engaged in the important and difficult work of preparing a dictionary or handbook of specifications covering all supplies purchased out of taxes, and designed to be of special service to purchasing officers of the

National and State Governments. This work requires cooperation with almost every industrial group in the country, and when completed will be a remarkable step forward in standardization of public purchase requirements.

As before mentioned, it is absolutely necessary for the Government to require in its work, the use of accurate standards of all kinds. The public can hardly be expected to appreciate the need for and value of exact standards in its purchases, if the Government itself does not set an example by demanding the highest accuracy. The Bureau has, therefore, aimed to take a leading part in the education of the public in the matter of standardization and has always maintained the closest relations with state and municipal libraries, laboratories, and educational institutions. It has distributed a number of charts and pamphlets which are particularly designed to be of service in everyday life. It has also greatly aided the public through its frequent service as an impartial mediator in disputes between municipalities and public service corporations. Many of these disputes can be settled through the assistance of an unbiased third party, such as the Bureau, with far less loss of time and money than would be the case if they were carried into the courts.

One of the most effective ways in which the Bureau aids American industries is through its system of research associates. These associates are sent to the Bureau by an industry or group of industries to work on some special problem. The salary of the associate is paid by the industry but he has the benefit of the Bureau's equipment and the experience of its staff. The results of the work are published by the Bureau for the public benefit. During last year 29 of these research associates representing 23 firms and industrial groups were stationed at the Bureau.

With the foregoing general statements in mind concerning the Bureau and its work, we are now in a position to take up in greater detail the field covered by each of the scientific and technical divisions.

The Division of Weights and Measures

The original standardization work that was carried out by the ancients was in connection with the familiar measurements of length and mass. Standardization of these measurements is absolutely essential in any civilization, however primitive. The division of weights and measures may, therefore, be considered to deal with the fundamental work upon which all the rest depends.

This division is charged with the custody of the fundamental standards of the United States. It is probably not generally known that we have no primary standard yard or pound. Our fundamental standards of length and mass are the meter and kilogram which were sent to this country from France by the Interna-

tional Bureau in 1889. Our standard yard and pound are derived from these, which are duplicates of the international prototypes, kept at Paris. The working standards which the Bureau uses in making comparisons with weights and measures submitted to it for test are compared at regular intervals with the fundamental standards of the country, and thus our measurements are in reality referred back to the standards deposited in the International Bureau at Paris.

The Bureau conducts a large number of tests of sets of weights for various private and state institutions and for the industries. As these tests require a great deal of time, it is not always possible for the Bureau to undertake all of the work of this nature that it would like to do. It is, therefore, important that its activities be confined to the testing of reference standards as the ordinary routine testing of weights is a problem which suitably belongs to the commercial laboratory.

The varied nature of the weights and measures work will be appreciated when one learns that the Bureau has four special cars for calibrating railroad track scales. Two of these equipments are high-capacity box cars specially constructed to hold a set of weights with a total weight of 80,000 lb. By means of a crane attached to the car operated by a gasoline engine and a special truck, these weights can be loaded on to the scale and its reading compared with the actual load placed upon it. Such equipment is much more accurate and reliable than the ordinary single dead-weight test car which most railroads use for this purpose. The Bureau, however, also owns two cars of this type for less accurate work. The weights, in the larger test cars just mentioned, are well protected inside the car and are not subject to the wear and consequent variation wich is bound to occur in the case where the car itself is used as the weight. During the fiscal year 1924, 19 master scales and 1019 commercial scales were tested with these equipments; 53.9% passed the tolerance as compared with 38.2% in 1914 when the work was started, good proof of the value of the work.

For the inspection and calibration of mine scales, which in many cases are located in inacessible territory, the Bureau maintains specially built motor trucks which serve the same purpose (to transport dead weights) as the cars mentioned above. These mine scale testing equipments have done a great service in aiding to settle disputes between mine operators and the workers and in assuring the giving of honest weights to the consumer.

During the war, munitions were produced in vast quantities in this country. The making of shells and similar articles on an absolutely interchangeable basis required the use of a great number of accurate gages. The Bureau took a leading part in assisting the military departments in this work. Its assistance

took not only the form of routine testing of large numbers of gages, but also the manufacture of gage blocks by methods developed at the Bureau, an industry heretofore confined entirely to one firm in Eruope. This process has now been perfected and adopted by one of the leading makers of precision tools in the United States.

