SUNSPOTS AND WEATHER: By Harlan T. Stetson, Ph.D.

SCIENTIFIC AMERICAN

November • 1937

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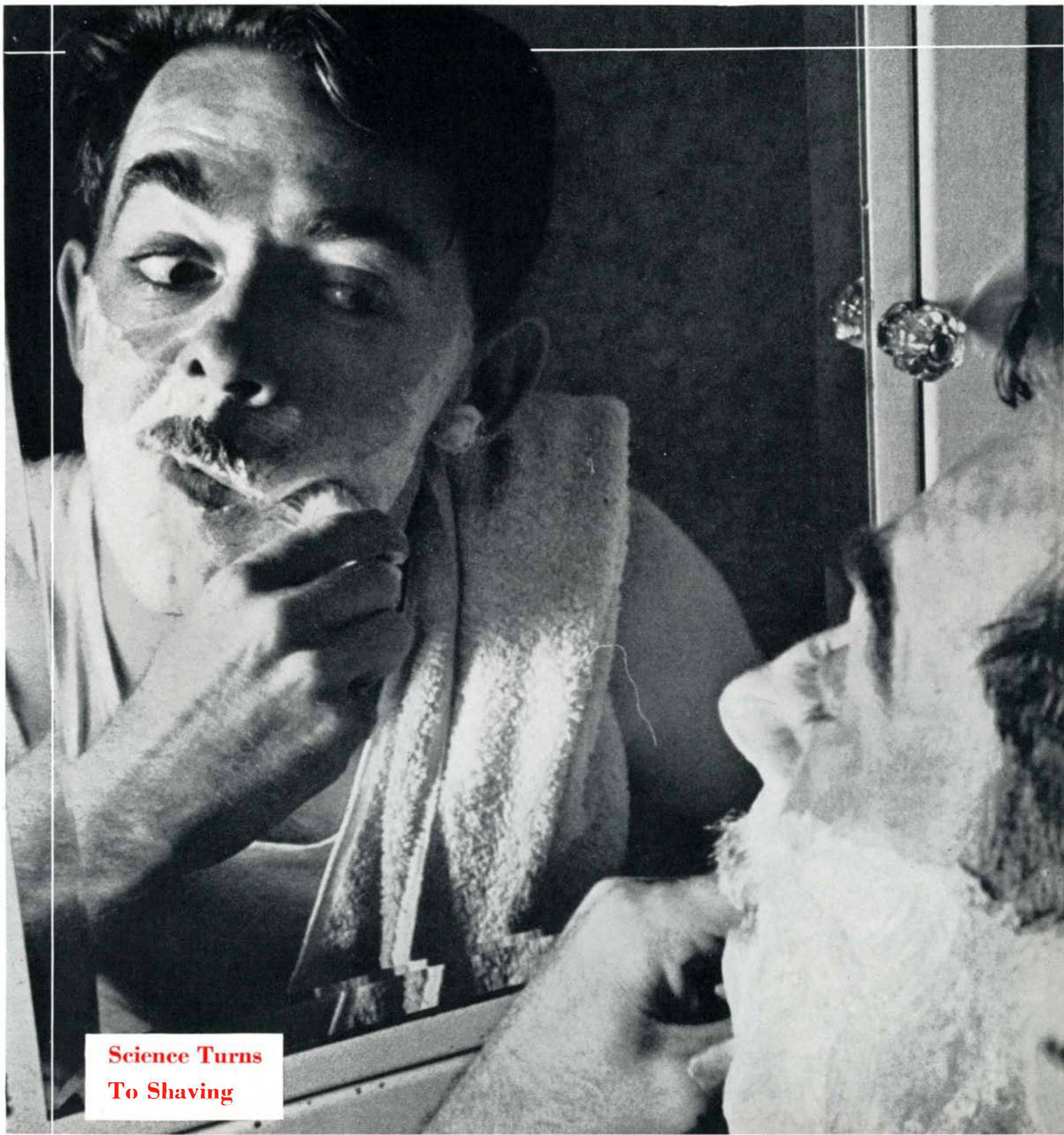
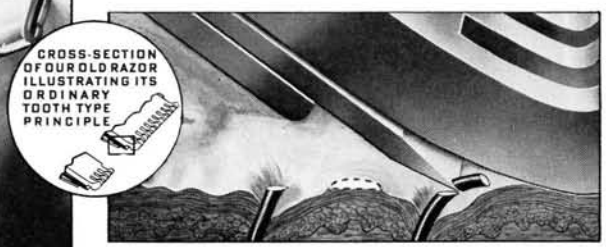


Science Turns To Shaving

Science looks at...whiskers

Every day of his life, man must shave. It takes time, it causes him trouble, it costs him money. Yet how much does man actually know about it? "Practically nothing," declared one of America's greatest independent research institutes about five years ago, and so went to work to get some really scientific knowledge about removing whiskers. This is No. 1 of a series, based on the findings of that five-year study.

SHAVING A HAIR SHAFT would be far simpler but for two complications. First, the whisker is set in a *yielding* rather than rigid base. The skin, like soft rubber, lets the whisker bend over when the blade strikes it, making a difficult cutting angle. Second complication is irregularity of the skin surface. Tiny microscopic ridges and furrows cover the face, and the whisker itself grows in a slight "pit." Problem is to cut the whisker cleanly at, or below, actual skin line, without nicking tops of the mound which rise around it.



HERE, GREATLY ENLARGED, is a side view of the tooth-type razor cutting a whisker. Its combing "teeth" (see circle) are not so designed as to stretch the skin taut enough to hold the whisker firm; it bends over as the blade cuts through it. This operation "pulled," did not feel comfortable to the shaver . . . left a long-pointed stub which his wife will complain of before the day is over. Notice (dotted lines) how the top of a ridge was nicked by the blade. Hardly visible to the naked eye, such nicks are nevertheless painful, cause "smarting" feeling you have after a bad shave.

THIS, SAYS THE INSTITUTE, is a close, comfortable shave. The razor: a Schick Injector, which the five-year research helped to perfect. Its chief advantage (in this particular problem) over the razor above is the "Guide Bar." Its surface is *flat*—not comb-like—has a slight "tread" which grips the skin, stretches it taut ahead of the blade. Notice how the whisker, held firm by the taut skin, did not bend from pressure of the blade . . . was cut off evenly with no long-pointed stubble to show or be felt. Notice, too, how the tiny ridges and furrows are pulled out flat and smooth, out of the way of the blade edge. They didn't get nicked, there is no "smarting" afterward.

SPECIAL TEST OFFER

FOR READERS OF SCIENTIFIC AMERICAN

this genuine **SCHICK INJECTOR RAZOR** and 12 blades—only **89¢**

Exactly the same razor as packed in the $2.00 Kit

This specially-priced Introductory Kit has been offered for sale in a number of cities. Your druggist may still have one. If he doesn't, fill in the coupon below, giving us the name of the store where you usually buy razor blades. This offer is good only to February 28, 1938. SEND THIS COUPON

Magazine Repeating Razor Co., Bridgeport, Conn.
Enclosed is 89c money order or check (stamps not accepted) for which please send me the Introductory Kit, Schick Injector Razor and a cartridge of 12 Schick Blades.

Your Name_____

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NO SLEIGHT OF HAND THIS... merely the quick, convenient way blades are changed in the Schick Injector Razor. Blades are sealed in a coating of oil in a metal Injector. A mere pull and push of a trigger shoots the old blade out, a fresh one in. Nothing to unwrap, take apart, twist or unscrew. Handy!

The SCIENTIFIC AMERICAN DIGEST

SCIENTIFIC AMERICAN

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NINETY-THIRD YEAR • ORSON D. MUNN, Editor

CONTENTS • NOVEMBER • 1937

WORKING up the lather preparatory to shaving is one of the vital phases of a good shave; this fact is forcefully brought out in the article "Science Turns to Shaving" starting on page 261 of this issue. Our cover photograph, by Camera Guild Inc., stresses the operation of lathering. Users of conventional blade type razors will do well to emulate.

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50 YEARS AGO IN . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of November, 1887)

CANAL—"Would it not be better for the Nicaragua Canal people to buy up the partially made Panama Canal works, and finish that enterprise? It looks as if it would have to be put on sale before long, although M. De Lesseps has lately issued a bulletin saying the canal would be finished in 1890, and no more money is required for its completion. The cash they have on hand, so he gives us to understand, is sufficient."

EDISON ON LABOR—"In reply to the question 'When motive power gets to be four times as cheap as it is, Mr. Edison, what will become of the laboring man?' the great inventor replied: 'He will be enriched by it. Machinery will be his slave. See how machinery has multiplied in the last 50 years.'"

GAS LIGHT—"About two years since, we were afforded the opportunity of privately inspecting an incandescent gaslight, which was then in a more or less incomplete condition, although it gave good promise of success. This was the Welsbach incandescent gaslight, which, since that time, has been perfected in all its details and put through practical trial. Its promise of success has been realized, inasmuch as it is now the subject of manufacture on a commercial scale."

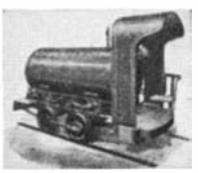
ELECTRIC WELDING—"The art of welding iron and steel by means of the heat of an ordinary fire is many centuries old, and it is perhaps one of those simple operations which would hardly be considered a subject for improvement; but the invention of electric welding by Professor Thomson not only facilitates the welding of iron, steel, and such metals as have heretofore been welded by the old time methods, but permits of the welding of cast iron, copper, brass, German silver, zinc, aluminum, and other metals which have generally been considered poor subjects for the welding process. Besides these, this new process has been successfully applied to the welding of unlike metals; iron and German silver, iron and brass, being examples."

TELEPHONE—"Few inventions of modern times took the public more by surprise than did the telephone. . . . It is now employing in the United Kingdom alone more than ten millions of capital, and earning over 750,000 dollars in dividends. . . . The telephone industry has, however, made the greatest progress in the land of its birth, there being telephone exchanges in at least 860 towns in the United States. In New York alone there are exchanges with over 7,000 subscribers, besides 2,500 private telephone wires."

