MARVELS IN MEASURING

Standards Able to Distinguish the Force of the Feeblest Breath.

ASTONISHING PRECISION OFINSTRUCTION

Remarkable Equipment of the New Bureau of Standards Established by the Government at Washington.

Such marvelous achievements as the measuring of candle light six miles distant, or the splitting of a human hair into a thousand widths, are among the accomplishments of the government's Bureau of Standards, recently established at Washington, to supersede the office of standard weights and measures.

The bureau is under the control of the Department of Labor, and the public's evident lack of familiarity with its functions may be ascribed to the fact that it is the first institution of its kind ever authorized on this side of the ocean.

For years Germany has maintained at Charlottenburg, on the outskirts of Berlin, what is known to scientists the world over as the "Reichsanstalt," or the "Physikalisch-Technische Reichsanstalt," an extensive laboratory, where standards of weights, neat, force, purity, capacity, velocity, intensity affecting metals, minerals, fluids and chemicals, as well as practically all manner of instruments and machines, have been determined with mathematical precision. A bureau of similar scope has existed a long time in Paris, while another is to be found in London.

Each of these institutions, although distinctive in itself and intended primarily to meet local requrements, forms part of a so-called international system of standards. The system has for its fundamental basis a series of unchangeable units. The Bureau of Standards constitutes an addition, in the western hemisphere, and its activities necessarily will be governed, to a large extent, by principles already evolved.

Solving Problems.

The experts of this bureau are scientists of wide experience, and they have at their command every approved means for further technical study. It is claimed that no problem within the range of their investigations is unsolvable for them. They are able, for example, to tell how many thousandths of an inch the works of a watch will expand when carried in the vest pocket and subjected slightly to the heat of the body; to measure the force of the feeblest breath, and to divide and subdivide 100 times the wave lengths of light, each wave being about fifty-thousandths of an inch long.

Broadly stated, the bureau's functions are as follows:

To supervise the custody of all standards; to compare the standards used in scientific investigations, engineering, manufacturing, commerce and educational institutions with those adopted or recognized by the government; to construct, when necessary, new standards, their multiples and subdivisions; to test and ascertain the caliber of standard measuring apparatus; to solve problems which arise in connection with standards, and to determine physical constants and the properties of materials.

A Dispenser of Information.

Information concerning standards and the methods employed to secure them will be furnished for the benefit of the United States government, any state or municipality within the United States, scenic societies, educational institutions, firms, corporations and individuals engaged in manufacturing or other pursuits.

Prof. William Hallock of Columbia university, who was a member of the United States Assay commission which met recently in Philadelphia, and is identified with the bureau of standards, explained the importance of the new institution.

"Many people are at a loss to understand," he said, "how the researches and tests of this bureau can be of any practical value to the average citizen. What does he care, anyway, about standards and decimal subdivisions? Just this much: If he buys a thermometer or an incandescent lamp or a set of scales or a lens or a machine—steam, gas, electric, pneumatic or hydraulic—or any one of a thousand contrivances in common use, he wants to know whether it is what it should be and whether it conforms with standards recognized in other parts of the world.

"To manufacturers whose products are brought into competition with those of other countries this knowledge is of the greatest importance. If American manufacturers, in offering their goods for sale in Europe, should represent them to be of a certain degree of fineness, or as fine as similar European products, and expert comparisons should show that the facts in the case had been misstated, it is easy to see what would happen.

"It has been necessary in the past for manufacturers in this country to pay individual experts fancy rates to test the quality and powers of their output, to make such tests themselves at much trouble and expense, or to ship their goods to France or Germany for inspection and measurement by foreign physicists. Now all this may be done right here, and instead of costing from $25 to several hundred dollars, the needed information may be had almost for the asking—a fee of only $2 or $3 being charged by the bureau to prevent its being deluged with nonsensical requests.

What Standards Mean.

"How and where do these standards of weights and measurements originate? The whole international system is built up systematically from three fundamental units. These are the unit of time—the second; the unit of mass—the gram, and the unit of length—the centimeter. No other arbitrary units whatever are employed, all other standards being derived, directly or indirectly, from these three.