One of the laboratories of the weights and measures divi- is devoted to the testing of clocks and watches. Many hundreds of timepieces have been tested for the United States Shipping Board, the War Department, and the public. Much of this work has been carried out in cooperation with the Horological Institute, and through this organization's plan for the certification of watchmakers a real advance has been made in the elimination of unskilled repairmen from this field. Other laboratories are devoted to the testing of volumetric glassware, gas measuring appliances, and the administration of weights and measures laws.

The Electrical Division

As, in the case of nearly all other kinds of work, one of the most important functions of the Bureau, with respect to electricity and allied subjects, is the establishment and maintenance of the fundamental standards upon which all electrical measurements are based, including cooperation with similar institutions in other countries so as to secure international uniformity. This includes the inter-comparison of standards and extensive research in methods of measurement and the development and improvement of subsidiary and derived standards. These standards are utilized and the results of the researches are immediately applied in the testing of reference standards and instruments for manufacturers, testing laboratories, universities, research institutions, Electrical utilities, utility commissions, engineering and other interests, and various agencies of the government.

The testing of electrical instruments and apparatus is of two main classes: First, there is the standardization of reference standards and precision instruments for manufacturing and other institutions which themselves make or standardize instruments for commercial use or which conduct research work. It is through the work of such institutions that the measurements made in practice are referred back to the standards of the Bureau. Second, a limited amount of testing of commercial electrical measuring instruments and devices, such as radio apparatus, magnetic materials, ignition appliances, etc., is done chiefly for the purpose of keeping the Bureau in touch with the needs of the industries, of developing improved methods of manufacture, and of improving apparatus and materials. The greater portion of this

testing is done for the Government services and takes the form of acceptance tests of materials purchased by other Government departments. This work serves the double purpose of providing information to be used in formulating specifications and of determining the quality of materials furnished in compliance with them. The research work has mainly to do with methods of measurement, the determination of the electric and magnetic properties of materials, and the development of those phases of electrical engineering in which measurement plays an important role. Electrical, radio, and illuminating engineering interests are all served by these investigations. The Bureau also rende rs important service both directly and indirectly to manufacturing and other industries. Much of this investigational work is on the more fundamental aspects of the principles involved, so that the results may be applicable to a class of problems rather than being limited to the one specific problem under investigation. Examples of this work are to be found in the correlation of magnetic and mechanical properties of iron and steel and in the study of galvanometers. Research work in radio communication, magnetism, radio activities, photometry, gas engine ignition work, etc., is along lines quite similar to that in the more purely electrical measurements. Standards have been and are being developed, methods of measurements are being improved, and important special problems of significance to the industries and in a number of cases particular importance to the Government, are being investigated.

One of the valuable services which the electrical division renders to the Government and also to the industries and public is the routine testing of incandescent electric lamps. For a number of years, all government purchases of this calss of material have been based on acceptance tests conducted by the Bureau. The standards of manufacture have thus been raised and much valuable information has been secured concerning the life and efficiency of these lamps. During the fiscal year ended June 30, 1924, the Government purchased 1,619,788 incandescent electric lamps based on the Bureau's inspection.

The Bureau's work on dry cells and storage batteries has been of the first importance and has resulted in better products and a reduction of unnecessary sizes.

The research work in the field of radio communication has yielded very important results. The construction of a satisfactory form of radio direction finder by means of which ships are able to determine the location of lighthouses, etc., many miles away, and when entirely obscured by distance and by fogs, has revolutionized navigation not only on the ocean, but in the air.

In drawing up laws governing radio transmission, the Bureau has given a great deal of assistance to other branches of the Government.

Of late years there has been a growing necessity for the formulation of safety codes covering industrial operations. The Bureau has taken an active part in the preparation of such regulations under the rules of the American Engineering Standards Committee, and a good portion of this work has been assigned to the members of the staff of the electrical division. Codes already published include the National Electrical Safety Code, the Code for the Protection of the Heads and Eyes of Industrial Workers, and the Logging and Sawmill Safety Code.