SPANISH NAVY—"The United States government has at last screwed up its courage to the extent of ordering ships that shall make 19 knots an hour. This is equivalent to being about a quarter of a century behind old Spain. The Spanish navy is now in possession of a war vessel, the *Reina Regente*, that sails at the rate of 21 knots per hour. (*Sic.*) Probably by the time our 19 knot ships are ready, Spain and other nations will have vessels that can make 25 knots."

TUNNEL—"At a recent meeting of the geological section of the British Association, a report was read on the present condition of the experimental heading for the channel tunnel between Dover and Calais, a distance of 21 miles, the completion of the work having been forbidden by the English government. A hole has already been bored 7 feet in diameter, one mile and a quarter in length, nearly the whole of which is actually beneath the sea bottom. Most of the work was done five years ago, and as it has gone through a chalky formation needing no lining, it has remained perfectly dry and the substance at the surface of the boring has become harder by exposure to the air."

COMPRESSED-AIR LOCOMOTIVE—"Among the various systems of underground haulage shown at the Newcastle exhibition is one employing compressed air, and which deserves special mention. . . . We illustrate, in the annexed engraving, the locomotive exhibited at Newcastle. It is a four-wheeled engine, with inside cylinders, and the portion which in an ordinary steam locomotive would be the boiler is replaced by a cylindrical reservoir containing air under pressure. This locomotive has been shown in action since the opening of the exhibition, and drawing generally four tubs, but sometimes six, each weighing 25 cwt. The total weight of the engine is about 2 tons. The cylinders are 4 in. diameter by 7 in. stroke, and the engine runs on a 33½ in. gauge."



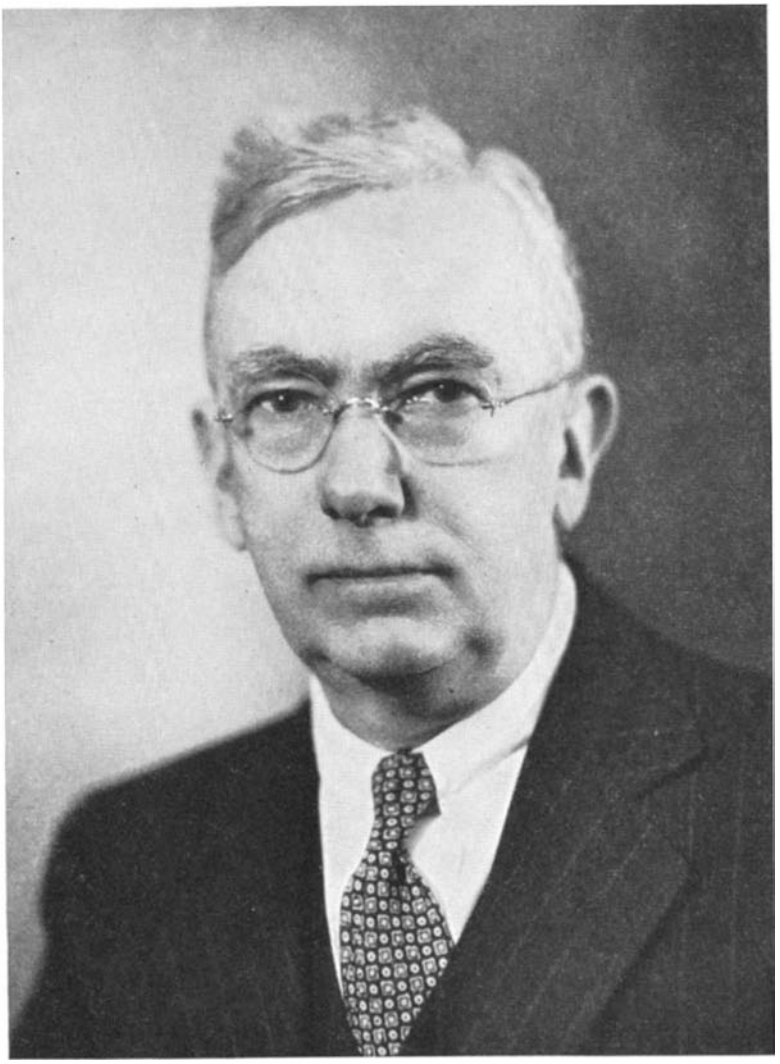
NON-MAGNETIC WATCH—"In these days, when dynamos and electric motors are everywhere met with . . . the production of a watch that is utterly unaffected by the strongest magnets is an improvement well worthy of special notice. . . . A cure for the whole affair is found in the invention of Mr. C. A. Paillard, of Geneva, Switzerland. He has applied palladium to the manufacture of watches, using it for those parts which are usually constructed of steel."

SPEED—"The fast locomotives used on the 'two-hour' trains of the Pennsylvania Railroad Company, between New York and Philadelphia, have 6 ft. 8 in. wheels, 18 in. cylinders, and 24 in. stroke. The engines do a mile in 50 seconds."

BRITISH RIFLE—"According to Sir Henry Halford, the new army rifle is to have a very small bore, about 0.3 inch, and will be a repeating rifle, with a magazine holding 10 shots. Owing to the reduction of bore, each soldier will be able to carry 166 rounds into action as easily as 100 rounds of the present ammunition. The trajectory of the arm will be very flat, so that, it is expected, as good shooting will be made at 1,000 yards with the new rifle as was made at 600 yards with the Martini-Henry, and at the same time the recoil will be reduced to one-third that of the present arm."

SECONDARY BATTERY—"A new type of secondary battery was employed on an electric launch recently tested by the French naval authorities at Havre. . . . The number of cells used was 132, which furnished a current of from 87 to 89 amperes under a difference of potential of 100 to 104 volts, and the weight per horse power per hour was about 73 pounds."

Personalities in Industry



DR. FRANK CONRAD

A SMALL, modest, elderly man, little known outside engineering circles, attended the last Milwaukee meeting of the American Institute of Electrical Engineers to receive the Lamme Medal, one of the Institute's highest awards, for "pioneering and basic developments in the field of electric metering and protective systems." This man was Dr. Frank Conrad, Assistant Chief Engineer of the Westinghouse Electric and Manufacturing Company, and behind him stretched a lifetime of important inventions, many of which are still in operation around us; some of them have helped to change the world.

The Lamme award was made, in part, to celebrate Dr. Conrad's invention of the small, round type, watt-hour meter. This occurred 30 years ago, and since then more than 30,000,000 meters of this type have been manufactured.

In all, about 300 patents have been issued to Dr. Conrad, nearly all for electrical improvements and developments, but none of these covers his greatest exploit. On November 2, 1920, at Station KDKA in Pittsburgh, he launched radio broadcasting on the world after months of experiment in his private radio station in a garage at Wilkinsburg, Pennsylvania.

Dr. Conrad's connection with broadcasting is not as widely known as some of his other achievements. Back before the World War, he made a five-dollar bet with another Westinghouse engineer over the accuracy of his watch. To settle the wager, he put together a small radio set to receive the Arlington time signals. He won the bet, but by that time it didn't matter. Radio had claimed him. When the United States entered the World War, Dr. Conrad was so widely recognized as an expert that the government called him to develop radio equipment for use in airplanes and in the front-line trenches. After the War, he went back to his experiments.

Early in 1920 Dr. Conrad began radio broadcasts from his garage-station, putting phonograph records, amateur performers, and speakers on the air regularly twice a week. Presently, one of Pittsburgh's large department stores, the Joseph Horne Company, advertised radio sets that could be used "to hear Dr. Conrad's broadcasts." With this evidence of widespread interest, the engineer was able to enlist the co-operation of Westinghouse officials and an intercompany radio station applied for a license to do commercial broadcasting. The application was granted and the new station became KDKA.

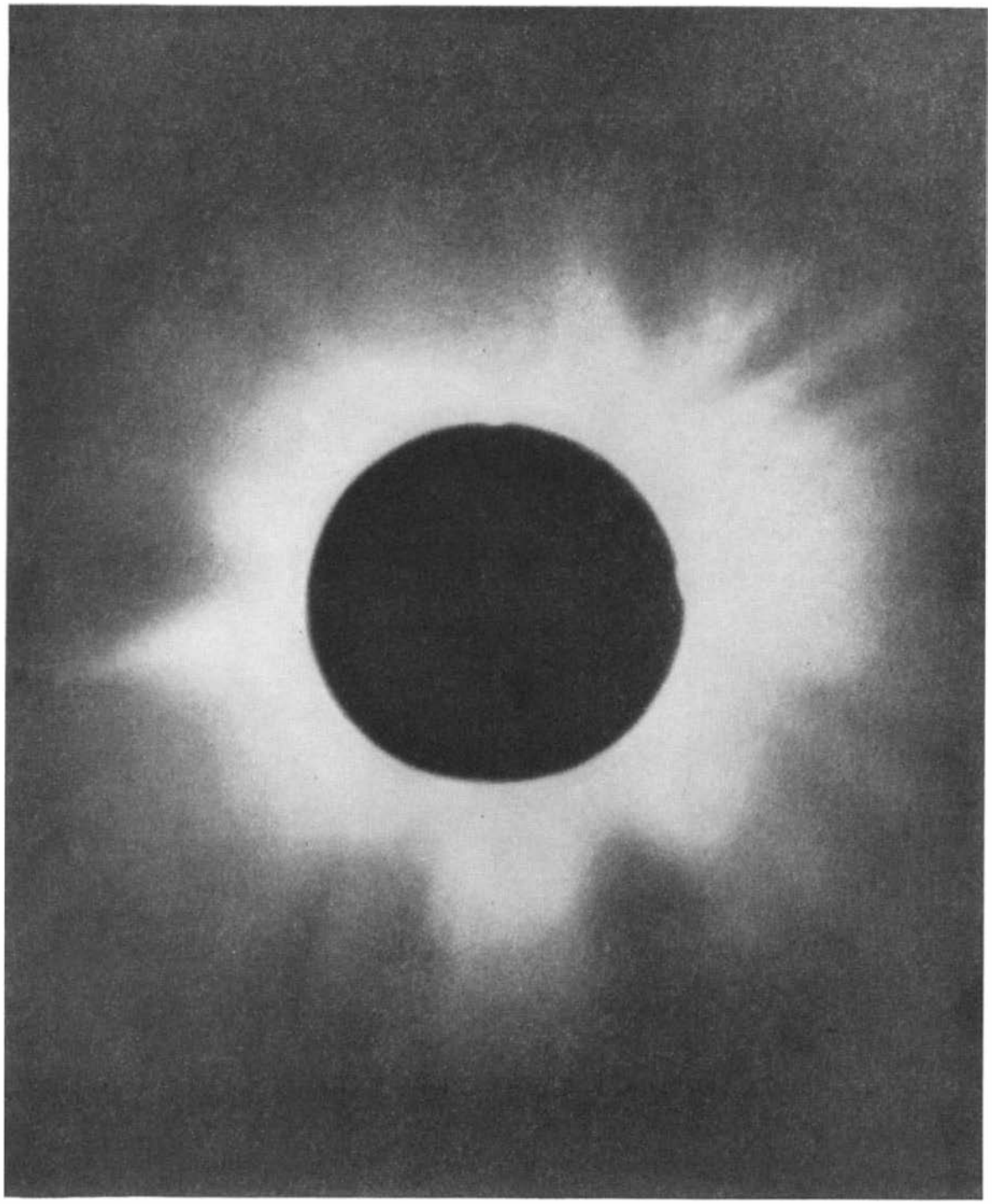
But Dr. Conrad, whose engineering, skill and imagination had started the whole business, was not present at the first broadcast. So fearful were the engineers that the makeshift apparatus at KDKA would fail, that they stationed Dr. Conrad in his garage, on a branch telephone line, to carry on the broadcast if the regular station should cease to operate.