"The notion prevails in many quarters that the bureau is a scheme to compel the use of the metric system. This is a mistake. The bureau does not determine the standard units to be followed. These are prescribed by congress, the scientists simply testing and constructing the standards already authorized. In 1866 congress defined the meter as being 39.37 inches, and our yard has been declared to be 3600-3937 of a meter. Similarly the pound has been defined as a certain fraction of the kilogram, and if you were to send sixteen ounces of anything to Washington to ascertain if it agreed with the standard, it would be compared with this fractional part of a kilogram before being pronounced a legitimate pound."

"In 1872 there was established at Paris, through the co-operation of several countries, including the United States, what was known as the International Metric commission, whose business was to manufacture copies of the standard meter and the standard kilogram. It should be remembered that the meter and the kilogram were defined long ago by the French academy, the standard meter being one ten-millionth of the distance on the earth's surface from the pole to the equator, and now represented by the distance between two lines on a metallic rod, preserved in the archives of the commission referred to. Two of these meter bars and two of the kilometer bars were turned over to the United States for permanent retention, and are now in safe keeping at Washington.

"To illustrate the delicacy of the processes employed by the commission:

"When comparing two kilogram blocks, their weight was noticeably affected by their relative position on the balance scale. Side by side they weighed exactly the same, whereas, when one was placed on top of the other, the under block was the heavier, for the reason that gravitation decreases as objects recede from the center of the earth. That process represented a delicacy in weighing of one part in 100,000,000, and in order to show the difference represented by moving the blocks as indicated it would be necessary to weigh to about one ten-thousandth of a grain.

Temperature in Millionths.

"It is possible to measure temperature to a millionth of a degree. One of the recent determinations in measuring radiant heat takes as the unit the amount of heat thrown off by a candle six miles distant. The instrument used to record these radiations is an exceedingly simple affair, consisting usually of a very light mica disk delicately suspended in a bulb from which most of the air has been exhausted. When the radiations from the candle fall on this disk they heat it sufficiently to force it back.

"As a rule, light lends itself very nicely to extremely fine measurements. It is no trick at all to calculate accurately to a thousandth part of the width of a minute substance that is almost invisible to the naked eye, this being possible through the interference of waves of light. If we have two systems of waves which come together so that the crests of one system coincide with the crests of the other, the two systems are then in step, as we say, and help each other. On the other hand, if for any reason one of them is a trifle behind, they come in out of step and neutralize each other. If the movement of a watch were to expand twenty-five thousandths of an inch in a temperature 15 degrees above the normal, this expansion would be equivalent to about two of these waves of light.

"Suppose you are buying or are manufacturing for sale some incandescent lamps, which should be, for example, sixteen candle power on a 110-volt circuit. You can send one of these lamps to the bureau and receive in return an official certificate stating whether it is or is not up to the standard. The laws define the unit of electrical strength and resistance, and also the resistance of a given column of mercury. The strength of an electrical current is determined by ascertaining the amount of silver which a specific current will deposit in a given length of time, as in silver plating. All we have to do is to weigh the silver deposited and we have the standard of current immediately.

"From time to time I have asked the bureau to test for this laboratory different pieces of electrical apparatus, such as cells, dynamos, ratio coils, resistance boxes and transformers. Other laboratories, as well as manufacturers, have submitted electric motors, steam engines, gas engines, microscopes, telescopes, photographic lenses, etc. The weights used recently by the Assay commission were all standardized by the Bureau of Standards.

An Aid to Business.

"If you are about to purchase some copper for electrical purposes and have shown to you a quantity of that metal, and are told that it is of a certain conductivity, all you need to do is to send it to Washington and find out if it has been correctly represented. The same thing is true as to the purity of gold and silver and all other metals. In the course of time the bureau doubtless will be able to test radium, thorium, actinium, polonium and other radioactive substances with the same degree of skill that has characterized its other experiments. In fact, in this field alone the bureau promises to be of immense value to our citizens, since it is commonly believed that radium and like properties soon will be found in abundance in the United States.

"The necessity for an institution like the one at Washington has arisen very largely within the last few years, and particularly because of the striking developments in the application of electricity for commercial purposes. If all measurements today could be made with the yardstick and the bushel, we would not be likely to have much trouble; but when we have to deal with a multiplicity of electrical quantities, involving volts, ohms, amperes and kilowatts, the need of a headquarters, a kind of supreme court, to which we can appeal, becomes apparent.