The telephone service standardization work is also of the first importance and as carried out under the direction of the Bureau of the Budget an annual economy of $69,000 in the operation of the Government's telephone service in Washington has been effected.

Division of Heat and Power

An idea of a portion of the work of this division is quite evident from its title, but the breadth of the field covered in the study of the phenomena of heat is probably not appreciated by the average non-scientific man. An important part of the work of this division consists of the calibration of thermometers of all sorts, of the mercury in glass, platinum resistance, and gas types, as well as pyrometers for measuring very high temperatures. The Bureau's work in aiding to place the manufacture of clinical thermometers on a more scientific and honest basis has been of great importance. The work in thermometry includes investigations of the melting points of various materials and the establishment of fixed points on the high temperature thermometric scale. Such work requires the use of a great deal of special apparatus and the highest degree of scientific ability. It is of great importance in many of the industries which are dependent upon the accurate control of temperatures. Through the Bureau's effort agreement on an international temperature scale has recently been brought about.

Standard samples for use in calorimetric work are distributed by the Bureau and serve as reference standards in the industries.

The production of extremely low temperatures and the liquefaction of air and hydrogen and ultimately of helium are carried on by this division. The liquid air plant is operated once or twice a week to maintain the necessary quantities of liquid air in stock. Valuable assistance to the refrigerating industries has been given through the investigations conducted by the heat division, and somewhat similar work on the properties of saturated steam is now in progress.

An interesting part of the work of this division is that concerned with the investigation of internal combustion engines, particularly those used for the propulsion of air craft. Prior to the establishment of the Bureau's laboratory for this purpose, no testing of airplane engines under conditions comparable to those of actual service had been carried out. The Bureau constructed a special laboratory containing a chamber within which an airplane engine could be placed and operated under the conditions of low atmospheric pressure and temperature met with at the high altitudes at which planes often fly. This work was of great value to our Air Service during the war and extensive investigational and development work on airplane engines has been carried out. Other work has been conducted in connection with automobile engines and appliances, and very thorough road tests of automobiles have been made, using recording apparatus designed by the Bureau. Through the Bureau's tests, brake linings have been greatly improved, resulting in an estimated saving of $15,000,000 per year to the public.

The determination of the fireproofing qualities of various materials is of great importance in building construction, and this division, in cooperation with various organizations, has conducted a thorough investigation of numerous fireproofing materials, fireproof coatings for building columns, theater curtains, etc. Results of great value have been obtained and assistance has been given to many architects and engineers through this work.

The Optics Division

Optical instruments and optical methods are used in nearly all branches of science, and the purely scientific investigations carried out in the laboratory often have an important application in practical work. One of the sections of this division is engaged with the study of spectroscopy, that is, the determination of the spectra of the various chemical elements. Such work is of great importance in the analysis of certain substances, as, for instance, very pure metals, since impurities may be detected by this means, when they exist in such small quantities that they could not be found by the usual chemical analysis. In connection with spectroscopy, the Bureau has developed special photographic plates sensitive to the longer or red waves of the spectrum. As showing how a scientific achievement may very often have an intensely practical application, it may be noted that the photographic plates developed in connection with spectroscopic analysis proved to be the best obtainable plates for aerial photography. By using such plates, photographs can be taken through haze, smoke, and clouds which may happen to be below the airplane.

Important contributions have been made during the last two years to our knowledge of the relation between the spectra of the different elements. This work has included the verification of the so-called alternation law for arc spectra and the so-called displacement law which states that the spark spectrum of any element resembles in structure the arc spectrum of the element just preceding it to the left in the periodic table.

Another optical field of great importance to the industries is that of polarimetry. As the polarimetric examination of sugar is one of the most important tests of that commodity, the Bureau has undertaken the work of standardizaing and in certain cases of adjusting polariscopes submitted to it by the sugar refiners. In this way, it has been of real benefit to this industry, as such instruments could not be readily procured during the war and many that were in use were in bad condition. The Bureau's laboratories have produced a number of the rare sugars for medical and other work. A satisfactory method for determining the color of sugar has been developed and has solved one of the most difficult problems confronting the sugar industry.