Dr. Conrad subsequently developed short-wave apparatus and helped establish the first radio relay station at Hastings, Nebraska. He was one of the first experimenters to demonstrate that short-wave radio could be transmitted across the Atlantic.

This lifetime of achievement was accomplished without the aid of a formal education. When Dr. Conrad joined the Westinghouse company in his teens, he had not even completed grammar school, and his first job was in the machine shops. His ingenuity soon attracted such attention that he was transferred to the research laboratories.

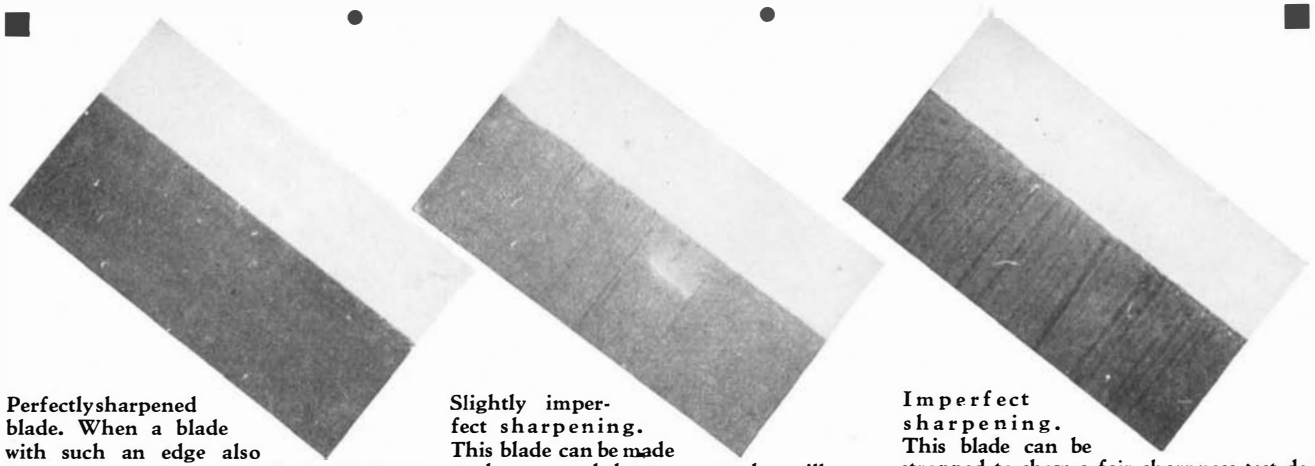
His present assignment, as Assistant Chief Engineer, is a roving one. He works on whatever problem interests him most. Other engineers bring him their worst puzzles for solution. Around the Westinghouse engineering laboratories he has a reputation for uncanny insight into the ways of materials and electricity. At one time he designed, by rule of thumb, a new type of transformer. Another engineer, to make sure the design was correct, labored for weeks with mathematics. His results were a complete confirmation of Dr. Conrad's design, worked out in about 30 minutes.

To people who call him a "scientist," Dr. Conrad is apt to reply that he prefers to be known as an engineer. With proper pride, he explains that scientists may discover important natural principles, but an engineer is a man who makes things work.



ASTRONOMY FROM ABOVE THE EARTH'S ATMOSPHERE

ASTRONOMERS often assert that what we human beings can see beyond the earth is only what the annoying earth's atmosphere permits us to see, and it is certain that we could see much more if we could go beyond it or successfully command it to draw away from in front of our instruments. However, by going in an airplane to an altitude of 25,000 feet (above most of the atmosphere) and photographing the sun's corona during an eclipse, Major Albert W. Stevens, a member of the Hayden Planetarium-Grace Eclipse Expedition, has revealed for the first time that the solar corona is not merely the familiar array of finger-like streamers from the sun but a globular layer a million miles thick surrounding it. The photograph shows the spaces between the "fingers" lightly filled in to a uniform distance.



Perfectly sharpened blade. When a blade with such an edge also shows a good sharpness test, it will have the best possible durability in actual use

Slightly imperfect sharpening. This blade can be made to show a good sharpness test, but will not be as durable as the perfect edge at left

Imperfect sharpening. This blade can be stropped to show a fair sharpness test despite ragged edge; its durability is poor

SCIENCE TURNS TO SHAVING

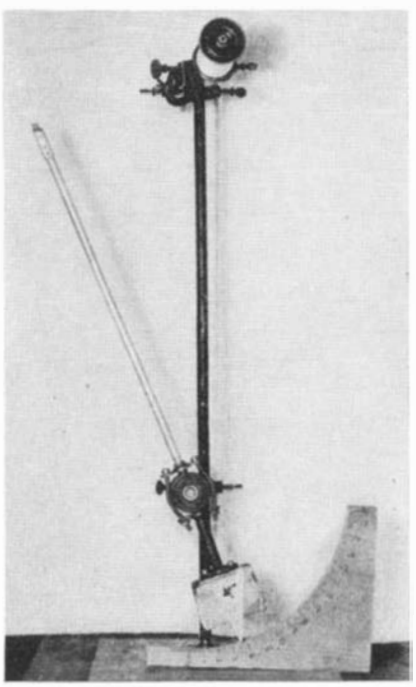
New Shaving Facts . . . Razor and Blade Design Important . . . So Is Blade Angle . . . Teeth in Blade Unnecessary . . . Razor Steels . . . Lather Two Minutes or More . . . Shaving Technic Often Poor

By ELBRIDGE J. CASSELMAN*

BEFORE the days of the pencil sharpener, the writer used a pocket knife to keep points on his school pencils. His best efforts with a hand stone failed to sharpen the knife sufficiently to shave hair. Therefore, it was a striking discovery to find that the freshly sharpened knife would shave after it had been stropped on the leather upper of his shoe. Since that time he has learned still more about sharpening cutting edges and has found that razors which have had a leather stropping as a final step are the sharpest edge tools.

POGONOTOMY (derived from two Greek words meaning "to cut the beard"), or shaving, was one of the early arts of history, rivalling the other arts of personal adornment in antiquity. The excavations of archeologists have uncovered in many places objects that they believed to be razors. The earliest razors were made of bronze and some examples are in the British Museum. The Roman razors were of iron, as were the razors recovered from the ruins of Pompeii. The writer has demonstrated the possibility of sharpening bronze, pure iron, and even copper to the point where shaving is possible, which strengthens the claims of historians. The ancients must have been stoical he-men, as experience with these materials shows they would never shave comfortably.

With the introduction of steel that could be hardened by heat treatment (Damascus steel, for example) it was possible in ancient Greece to produce razors of quality about equal to those of today. Natural stones were available for grinding an edge and for honing it; textile materials and tanned leather had been in existence for centuries, so that an edge sharp enough for shaving could have been produced by methods much like those in present use. No doubt shaving was occasionally accomplished with first rate equipment, but lack of knowledge of what constituted good equipment must have doomed many attempts to make good razors.



Early model of a sharpness tester. Blade held in top of swinging arm

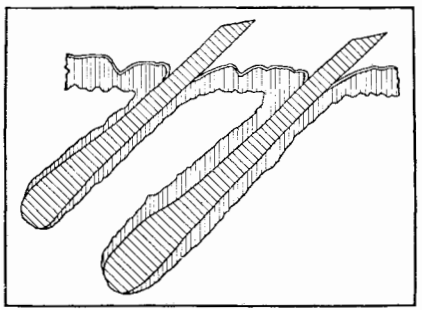
In the important matter of preparation for shaving, we have little evidence of the ancient practices. Detergents were known and used, especially in religious rites, but the types of soap that we use today, especially those containing a minimum of alkali, were probably little known or utilized. Shaving must have been torturing, and it is natural that a special group of artisans, the barbers, should have been formed, whose business was shaving and tonsorial adornment. Rome's first barber came from Sicily about 300 B.C., but there were barbers in Greece before 400 B.C.

The difficulties and discomforts of shaving probably had some influence on tonsorial styles, but there were other influences as well. The Bible contains decrees regarding shaving and the use of razors. Alexander the Great reversed the Macedonian fashion of wearing a full beard lest an enemy be given a "handle"

*For the past five years the writer has engaged in a comprehensive study of shaving technics and devices. Facilities for the investigation were provided by a Fellowship at Mellon Institute of Industrial Research in Pittsburgh, maintained by the Magazine Repeating Razor Company. In these studies all phases of shaving were examined, from the physiology of the growth of hair to the metallurgy and sharpening of safety razor blades.

to seize in slashing at soldiers' throats. Among the Romans the younger Scipio deserves a place in the history of personal hygiene as the first Roman to shave every day. The Roman emperors did not all follow his example; from Hadrian to Constantine they were full-bearded.