"The Reichsanstalt has been a godsend to Germany and the rest of the world for a good many years, but it will be necessary no longer for Americans to seek abroad information relative to weights and measures, since the bureau of standards is thoroughly able to answer all these inquiries."—Philadelphia Ledger.

ATTACKS NEW LADING BILL

Plan of Eastern Railroads Contested by the Illinois Manufacturers' Association.

The legality of the new bill of lading to be put into use by the railroads running east of Chicago October 1 is attacked in an opinion given the Illinois Manufacturers' association by Levy Mayer, its general counsel. The effect of the new bill is to give two rates, one being an increase of 20 per cent if the road is to be liable for loss or damage, the second being the present rate, and with liability greatly restricted. Mr. Mayer declares that a railroad, under the common law, cannot, under an express contract, limit its liability "for gross negligence or willful misconduct or misfeasance committed by itself or its servants or employes."

Based on this opinion, a suit will probably be brought by the association, which is a corporate body, and capable of legal action, or by some Chicago shippers to test the new bill in court.

"We will have to take the matter into the courts to get it settled," said John M. Glenn, secretary of the association, last night. "But all that is in the future, and the association has not definitely decided on any action."

Salient points of Mr. Mayer's opinion follow:

"The uniform bill of lading, however, attempts to greatly limit the carrier's liability at common law. The liability of the carrier at common law is ordinarily that of an insurer against all losses or damage not arising from the act of God, the public enemy, the act of public authority, the act of the shipper and the inherent nature of the goods shipped.

"This statute does not in terms prohibit a common carrier from limiting its common law liability by special contract. In many respects a carrier may, by express contract, limit its strict common law liability. It may by special contract limit its liability to such loss or damages as may occur on its own line of carriage or against loss by fire without its fault or against other loss not attributable to its negligence or that of its servants. But a common carrier cannot, even by express contract, exempt itself from liability for gross negligence or willful misconduct or misfeasance committed by itself or its servants or employes. The conditions of the uniform bill of lading, therefore, even if otherwise valid and even if accepted by the shipper, will not abrogate the liability of the carrier for gross negligence or willful misfeasance.

"The shipper is not, however, obligated to accept the uniform bill of lading. He is entitled to have his goods carried under the strict common law liability of a carrier. The carrier can, as already indicated, by special contract limit its common law liability. Where the carrier has two rates for carrying goods, one if carried under a special contract at reduced rates, and the other, a higher rate, if carried under the common law liability, the shipper must have real freedom of choice in making his selection. If the carrier affords the shipper no opportunity to contract for the transportation of freight under its common law liability as an insurer, but receives it under a restricted liability, a contract containing such restriction is void. The fact that such contract was knowingly entered into by a shipper and without demand for a different contract makes no difference. And if the carrier accepts freight without notifying the shipper of a provision in the shipping contract limiting the carrier's liability, in consequence of a reduced rate, or that he can pay a higher rate with unlimited liability, such provision limiting the carrier's liability will not be enforced."—Chicago Chronicle.

PRESERVING MEAT BY STEAM

An Australian Method Which Is Successfully Employed by Steamship Companies.

"Keeping meats sweet and pure in a refrigerator by means of steam sounds a bit queer, doesn't it?" I was asked by George L. Cameron, superintendent of a meat-packing establishment, who continued in explanation without awaiting my answer. "Yet that is a method now in vogue on the big steamers which carry meats from this country and from Australia to Europe. Meat placed in refrigerators where the atmosphere is kept continually at an average temperature of from 36 to 40 degrees will remain fresh, but not entirely untainted, for an indefinite period.

"I think the Australians solved the problem first. They worried over the matter for a long, long time, and adopted expedient after expedient, tried experiment after experiment, but all without avail, until some one thought of using steam to volatilize the gases which caused these annoying conditions and draw them off. A steam pipe was placed in a wooden duct at the bottom of a refrigerator chamber stored with meat; the gases of this kind are low lying, and the duct led directly to the brine tanks. This experiment occurred at Sydney, and for eighty-nine days the refrigerator compartment was kept closed, at the end of which time it was opened, the meat drawn forth and every piece thoroughly tested. It was as fresh and pure, without the slightest suggestion of bone odor or mold, as on the day it was packed. The gases had been volatilized by the steam, carried off by the wooden duct and the entire noxious condition purified by the brine tanks. With this aid to the refrigeration process, provided care be taken that the temperature never falls below freezing point, save occasionally, so that the meat will not become frozen, meat may now be kept for years, and be perfectly fresh when taken forth for consumption."—St. Louis Globe-Democrat.