The section of the Bureau devoted to colorimetry carries on some interesting and varied work. The study of colors and color standards is of great importance in many lines of industry, and strange as it may seem the specification of a given color is not any easy matter. Many kinds of oils and other liquids are sold on the basis of color, and the use of accurate standards in this work is of the first importance.

Another section deals with atomic physics, radium, and X-rays. This is a new field of work in which development is very rapid. A better understanding of the structure of the universe will be the result of investigations such as this section is conducting.

Still another part of this division deals with optical instruments and has devoted a great deal of time to the study of the design of this class of apparatus. Nearly all these instruments were previously made abroad but a number of American firms are now entering the field and it is the desire of the Bureau to assist them in every way possible. A great many binoculars and other optical devices were required by the military and naval branches of the government service during the war. Nearly all of such instruments were first tested by the Bureau and rapid but accurate methods of determining the constants of optical instruments were perfected in this laboratory.

The use of radiometry for purposes of secret signalling was a system developed by the radiometry section of the Optics Division during the war and which has been carried by the Bureau to a practical point. Many studies have been made of the radiation from heavenly bodies, notably those of the radiation from the planets Venus and Mars carried out during the past summer in cooperation with the Lowell Observatory, Flagstaff, Arizona. Some

valuable information has been gained concerning the conditions existing on these planets. Other work has covered the heat radiation from different painted surfaces which has yielded important information concerning the best paint to use for household radiators, roofs, canopies, etc.

Interferometry or the interference of light waves has been used to measure small changes of length and has been employed by the Bureau to rule some very precise steel scales for a manufacturer of precision tools. These scales are so accurate that no correction has to be added or subtracted from their readings, even in the finest work.

The Chemistry Division

A great deal of the work of the Chemistry Division is in cooperation with the other scientific divisions of the Bureau. Many of the problems which come to the Bureau for solution demand chemical analyses as a part of the work. It must not be inferred, however, that the chemistry division does not initiate and deal with many independent investigations. It likewise carries on many tests purely chemical in their nature for other Government departments and in some cases for municipal institutions and private parties. It also distributes many standard samples of various materials which are used for reference purposes in the industries. This work alone is of the greatest importance. In certain of the work carried on by the Bureau, absolutely pure substances are necessary and the preparation of these forms a part of the activities of the chemistry division.

The field of electro-chemistry is becoming more important each year and in the solution of such problems the Bureau has taken an active part. Accurate data are lacking on a good many of the processes of electroplating and the work of the chemical division has been of real assistance to this industry.

In the case of the section of paints, varnishes, etc., as well as the one dealing with miscellaneous organic materials, a great deal of work is carried out for the General Supply Committee of the Government and hundreds of samples are tested every year. Many specifications are likewise prepared for the Federal Specifications Board.

Another section devoted to gas chemistry has been largely employed during the past few years in investigating gas appliances and in determining upon the types of construction and conditions under which such devices should be used. This has a direct bearing on the public health and on fire hazards and is therefore of great importance.

Chemical work is also important in the testing of cement, bituminous materials, paint, varnishes, and soap. The Government is a large buyer of all classes of these substances and nearly all of the acceptance tests, to determine whether the article supplied complies with the Government specifications, are performed by the chemical division of the Bureau.

Mechanics and Sound

The work of this division covers the physical testing of fabricated metal and to a certain extent of wooden structures, the testing of such appliances as water current meters, ventilators, fire extinguishers, pressure gages, fittings for heating systems, aeronautic and similar measuring instruments, the determination of the aerodynamical properties of air craft in the Bureau's wind tunnels, and studies of sound transmission and similar phenomena. One of the Bureau's wind tunnels gives an air speed of 75 miles per hour, another 80 miles, while 190 miles per hour can be obtained in the third. The first of these tunnels has a diameter of ten feet, so that very large models can be tested.

One of the sections of this division is devoted to the testing of metals and wood and is equipped with machines capable of determining the properties of any size specimen from the lightest piece of wood to a full size steel column. The equipment includes the largest testing machine in the world, with a capacity of 10,000,000 lb., in compression, as well as two Emery testing machines, one of which is the largest high precision machine in existence. It has a capacity of 2,300,000 lb., in compression, and about one-half that in tension. It is so designed that both tensile and compressive strength tests can be carried out with the highest degree of accuracy and with the maximum of convenience. The mechanical equipment of this section includes, beside the tensile and compressive machines just mentioned, a full assortment of torsional, cross bend, impact, and hardness testing machines.