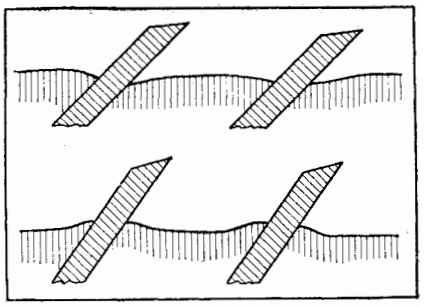
There have been controversies, frequently acrimonious, regarding shaving the beard, based on everything from



An enlarged section through the hair and skin of beard; glands, muscles, nerves, and so on, not shown. The drawing indicates the average thickness of the corneum and epidermis, coarse wrinkles, and the pit surrounding the hair shaft

piety to sanitation. Even today the discussion occasionally appears in British newspapers and periodicals. Medical men have taken sides at times, the defenders of the beard pointing out its value as a heat insulator and air strainer for the pathogenic organisms; the opponents have held the beard to be unsanitary because it is a micro-organism trap. Most physicians in America are clean-shaven and few favor the unshaven face. Neither physicians nor their collaborators in allied fields have ever demonstrated that daily shaving affects the hair. Their evidence indicates there is no effect whatsoever on the growth rate, coarseness, or density of spacing, after the change from the downy hair of adolescents to the stubborn beards of manhood.

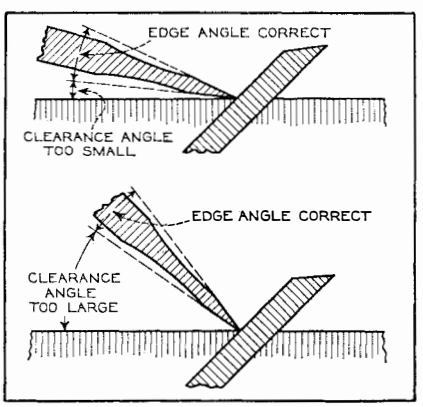
THE art of shaving as practiced by barbers has probably changed little with age, except as they have taken advantage of the few advances made from time to time. One of these advances was the introduction of "hollow grinding" in the 18th Century, which facilitates the honing process in the sharpening of a razor. Another was the development of soaps less harmful to the skin than the soda and potash chemicals available to older civilization as detergents. The present practice, in which most men shave themselves, did not take place until the invention of the replaceable safety razor blade. This forward step made it possible to transfer from persons to machines the great skill necessary to sharpen a razor and to replace this dexterity with the relatively simple motions of reloading a safety razor.



***Top:* Sectional drawing of hair and epidermis after mild stretching of the skin. *Lower:* The same section after over-stretching skin, especially over the bony parts of the face**

The replaceable safety razor blade was invented at the beginning of the 20th Century. A guard bar for preventing the cuts that occur when unskilled hands use a knife-type razor had already been fitted to such razors as early as 1875 by Michael Hunter, of Sheffield, England. Rolling mills producing steel six to twelve thousandths of an inch thick were unknown. The cheap replaceable blade, manufactured from such steel, had to wait for the coming of these mills. Tool steel of these dimensions can now be rolled by any "wire mill" and any one of several manufacturers can produce sharp blades from it. Today such blades are used by about 90 percent of American men.

The effects of the widespread use of safety razors have been social, economic, and dermatological. Among the social effects may be mentioned the passing, probably for good, of the full beard as a style. Faces that are smooth shaven every day have been with us in large numbers for over a quarter-century, and have demonstrated that their contribu-

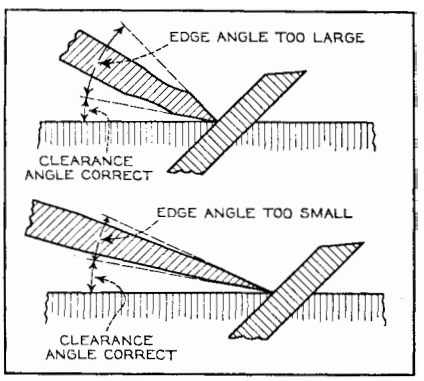


***Top:* The shaving condition which pertains when the edge angle is correct but the clearance angle is too small. This results in a long, pointed stubble, minimum damage to the skin, and minimum discomfort due to "pulling." *Lower:* Shaving condition when the edge angle is correct but the clearance angle is too large. Results in this case are a close shave with little effort, maximum damage to skin, and great discomfort due to "pulling," unless the razor blade used is very sharp**

tion to personal hygiene outweighs the debatable value of the beard as a protection for the skin. Socially, this is probably quite important for it is believed that the psychological effect of the daily shave is to improve the temperament and the temper of the nation. The dermatological effects have been, in general, the promotion of skin health.

Of shaving in general and razor blades in particular, science has learned many things in recent years. In the following discussion, new facts will be told and old traditions smashed—all in the interest of better shaving. The technical opinions expressed have been arrived at as a result of extensive laboratory investigation.

One of the first studies made—a fundamental measurement—was of the change in sharpness of razor blades as a result of shaving. The device used for this purpose (U. S. Patent #1,983,597) depends directly upon the capacity of the edge to cut very fine rayon fiber at a point ½ inch below a grip from which the fiber is freely suspended. Instead of measuring the force necessary, it was found more suitable to measure the velocity of the blade, when freely swinging on a pivoted arm, necessary to cut



***Top:* Shaving condition when clearance is correct but edge angle is too great. The principal effect is increased "pulling" during shaving. *Lower:* Shaving condition when clearance angle is correct but edge angle is too small. The results are: A close shave with little effort, considerable damage to skin, and minimum discomfort due to "pulling"**

the fiber. The results are expressed arbitrarily in velocity units—feet per second—which are a direct quantitative measure of the shaving quality of the blade. An early model of the device is shown in one of the accompanying illustrations. The scale of the testing device was graduated to cover the whole useful range of razor blades, from the scale reading of ½ unit, which represents the sharpest blades ever tested, through the range of 6 to 9 units in which many men discard used blades, and to the range of 10 to 16 units in which blades are useless for shaving. By means of this test, it is possible to study the effects of

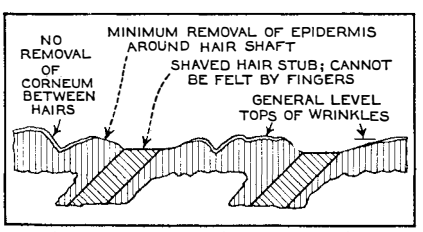
sharpening practice on both sharpness and durability; the effects of steel composition and quality upon the capacity of a blade to take a sharp edge and to retain it when in service; and the effects of shaving practice and of blade storage upon the failure of the blade edge. It was found to be a very useful means of control and interpretation in all kinds of shaving tests. The microscope was also a useful accessory in these studies; it was particularly valuable for the examination of blade edge profiles.

Data of great importance were obtained from the reports of experimental shavers, of whom some 10 to 15 shaved themselves according to directions every day for several years. They were provided with experimentally prepared razors, blades, and soaps. They observed, as a routine matter, the effort required for a close shave, any "pulling" sensation or other discomfort during the process, and any evidence of skin injury.

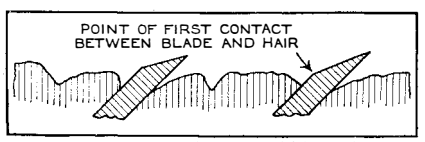
LABORATORY methods were also devised for measuring the quantities of skin and hair removed by each daily shave. These methods involved collecting the debris from the razor and centrifuging it in suspension in a soap solvent.

The time required to soften hair by soap and water solutions was made a separate study by measuring the stretch of submerged single hairs under a load of 16 kilograms per square millimeter during definite time intervals. By this method, the tremendous effects of water temperature on the rate of hair softening were demonstrated in the laboratory.

All important conclusions reached in the tests were checked by the so-called "comparison shave," a method which the average shaver can apply. The technic calls for the use of two single-edge razors that are alike in every respect except for the condition that is to be studied. The beard is completely softened as described subsequently (unless, of course, lathering procedures are



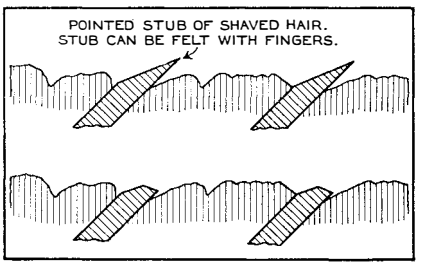
The condition of the skin and hair after proper shaving with keen edge



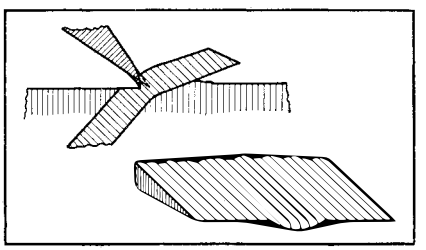
Condition of hair stubble when shaved without stretching the skin. The stubble can be felt with the fingers, especially against the grain

being studied), and one razor is used on each side of the face. On subsequent days the order of shaving the face is reversed so as to eliminate differences arising from any uncontrolled variables. Pains are taken to compare carefully the amount of effort required to get a close shave, the amount of pulling or other discomfort such as scraping sensations, and the amount of skin damage.

Failure to control essential variables by some such test is probably responsible for many of the false notions regarding shaving; for example, the relative importance of actual shaving and corrosion of the edge during storage as contributing factors in the failure of the cutting edge. The edge becomes dull



***Top:* The pointed stubble of the shaved hair results from the use of a dull blade, too small a clearance angle or too great an edge angle. *Lower:* Condition of the hair stubble when shaved first with the grain, then against—medium sharp blade**

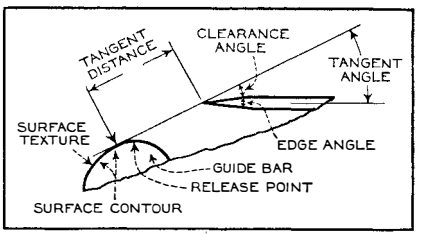


***Top:* The extreme edge of the razor blade is slightly deflected during the actual cutting of the hair, as shown in the lower drawing. This is exaggerated by a small edge angle and also by a large clearance angle**

during shaving, not during storage, unless it is left actually wet for some hours.