MODERN RAPID-FIRE ARMS

The Infantry Magazine Rifle, Machine Gun and the Long Distance Small Arms Fire.

All armies are now at work trying constantly to perfect the infantry arm, and it is probable that sooner or later the automatic rifle will replace the magazine arm.

The adoption of protective armor shields by the field artillery has led to experiments for the purpose of giving to the projectiles of the infantry arm a greater power of penetration. To accomplish this it has been proposed to use in the infantry bullet a central steel core, or to make the ogive (pointed end) of steel, or finally to make the entire ball of steel. Efforts are also being made to obtain a more powerful powder, which will give a higher muzzle velocity. None of these projected improvements, however, will interfere in any way with the early adoption of an automatic gun.

In view of these probable improvements in the infantry rifle, the question arises, will the machine gun any longer be needed when every man is provided with an automatic gun capable of a very high rate of fire for at least some seconds.

A small number of men armed with automatic rifles can produce in a given time as great a hail of projectiles as a machine gun. But it is not for this reason that the military world is inclining to an automatic infantry gun. In choosing a new arm for the infantry it is a mistake, according to the best authorities, to lay too much stress on rapidity of fire. The manufacturers of infantry rifles, like those of automobiles, have fallen into the error of supposing that an increase of rapidity alone is the basis of all progressive improvement.

The adoption of an automatic gun is not engaging the world's attention because of the possibility of thereby attaining a prolonged rapid rate of fire, but because it will furnish the means of delivering rapidly a comparatively small number of shots without taking the gun from the shoulder. This will increase the chances of hitting a comparatively small or a fleeting target at some distance, because the soldier can fire a series of shots without lowering his piece or changing his sight.

It is evident, therefore, that along with the automatic infantry arm armies can still utilize machine guns for obtaining a continued rapid fire of long duration.

But there is another difference between the two arms, in that the automatic firearm of the infantry will always be a light affair, while the machine gun, because of its mechanism, accessories, tripod, etc., is necessarily more or less heavy.

In the construction of the infantry gun the first condition to be fulfilled is that of accuracy, and the ranges to be considered are primarily those at which comparatively small targets (skirmishers kneeling or lying down, for example) may be still so clearly visible as to be fired on with effect. This arm is therefore intended, above all, for comparatively short ranges.

The machine guns, on the other hand, are so constructed as to give a prolonged rapid fire, and their cone of projectiles is sufficiently dense to admit of their effective use at comparatively long distances. Accuracy is therefore not so important, and hence this arm is better for long range fire than the infantry rifle, and another advantage lies in the fact that it may be fired over our own infantry advancing to the attack, even on level ground. This does not exclude the use of the machine gun at short distances, if the circumstances require it, although in general the well aimed fire of infantry armed with an automatic gun is then more effective.

The distinction between long range and short range fire is not new. Indeed history proves it to be very old. Even in the time of Frederick the Great light guns for firing at the longer ranges were attached to the infantry, and in several armies since that day specially trained marksmen have been utilized for the longer ranges.

At present it is held that the machine gun will in future actions be charged with the fire at long range, which recent campaigns have shown to be so effective. The circumstances in which it will come into play are easy to determine. For example, a body of troops on the defensive should force the adversary to give up his close order formations (which facilitate his advance) as early as possible, and should break down the morale of the enemy. In both cases the machine gun will prove effective. Moreover, if the defender forces the enemy to open his fire prematurely he again gains an important advantage. Here again machine guns would be of use. In the attack, on the other hand, firing at long range may attract the fire from our own troops advancing in front, which will be an advantage for the attacker, since the advancing troops can thus more readily reach their position for decisive action without too great loss. The co-operation of several firing lines, made possible by the use of machine guns for fire at long range, will also contribute to success in the final assault.

The machine gun detachments are to be attached to the infantry in the future. The fire of machine guns is intended to contribute only indirectly to the result, the fire at short range by infantry being still the only direct decisive element in battle. The main use of the machine guns will be to permit the infantry of the attack to advance more rapidly to the principal firing position, and from there to attempt to gain the superiority of fire. This appears to be the latest conclusion of the authorities on the subject.—New York Sun.