Structural, Miscellaneous, and Engineering Materials

This division is pre-eminently the industrial division of the Bureau. Its work is carried on in close cooperation with the various industries of the country and includes the investigation and testing of the ordinary materials used for constructional work, as well as rubber and leather goods, textiles, and paper.

The first section of this division deals with investigations of cement and concrete. It is equipped to carry out work both in the laboratory and in the field, and conducts at all times a great number of routine tests of cement used in governmental construction work. This part of the Bureau's work has increased greatly during the past few years and requires the services of a small field force and three branch laboratories devoted to cement testing. These greatly aid the Government in rapidly carrying out its construction programs. The investiga-

tional work has covered the strength of concrete, properties of waterproofing materials, weathering of building stone, sagging of stone with age, etc.

Closely allied to the work on cement and concrete is that conducted by the Bureau on lime and gypsum. This work includes investigations of the effect of different kinds of lime upon the properties of plaster, possible ways for improving the quality of lime plaster, and investigations of the best means for manufacturing sand-lime brick. Work has also been done on the use of reinforced gypsum and through these investigations the usefullness of this material has been greatly increased.

Other sections of this division are concerned with the physical testing of rubber, leather, textiles, and paper. This work necessarily requires familiarity with all of the manufacturing processes used in the production of the finished articles and in order to enable the Bureau to test the relative merits of various manufacturing processes, a small size but complete rubber mill and paper mill have been provided. The textile section is quite completely equipped with cotton mill machinery and a number of special appliances for the rapid and accuate testing of cloths.

Specifications have been drawn up covering automobile tires and tubes, and investigations have determined the power loss in tires of different construction.

The Metallurgical Division

This division is concerned with the thermal analysis and structure of metals, heat treatment and its effect upon metals and alloys, including the researches involved in determining the causes of metal failures, the study of heating and cooling curves, the investigation of hardening, annealing, tempering, cementation, determination of the critical ranges, and the preparation of pure metals and alloys. In connection with this division, a complete experimental foundry for ferrous and non-ferrous metals is provided. Besides being employed in investigational work, it turns out quite a number of castings used in the Bureau's machine shops for the construction of special apparatus. Foundry practice in connection with various kinds of metals can thus be studied and a great deal of valuable information is also obtained concerning furnace behavior, the relative merits of various types of foundry sands, etc. For studying the numerous phases of the working of metals, a small-sized electrically driven rolling mill, a forging press, and other similar equipment has been installed. The laboratory devoted to the microscopic study of metals is unusually complete. Valuable work has been done here on the causes of failure of railroad rails and similar important problems. An experimental heat treating plant in which the effects of high temperatures on various alloys of

steel can be studied is maintained by this division. Many special investigations, such as the determination of the causes of failure of chilled iron car wheels, are continually carried on for the benefit of metallurgical industries of the country. In cooperation with the chemical division, analyses of metals are conducted and pure metals and alloys are produced for scientific purposes.

A great deal of investigational work is carried on in this division to determine the best composition for brass, copper, bronze, and similar materials needed by other departments of the government. Some physical testing of metals is likewise carried on by this division, in cooperation with the Division of Mechanics and Sound, though the metallurgical division has some testing machines of its own for the more usual classes of work.

The Ceramic Division

The first section of this division is concerned with clay products, the development of new uses for clay, the replacement of imported by native materials, improvement of the quality of clay products, and in making routine tests for the government involving the use of clays and similar materials.

An important work of this division is in connection with refractories of all sorts for use in furnaces and other places where high temperatures must be withstood. In cooperation with the section devoted to the manufacture of optical glass, a special form of glass pot has been developed using for the material a refuse from earthenware and wall tile manufactruing plants. The use of these pots has revolutionized one portion of the optical glass industry, and they are already employed commercially by several glass makers.