Some of the well-confirmed results of this five-year study can be stated. The most probable cause of unsatisfactory shaving with a new factory-sharpened blade is incomplete preparation of the beard. (Correct preparation will therefore be dealt with in detail later in this article.) The tendency to ascribe all shaving troubles to the blade is so widespread that razor-blade technology will be considered here.

Safety razor blades are made by automatic machinery that does on a large scale what barbers do by hand. The blade is hollow ground to give the edge its general shape and dimensions. It is then honed with the finest honing materials, increasing slightly the angle



There is more to the design of a safety razor than merely making a new type of guard and blade. The drawing shows some of the important features which must be taken into consideration if shaving with the razor is to be satisfactory. The features shown pertain to a solid guard type of razor. If the guard consists of teeth, two to three degrees are added to tangent angle

that was produced at the edge by the grinding. Then it is stropped, using a considerably greater footage of stropping than does the average barber. Furthermore, the stropping pressure and angles are controlled to a much more accurate degree than can be done by hand stropping or by any of the resharpening devices. When the pressure adjustments are correct for the grade of steel being sharpened, the result is a "perfect" edge. We can define such an edge as one having a sharpness under 1.5 units on the scale described above; one having no visible teeth or serrations in the profile of the edge; and one having the bisector of the edge angle parallel to the central plane of the blade. Both the radius of curvature of the edge, and the teeth (if invisible ones are present), are much smaller than the average spheroidized carbide particle that is a characteristic constituent of razor grade steel. The makers of the best razor blades attain this condition in a large proportion of their product. When a blade is in this condition, it will give the best possible satisfaction and maximum durability in shaving.

THE quality of the steel has an indirect effect only on the durability because, within a surprisingly wide range of steel quality, all perfect edges have almost equal durability. The quality of the steel has an important effect, however, on the ease with which a perfect edge may be produced. To that extent it affects the lasting qualities indirectly. It is of economic importance to the blade maker to use the steel that sharpens the most easily, hence it follows that razor blades are made from the best steel for the purpose.

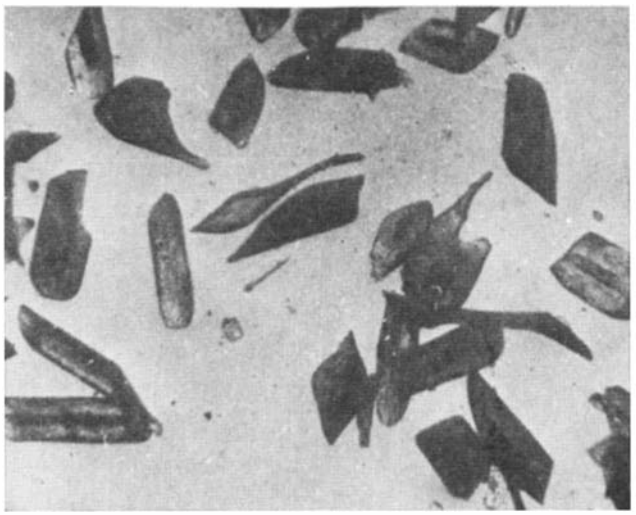
The most frequent departure from perfection of the edge is in the presence of small teeth or serrations. They are hard to eliminate; the correct adjustment of factory stroppers to do so is something of an art. They are the most important single item that affects the durability of the edge. Freedom from

serrations is the prime essential of good durability, compared with which other factors including steel quality are of minor importance. As a condition, it was so frequently missed by barbers and by the early makers of replaceable blades that a traditional belief in the necessity for fine teeth in the edge of a razor has grown up. Because of the failure of hand stropping to attain this toothless condition, the skilfully manipulated "slanting" stroke for shaving has been developed by many users of barber's razors. Such stroking methods are unnecessary with the best safety razor designs, although their use is always beneficial. A diagonally directed stroke definitely prolongs the effective life of the blade edge when it begins to get dull.

When a razor user thinks he has found a blade made from soft steel (a frequent complaint), the chances are that, instead, he has a blade with a rough edge. It is possible but not economical to put "perfect" edges on steel that is considerably softer than razor grade steel. And it is extremely difficult to put perfect edges on harder steels than those of razor grade. To do so would result in a practically inconspicuous gain for the user. Steel for a perfect edge, produced economically, must be neither too soft nor too hard.

The satisfaction that a blade will give can be predicted by simple non-destructive tests for sharpness and freedom from roughness. These tests are also useful in evaluating the effectiveness of blade resharpening devices. Most of the resharpeners that are available at present will improve a blade from the condition where it is no longer useful (say a sharpness of 9 units) and make it again serviceable for one complete shave without further resharpening. No resharpener will prepare blades that are the equal of the factory sharpened blades for which safety razors should be designed. If one finds that a resharpened blade gives him a close shave, it is strong evidence that the razor in which he uses it is improperly designed. A bloody face often results from the use of a new factory-sharpened blade in such a razor.

The actual shaving operation itself removes from 0.006 to 0.030 cubic inch of dampened skin along with the daily growth of hair. This skin is not removed in a uniformly deep layer over the shaved area, but principally from around the individual hair shafts. The effect is not important normally, since the outside layer of skin is constantly wearing off and replacing itself by natural growth. When it is aggravated, bloody spots sometimes appear, leaving the skin open to infecting agents, and providing a mechanical basis for ingrowing hairs. This aggravation may result from any practice that contributes to a "close" shave. Among such procedures are the use of a new sharp blade in a razor that is designed to be used with dull blades; shaving over the face more than once, especially against the grain; and pressing hard on the skin with the razor. The design of razor that minimizes the skin removal is also the one that lessens the pulling and scraping effects of shaving.



Hair chips—cross-cut, splintered, and sliced—as removed in normal shaving. Magnification is about 40 diameters

Some of the important features of safety razor design are shown in the accompanying drawings. It is to be noted that the shaving angle between the blade and face is controlled principally by an element of the razor design which is called the "tangent angle" in one of the illustrations, rather than by the user's method of holding the razor. The other drawings bring out the complex situation of conflicting items in the choice of the tangent angle. The selection of a large tangent angle to secure a close shave results in excessive removal of the surface skin and in the probability of pulling discomfort.

DESIGN for a safe, comfortable shave results in the possibility of failure to get a close shave. The safest shave is obtained when the tangent angle built into the razor is less than 25 degrees. Even when a new sharp blade is used with such a razor, it must be passed over the face more than once in all directions for a close shave, and the third or fourth shave with the most durable type of blade may seem to be unsatisfactory. For this reason, very few commercial safety razors are constructed to have such small tangent angles. The tendency of many razor makers has been rather to conform in their designs to the needs of those who want a close shave in a hurry. That is, they have adopted a large shaving angle. Some commercial safety razors have been found with tangent angles measuring as high as 56 degrees. Such razors give the user a feeling of scraping during use, and, therefore, sacrifice both freedom from skin irritation and comfort to give the user a close shave with dull blades. Of course, an angle exists that gives a good compromise between these conflicting effects. It is not the same for all users because of the wide variation in individual tastes and needs; however, a tangent angle of 28 to 32 degrees appears to be the most suitable for many men.

Even in the case of correctly designed razors, some variation in effect will be observed occasionally. In razors where the blade edge is definitely placed with relation to the guard by a stop or lug, this variation may be due to an unsymmetrically honed or stropped edge; that is, one where the bisector of the ultimate edge angle is not in the same plane as that of other blades of the same make. Obviously, the shaving angle will be affected thereby. In the usual double-edge razor having no stops, both this unsymmetrical condition and varying blade width dimensions may be the cause.

Speaking in terms of the shaving practice of the average man, the most probable cause of dissatisfaction is his faulty facial preparation. Water is actually the great softening agent for hair. No other material is comparable with it, except those having a specific chemical action, and these are sometimes dangerous as their action extends to the skin as well. Water penetrates the hair by absorption, reducing its strength and hardness some 60 percent and its elastic properties about 90 percent. The softening effect is quite important when we remember that dry hair is harder than lead, aluminum, or annealed copper, being comparable with dry paper in its capacity to ruin cutting edges. The ultimate effect of water is little influenced by its own hardness or softness. The degree of alkalinity introduced by soap may make the final hair condition somewhat softer than does neutral water. The rate at which the soft condition is approached, however, is affected by some important factors, of which water temperature appears to be the most pronounced.

Lathering the hair with hot instead of cold water is sure to bring about the approach to complete softening sooner. However, a detergent is necessary for the removal from the hair of

(*Please turn to page* 314)

OUR POINT OF VIEW

Who Foots the Bill?

SINCE the railroads have long been a political football, it is not so hard to understand part of the motive behind the effort to limit the length of freight trains to 70 cars by law. The Senate recently passed and the House has pending a bill to make this limitation. The stated theory behind it is that the limitation will improve railroad safety.

We are not interested in the politics of the question but, as a shipper and a consumer of shipped goods, we are definitely concerned. Farmers, shippers, and industry in general are concerned, for they—and we—would have to shoulder a vastly increased railroad burden; the alternative is bankruptcy for the railroads and inefficient, wasteful, costly government operation.

The railroads are not wealthy. In the past, many of them have been bankrupt and even now 28 percent of the railroad mileage of the country is in the hands of receivers or trustees in bankruptcy. Despite this fact, railroads have spent over eight billion dollars since 1923 in additions and betterments to their properties —eight billions which benefited the entire country.