NEW YORK'S SUBWAY CITY

Big and Little Stores Opening Into the Tunnel—Much Business in Cellars.

With the approaching completion of the subway system a luxurious city of the under world is springing into life, at which New York, accustomed as it is to the unusual, may be astonished. Heretofore underground shops in New York have always been associated with dampness, darkness and even dirt. Now there seems to be a strong tendency toward them as the subway system approaches completion. The idea that because a place of business is beneath the street level it must of necessity be dark and given over to a cheap class of business is disappearing, and underground stores are being fitted up for the first lines of trade.

A striking illustration of the way this "underground" movement has affected even the arts is afforded in a new building at Fifth avenue and Thirty-fourth street, where luxurious art galleries have been fitted up beneath the sidewalks. The rooms are so well lighted that they have been selected by the Society of Illustrators for its third annual exhibition. On the face of things an underground art gallery seems an impossibility, but a step inside the pretty rooms beneath the sidewalk at Fifth avenue and Thirty-fourth street will soon convince one that the underground gallery is far from impossible.

The quarters are entered from the Thirty-fourth street side. A short flight of steps leads down from the level of the sidewalk to a small areaway, from which the entrance to the main part of the store opens. Another short flight of steps leads from this store down to that beneath the level of the walk on the Fifth avenue front. From this room one passes through a doorway into the room beneath the sidewalk on the Thirty-fourth street side of the building.

Contrary to what might be expected, the arrangement is not in the least unpleasant. The ceilings are so arranged that they are fully a foot below the sidewalk itself, and so well has the sidewalk been supported and the ceiling arranged that there is no vibration and no sound of the constant foot travel back and forth that is going on overhead. At convenient points great skylights run through the ceiling to the sidewalk. Considerable daylight is also admitted through these, and also through small windows opening into the areaway on the Thirty-fourth street side. This, supplemented by electricity, makes these underground shops as light as the rear part of many on the ground floors of downtown skyscrapers. The use to which the rooms are being put as art galleries is the best test which could be applied to their lighting. The only noise from the busy street to disturb the quiet of these subterranean rooms is the occasional rumble of a passing crosstown car as it bowls along through Thirty-fourth street. Heated, lighted, well finished and attractively furnished, no one would think, to step inside them, that just the other side of the wall is a conglomeration of curbstone base, sewer pipes, gas pipes, water mains and other things long ago buried beneath the street surface.

A rush for sub-surface stores is predicted, but, as one man put it, "What a 'come down' it would be for a man with an office on the top floor of the Flatiron building to move into one of them." Among other things, it is pointed out that it would be vastly more convenient for a woman going shopping to take a subway car, get off at a subway station and make her way to the subway entrance of one of the great department stores than to go by way of the present day elevated system, and praise is being sounded over the manifest advantages of such a system on a rainy day.

Indeed, if all which the advocates of the sub-surface city predict comes to pass, the New York merchant of a few years hence will not only have his address specified as to the east side or west side of the city, but the upper or nether side as well.—New York Tribune.

Not in the Same Line.

"This is our latest novelty," said the manufacturer proudly. "Good work, isn't it?"

"Not bad," replied the visitor, "but you can't hold a candle to the goods we make."

"Oh, are you in this line, too?"

"No, we make gunpowder."—Youth.

Sad Fate of a Library.

"Yes," said the citizen, "we had a circulating library, but it doesn't circulate round here no more.

"What's the reason?"

"Feller come along one dark night an' circulated it away from here—stole the whole business!"

"Of what did the library consist?"

"'Pilgrim's Progress,' a Bible with a brass clasp to it, six almanacs, an ten pounds o' Webster's Dictionary—the one without bridge to it, an' I reckon ef it had had a bridge he'd a' took that, too!"—Atlanta Constitution.

Gets $100,000 a Year

Because he has a keen, clear brain in a vigorous body. Electric Bitters give both and satisfy or no pay. Try them. 50c. For sale by Kuhn & Co

Ten free trips to the World's Fair each week. See coupon on page two.

Applications for Divorce.

The following petitions for divorce have been filed with the clerk of the district court: Nellie S. Miller against Frederick L. Miller, drunkenness, cruelty and nonsupport; Frank Mauss against Barbara Mauss, desertion; Mary Williams against Benjamin Williams, cruelty and nonsupport.

Ten free trips to the World's Fair each week. See coupon on page two.