Strength tests are conducted on hollow tile walls and constructions using architectural terra cotta and similar materials, and in cooperation with the Heat and Power Division considerable work has been done on the investigation of fire-resisting protective coatings for building columns.

Section 2 of the ceramic division is devoted to the manufacture of optical glass. It should be noted that only a few years ago not a pound of optical glass was produced in the United States, all of it was imported from a few firms in Germany, France, and England. The Bureau foresaw that in the event of an emergency this supply might be greatly curtailed. After the commencement of the war in Europe, the Bureau undertook a complete study of the manufacture of this kind of glass and at the time the United States entered the conflict it had worked out a satisfactory process for producing the ordinary grades of optical glass. It was only after a long and exhaustive investi-

gation that the proper technique for the operation of the furnace, the best design and most satisfactory materials for use in constructing the glass pots, etc., could be worked out, and the final result - the production of high-grade optical glass - is one of the most important accomplishments of the Bureau. This work has all been conducted in the closest cooperation with and for the benefit of the American glass industry.

Another section of the ceramic division is concerned with the study of enamels for use on metal ware. The production of satisfactory enamels for this purpose was an art previously known only in Europe and the development of satisfactory processes in the United States is of extreme importance. The causes of cracking of enameled ware has been discovered, and remedies for this defect worked out, so that this serious loss to the industry has been greatly reduced.

Simplified Practice

The division of simplified practice has for its object the reduction of waste through the elimination of unnecessary varieties of manufactured products. The division serves as a centralizing agency in bringing together producers, distributors, and users, in cooperation with American industries.

Up to the present time the following simplified practice recommendations have been accepted by the representatives of the industries concerned, and have been printed:

1. Paving brick.
2. Bedsteads, springs, and mattresses.
3. Metal lath.
4. Asphalt.
5. Hotel chinaware.
6. Files and rasps.
7. Face and common brick (clay).
8. Range boilers and expansion tanks.
9. Woven wire fencing.
10. Milk bottles and caps.
11. Bed blankets.
12. Hollow building tile.
13. Paints, varnishes, and containers.

The following recommendations are now in process of acceptance: Paper, lumber, brass lavatory and sink traps, steel barrels and drums, forged tools, blackboard slate, roofing slate, structural slate, bolts and nuts for farm equipment, hot water storage tanks, asbestos paper and millboard, builders' hardware, and hospital beds.

Simplified practice recommendations are being considered for concrete blocks, cafeteria and lunchroom chinaware, refractories, steel lockers, steel reinforcing bars, warehouse forms, oil storage tanks, sheet steel, terne plate, eaves troughs and conductor pipe, shovels, furnace parts (registers for warm air furnaces), window sash and doors, and field surveys are in progress covering many other lines.

Building and Housing

The work of this division includes gathering and distributing scientific, practical, statistical, and other information tending to encourage, cheapen, and improve construction and housing. It covers investigations for use in framing local building and plumbing codes, and a study of problems connected with city planning and zoning.

As a part of the division's activities, information on the prices, production, consumption, and stocks of building materials, and on building activity is collected, analyzed, and distributed. Special attention is paid to factors bearing on the housing problem. The work includes studies of building practices, and cooperation with efforts to reduce seasonal operation in the construction industries.

The last named work has met with considerable success during the past year. Seasonal operation has been found to be due more to custom than to climate, and through its efforts the Bureau hopes to even up the curve of construction work, which will result in steadier employment to workers and reduced costs to builders and the public.

The work in connection with zoning is of great importance, since a large number of cities and towns are adopting zoning ordinances each year. It is important that these regulations be prepared with care, so as to stand up under court decisions, and it is also advisable to have them as uniform as possible throughout the country. In this particular field the Bureau has been of real assistance.

It has also aided the individual home owner through written advice and reply to inquiries and by means of publications designed to give sound advice on home buying and construction to the general public.

Conclusion

In conclusion it may be stated that any description of the Bureau's work becomes obsolete almost as soon as written. Any work of this kind which is so largely concerned with the development of new methods and the improvement of old ones, necessarily requires that improvements and changes must follow from day to day or the work could not be considered worth while. The foregoing pages, however, give a fairly good general idea of the main lines of investigation at present being conducted by the Bureau.