The new bill, if it becomes law, would make necessary the operation of 147,000,000 additional train-miles to handle the traffic of a normal year (based on 1930), would involve out-of-pocket operating expenses (also 1930) of not less than 125,000,000 dollars, and would force tremendous capital expenditures for track and yard facilities and for engines suitable for shorter trains. Add this 125,000,000 dollars to the loss due to reduced freight revenues because of reduction of average revenue per ton per mile; and increases in expenses due to the advance in prices, to previous advances in wages, and to demands for other wage advances—adding all these, we have a total of 639,000,000 dollars. This would wipe out 95 percent of the net operating income earned in 1936. The public would pay this or government operation would inevitably follow.

Perhaps the improvement in safety is worth this increased cost? No. Statutory three-judge courts sitting as District Courts of the United States in both Nevada and Arizona have decided otherwise in cases involving state train-length limitation laws. The actual record is equally as emphatic. From 1923 to 1935, the number of cars in the average freight train increased 16 percent while accidents to trainmen were reduced 61 percent and to passengers 71 percent. Additional train-miles would correspondingly increase the opportunity for such casualties. Obviously, grade-crossing accidents would also increase in proportion to the greater number of trains passing any given crossing.

The theory thus failing to hold water, there remains only the actuality. The new law, if passed, will necessitate increasing the number of trains—ergo, the number of train crews composed of more men to raise the membership of the engine and train service brotherhoods sponsoring it. For such a reason must we, the public, foot such an enormous bill or risk disastrous government operation of the railroads? If the brotherhoods are myopic, isn't it about time that we, the public, take a hand?

To Amplify Wealth

ONCE more in scientific circles there is much discussion, some of it heated, concerning a practical question which probably will not down until it is definitely settled one way or the other. The question is whether scientists should continue making discoveries and giving them freely to the world—which means in actual practice giving them to astute business men who use them in profit making—or whether the scientists should patent their discoveries and, through suitable agents of their own choosing, in effect put science itself into business. The proposal is that science should use the profits for the further maintenance of laboratory research which in turn will make possible still other discoveries. In neither case would any scientist personally acquire any wealth.

The idea is a kind of "regenerative feedback." It is now being considered because the sources of large funds are likely more and more to dry up as our nation passes out of the period in which freshly opened resources will permit the acquisition of huge fortunes to be shared by science.

In large measure, while the world is slowly coming to sense the roundabout connection between money granted for scientific research and the returns from that research, it still fails to sense that connection very clearly, and therefore it fails to reinvest a large enough part of its earnings in scientific research. Therefore, until that realization has fully arrived, why should scientists not retain control of their discoveries and feed the proceeds back into the circuit, thus bringing about greater amplification of the research funds? To some extent this is already being done.

Times change and, with them, conditions change. Despite some minor drawbacks freely admitted, which might affect the system, we strongly favor this regenerative feedback for the funds of scientific discovery.

Radicals

FACE washing is reported by one psychologist as having a definite bearing on the character of young political radicals. No; not simply too much face washing but too much face washing against the will of dirty faced youngsters. Their revolt, as children, against this hygienic rite is said to exemplify their rebellious spirits and to lead them, in combination with the attendant nagging, reproach, and ridicule, toward an "agin everything" attitude.

If the good doctor means that radical youth didn't relish face washing as children, we agree that this is almost self-obvious. Radicals are malcontents. Quite likely they would be constitutionally opposed to anything so illuminating, if we might so express it, as to show the clean skin beneath. In a highly competitive economy wherein it is given to each according to his ability and enterprise and where the knocks are hard, they "can't take it." They are the Something-for-Nothing boys of the order of jackals; lacking the will to work out their own destinies or the ability to outline an orderly plan for human progress, they demand hand-outs and would attach the fruits of other men's labors (by force, if necessary) and destroy the competition against which they can not stand up. Knowing their inability to adjust themselves to our system of struggling for existence, they mask their inferiority complexes with a pose of intellectualism, so called. And still they refuse to wash their faces!

As we read the report, however, we got the impression that the psychologist meant that forcing the child to wash his face influences him to become radical. If so, the report must have erred; the doctor could not have meant that. Resistance to face washing is too general among children. Indeed, the large majority of children don't like it, have to be driven to it. But most of these youthful revolters are not revolutionists. Of superior intellect, they are the red-blooded, hard-hitting fighters of future competitive businesses and governments. They are the little rascals, freckle-faced and grimy, whose faces, in later years, will be marred by the dust and sweat of the arena of progress.

RA-MOSE AND HAT-NUFER

EDITOR'S NOTE: Human interest rather than special archeological or historical significance is the mainspring of the intriguing account which follows. Its reader will be at the side of the archeologists of the Metropolitan Museum of Art Egyptian Expedition as they withdraw object ofter object from the well-packed tomb, not of dazzling royalty but of two plain, middle-class people—commoners—whose only claim to note lies in the pertinent fact that their son, by hook or crook, and no doubt by the plentiful exercise of gall, had risen from his humble station to the rank of personal dictatorship behind the throne of Egypt occupied by a regent queen—herself in part a usurper.

With occasional smiles at some of the rather amusing facts revealed, we shall learn just how this dictator buried his father and mother—the one with meager attention, the other with considerable display for a commoner—and how he planned to have himself finally buried in royal splendor before fate caught up with him and probably "bumped him off." No doubt Ra-mose—for that was the dictator's father's name—would have been considerably annoyed had he known that several hundred thousand inquisitive American readers 3400 years after his decease would be amused to learn that he had but one shirt—"grafted," at that, from the royal linen stores.

In order to understand the account, which is from the *Bulletin* of the Metropolitan Museum of Art, it is helpful to know the background. About 1000 years after the pyramid age in Egypt, when the capital had been moved 250 miles up the Nile to Thebes, and about a century before the time of Tutenkhamon, a king named Thutmose II ruled, and in the year 1501 B. C. he died. His little son was too young to rule, so the regency was entrusted to the widow, Queen Hat-shepsut—not to be confused with the humbler Hat-nufer previously named. The queen was young, and herself admits in inscriptions that "to look upon her was more beautiful than anything; her splendor and her form were divine; she was a maiden, beautiful and blooming." A frank woman!

Among the contemporaries of this beautiful and blooming queen was an able, energetic, handsome (we have several of his portraits) and ambitious man named Sen-Mut. After the king's passing, this opportunist lost no time in feathering his own nest with the person in power, just as similar things are sometimes done today, 3438 years later. Forthwith, Queen Hat-shepsut appointed him to an office that gave him charge of the Temple of Karnak and of the Royal Palace. Soon he had absorbed other offices, and in time he was the queen's right hand man in various senses—he became Overseer of Overseers of all the Works, Superintendent of the Royal Slaves, of the Treasury and of the Armory; and, in addition, he became Superintendent of the Private Apartments, and then of the Bathroom and finally of the Royal Bedrooms. In short, Sen-Mut, by the simple process of reaching for more, became Chief of the Works.

As no woman could be full ruler of Egypt, Queen Hat-shepsut did something quite original—she had herself declared King! Today one may see in the Metropolitan Museum of Art, in New York, large granite statues—true originals brought from Egypt—of this queen which depict her as a man king. There are evidences that this new usurpation rôle of the queen's was the idea of Sen-Mut the resourceful, and was promulgated by him.

With everything going his own way Sen-Mut next thought of his own burial and built an expensive tomb in plain sight on a hill, and this tomb was discovered a century or so ago. Then the old fox secretly built another tomb for his actual burial, only recently discovered. For it, he tunneled under the sacred precincts of Hat-shepsut's royal temple, and he had it made like the queen's. On the ostensible tomb he left the following modest inscription: "I was the greatest of the great in the whole land. I was the guardian of the secrets of the king in all his places; a privy councillor on the Sovereign's right hand, secure in favor and given audience alone; a lover of truth who showed no partiality; one to whom judges listened and whose very silence was eloquent. I was one upon whose utterances his Lord relied, with whose advice the Mistress of the Two Lands was satisfied, and the heart of the Divine Consort was completely filled. I was one whose steps were known in the palace, a real confidant of the Ruler, entering in love and coming forth in favor, making glad the heart of the Sovereign every day. There was nothing from the beginning of time which I did not know." Sen-Mut also is frank!

However, after 18 years of this kind of rule the stripling son of the deceased king (by another wife than Hat-shepsut) had grown older. Just what happened is unrecorded but these are the evidences: In Sen-Mut's secret tomb all his own portraits are found to be mutilated—the faces are smashed, though Hat-shepsut's name is still granted due respect. Something apparently "happened" to Sen-Mut! He disappears totally from history—both of his tombs were found quite empty. Three years later Hat-shepsut herself died. The new king, Thutmose III, was at last sole ruler of Egypt. One of his first moves was to have all the statues of Hat-shepsut hauled to the dump and broken in pieces, with every conceivable indignity heaped upon her likeness. Some of those same statues, carefully put together again, are to be seen in the Metropolitan Museum of Art.

At some time during the reign of Hat-shepsut and her stooge Sen-Mut—if the circumstances were not reversed—the parents of Sen-Mut died, and the account which follows concerns wholly the excavation of their tomb. A large part of the simple objects described and shown in the illustrations are to be seen in the originals at the Metropolitan Museum of Art in New York. One's feeling on viewing them is, how remarkably well they were built, how remarkably preserved after 34 centuries—fully as fresh as the things only a century old that we find in our own attics. Even the food found in the tomb looks edible—the raisins and dates as if they could be soaked and eaten today, the cakes brittle with age but sound, and on viewing all these objects the distant story is as if it had happened but yesterday.

(In Three Parts—Part One)

By AMBROSE LANSING

Associate Curator of the Department of Egyptian Art of the Metropolitan Museum of Art; In Charge, Metropolitan Museum Excavations in Egypt

and WILLIAM C. HAYES

Assistant Curator of the Department of Egyptian Art of the Metropolitan Museum of Art

JANUARY 11 proved to be a memorable day. In the early morning word came down from the dig that the section of the gang clearing the upper slope of the hill had uncovered another deposit of objects close against the rock face, a short distance below the forecourt of the tomb of Sen-Mut. The deposit consisted of a rectangular tambourine, into which had been thrust, through a gaping hole in the rawhide cover, the parts of an elaborately carved chair of boxwood and a darker wood, and the upper part of a cedar headrest of good quality. The tambourine (Figure 1), a rectangular wooden frame with incurved sides and ends, completely covered by a single large piece of tightly stretched rawhide, is the only example hitherto found of its type, which is, however, like the lute, well known from New Kingdom paintings (Figure 2). The chair, shown reconstructed in Figure 3, has a well-preserved seat of cord mesh. Its legs are carved with care to represent those of a lion, and its paneled back displays at the top an openwork design, composed of a figure of the household god Bēs, flanked on either side by the symbols of stability and protection.

The deposit constituted in itself a find of no small interest and value, and for some time our attention was focused entirely on noting and photographing it and on the delicate task of extricating the chair fragments from the tambourine. Not until the position of the base of the headrest was noted was a more important aspect of our discovery revealed. This part of the headrest was wedged between two chunks of limestone at the base of what at first had appeared to be no more than a slight projection in the neighboring rock face but on closer inspection proved to be a separate slab of stone. This was held in place and plastered over with coarse white mortar, unquestionably the blocking of the doorway of an intact tomb.

The tomb had been made and sealed up just before the commencement of the work on the great tomb above, and shortly afterward the sealed doorway had been buried deep beneath the fill of the artificial terrace thrown out in front of Sen-Mut's forecourt. The position of the newly discovered tomb—squarely in front of the center of that of Sen-Mut—added considerable zest to our speculations as to its occupants.

The removal of the blocking, effected after its method of construction had been recorded, laid bare a tiny, rectangular doorway flanked by rough jambs of cut limestone, and, behind it, one small rock-cut chamber, 1.3 meters in height, 2.5 meters deep, and 2.9 meters wide. Our first glance through the doorway (Figure 4) opened up no extensive vista, for the eye was immediately confronted by an uninscribed, white Canopic chest, shrine-shaped and mounted on sledge runners (*D* in the plan, Figure 5) and, beside and behind it, a mass of coffins, boxes, baskets, and jars, so tightly packed together and so completely filling the little room that practically no free space remained.

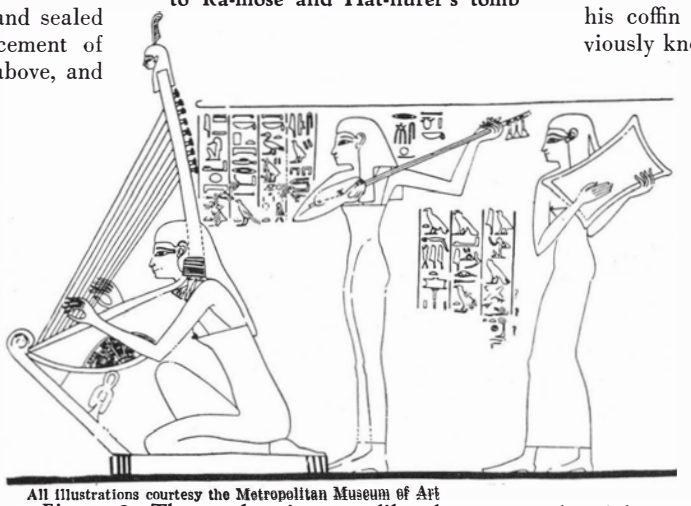
Disregarding for the moment a pair of uninscribed, rectangular coffins, clearly visible on the west side of the chamber, our attention centered on a great black anthropoid coffin which lay just to the right of the line of the doorway and extended northward, back into the gloom beyond (II in Figure 5), and beside it, against the chamber's east wall, another coffin, also anthropoid but much smaller and painted white. Both coffins were covered by a series of linen palls concealing the bands of hieroglyphic inscription with which we knew them to be decorated; but by raising one corner of the pall over the foot end of the black coffin, which lay within arm's reach of the doorway, we were able to read the bottom of the last column of inscription on the near side of the coffin. The title and name were those of the "House-mistress Hatnufer," and when further preliminary investigation disclosed the name "Ra-mose" on the lid of the white coffin the problem of the ownership of the tomb was solved.

At this point we remembered a small rectangular panel of relief which occupies the center of the stela in Sen-Mut's Deir el Bahri tomb discovered by the Museum's Expedition in the winter of 1926-1927. The panel depicts a family group (Figure 6). At the center sits the great Sen-Mut and beside him his "beloved father," his arm thrown affectionately about his son's shoulder. Facing them is the mother, in her extended right hand an open lotus flower, which she holds in gracious gesture before her son's face. The names written over the heads of the parents in this panel (and appearing elsewhere on monuments of Sen-Mut) are the same as those which we had just read on the coffins in the newly discovered hillside tomb, Ra-mose and Hat-nufer.

The father, Ra-mose, bears no title on his coffin and only rarely on the previously known monuments the no longer functioning courtesy title "dignitary." He was therefore a commoner, probably a peasant, for at this time anyone engaged in the learned professions or associated with the state or religious administration could always summon up a title of some sort with which to grace his name on formal monuments. Hat-nufer, Sen-Mut's mother, likewise appears to have been without special rank. Her name is frequently preceded by the title "house-mistress," but this implies only that she was the senior woman in an independent household. Whatever notice these persons received was due, we may be sure, to the distinguished position of their son—a self-made man in every sense of the expression.

Four days were devoted to the preparations for safeguarding the tomb and

Figure 1: **Tambourine and chair fragments at the blocked entrance to Ra-mose and Hat-nufer's tomb**



All illustrations courtesy the Metropolitan Museum of Art

Figure 2: **The tambourine was like the one at the right**

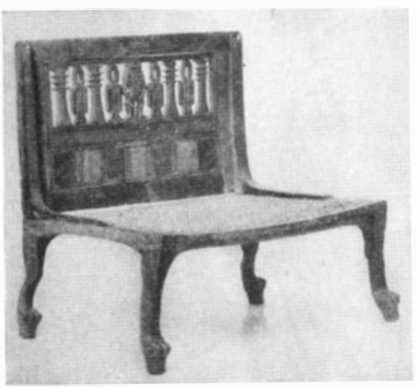


Figure 3: **Hat-nufer's chair, its cording as fresh as if nearly new**

Figure 4: **How the tomb of Ra-mose and Hat-nufer appeared when it was first opened**

its contents and for its subsequent clearing. The Director General of the Antiquities Service was duly notified of the discovery; relays of extra guards were arranged; a stout wooden door, which could be securely sealed when nightfall should put an end to each day's work in the chamber, was provided; carrying litters were built for the transport of the bulkier objects; and trays, packing materials, varnishes, and other preservatives were checked over and made ready. The morning of January 16 saw the commencement of the actual clearing, which was accompanied by the keeping of a plan of the chamber recording the position of each object before it was removed (Figure 5), and was constantly interrupted by the taking of photographs of groups of objects in position and by the precautions necessary to ensure the safe removal of the more fragile articles. Fortunately, almost everything found in the tomb (which, situated high up in the desert slope, had completely escaped the ravages of dampness and termites) proved to be in excellent condition; and the clearing was accomplished with ease in five days, the chamber completely emptied by January 21 and its contents stored safely in the Expedition's workroom.

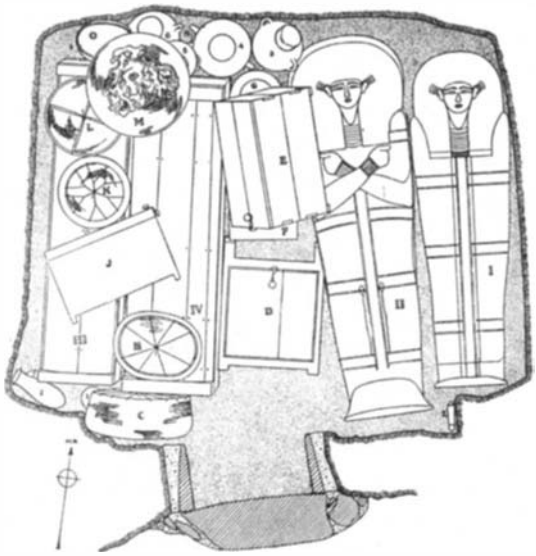


Figure 5: **Plan of tomb of Ra-mose and Hat-nufer**

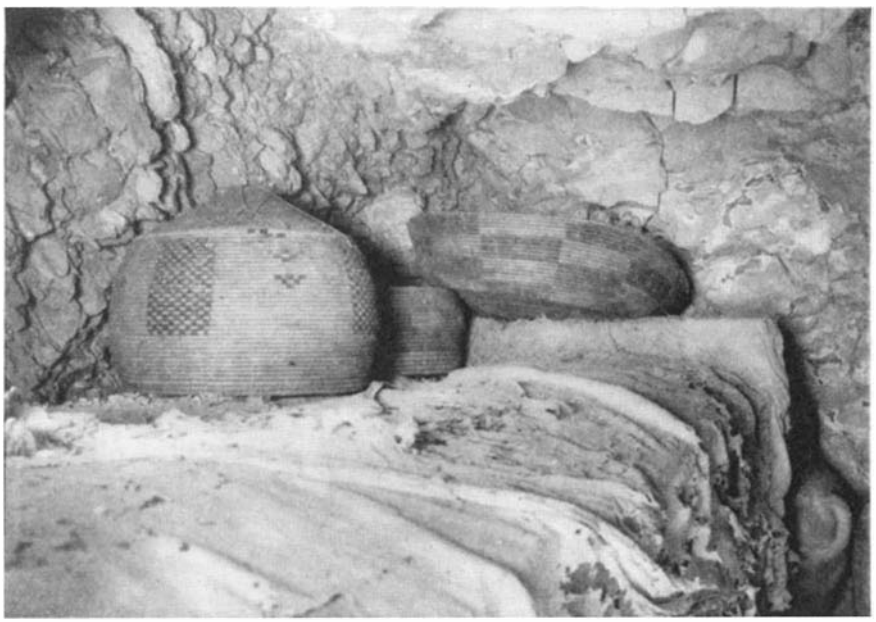


Figure 7: **Baskets, perfectly preserved, found on the two rectangular coffins**

The first item removed was the wreck of a pillow, or bolster, of red leather, stuffed with bulrush down, which, the cover having been extensively eaten by mice, lay spread over the decorated grass basket (*C*, Figures 4 and 5) just to the left of the doorway. This was followed by a pair of sandals of red and yellow leather, also damaged by mice, found tucked in between the lid of basket *C* and the south end of coffin IV, and then by the basket itself. Next came the Canopic box (*D*), the linen chests *E* and *F*, the alabaster and pottery jars, the chest *J*, and the baskets packed on and around the two rectangular coffins (Figure 7). It was necessary to remove these two coffins before those of the owners of the tomb (Figure 8) could be squeezed out through the narrow doorway. Of the latter, Hat-nufer's coffin, of course, preceded that of her husband, the last object cleared.

This is naturally the exact reverse of the order in which the items were originally inserted into the chamber. Ra-mose's coffin was the first to have been set in place. It was followed in turn by the coffin of Hat-nufer, then by coffin III, and finally coffin IV. The boxes, baskets, and some of the jars, which, as we shall see, were probably the property of Hat-nufer, must have been placed where they were found after the introduction of coffins III and IV.

Figure 6: **Sen-Mut and his parents, from the stela in Sen-Mut's tomb**

(*To be continued*)

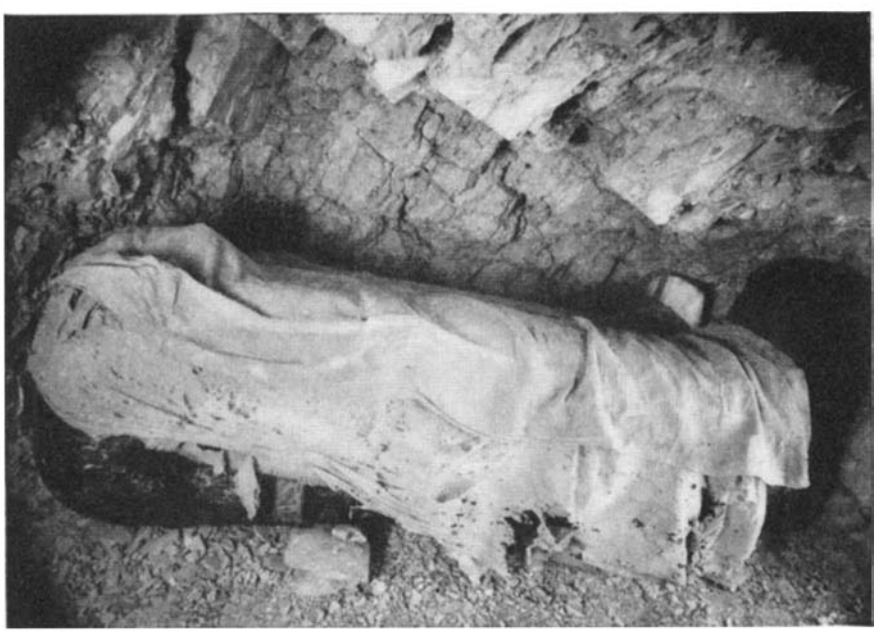
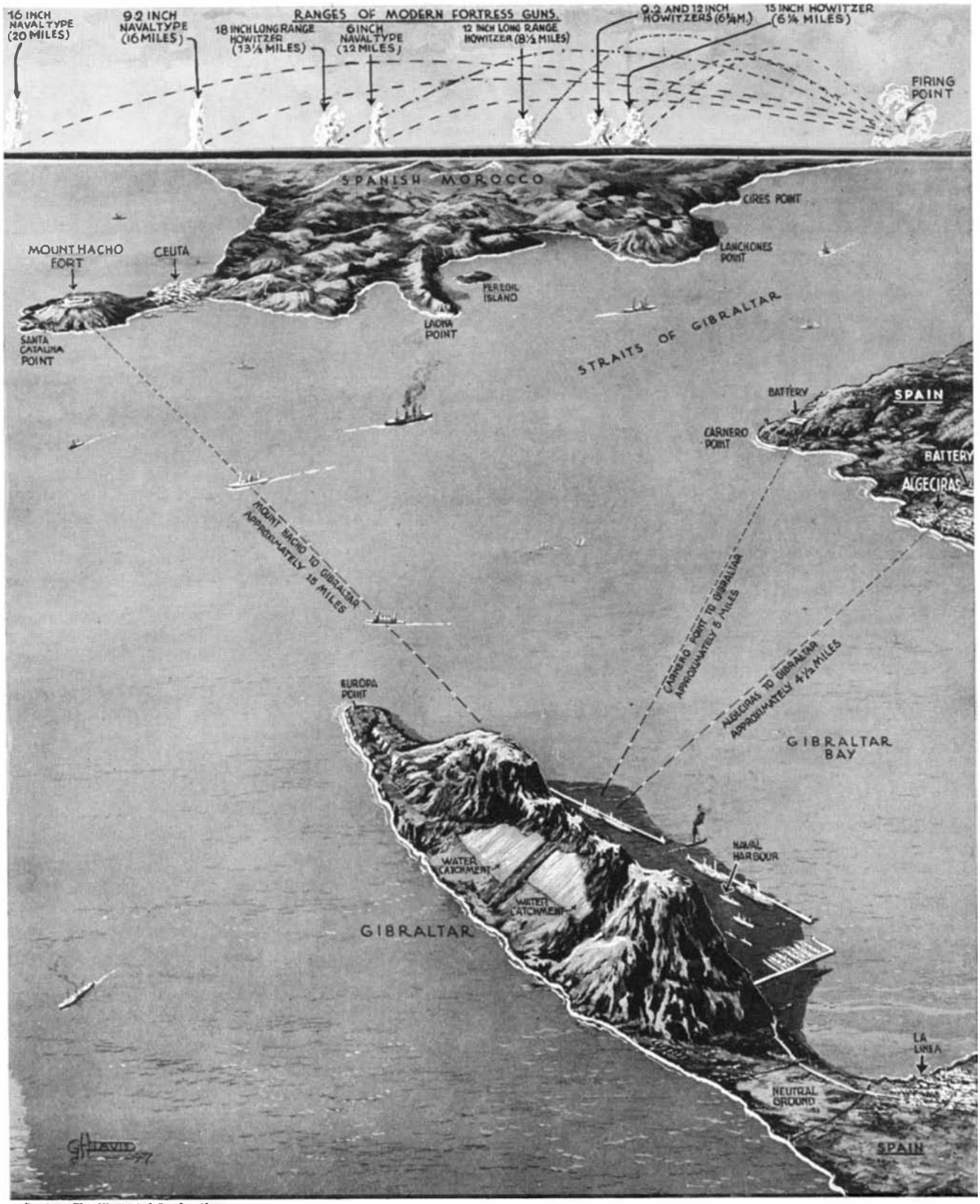


Figure 8: **The coffins of Ra-mose and Hat-nufer covered by their palls of linen**



Courtesy *The Illustrated London News*

THE BATTERIES NEAR GIBRALTAR

TO those who believe that the fortress of Gibraltar stands on an isolated point within the range of naval guns only (and many do have that impression), it will come as a surprise to learn that this is far from the truth. Shore batteries or fortress guns could fire upon the rock from three points of the compass: From the north in Spain; from the west across Gibraltar Bay; and from Spanish Morocco to the south. The rock, under such attacks, would provide scant shelter for its adjoining Naval Harbor (British). The scale of comparative gun ranges at the top gives point to the distances marked on the drawing and show why Great Britain is disturbed over recent reports of fortification of the Spanish and Moroccan coastline. Britishers would like to know what kind of guns are being mounted thus to command their fortress. Note particularly the water catchments by means of which rain water is collected for supplying the garrison.

Coal-Coking by Electricity

New Electrical Process Makes Coke, Gas, and Tar . . . Cheaper . . . Simpler Retort . . . Can Operate on Off-Peak Power . . . Consumer, Utilities Profit

By H. STEVENS

THE recent enactment by Congress of the Guffey Coal Bill promises to remove the fear of bankruptcy from an industry which has suffered unusually from the economic crises of the early 1930's. Even during the boom days, the coal industry was steadily losing ground. The increasing use of natural gas and oil made great inroads into the fuel market, while developing hydro-electric plants took their share of the business of manufacturing electricity. These conditions were aggravated by the economic slump, with the result that the coal industry has for years been characterized by widespread bankruptcy and unemployment.

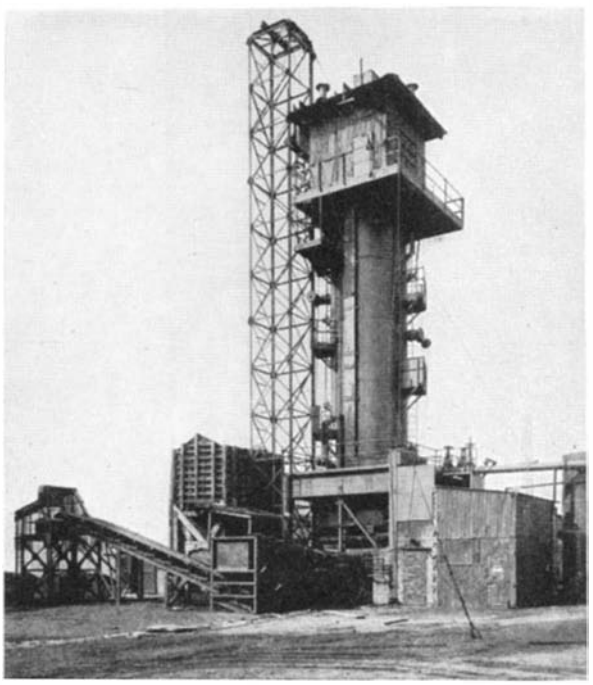
The Guffey bill provides for a National Bituminous Coal Commission which is authorized to investigate new uses for coal which will increase its market. The new process for the electrical carbonization of coal may, conceivably, come in for serious consideration as an economically important use for coal.

Briefly, electrical carbonization of coal is the use of electricity to make coke, gas, and tar from soft coal. In all carbonization processes, coal is heated. When soft coal is heated, it gives off gas and tar and what remains is coke. The electric process differs from others not only in that the heating is done with electricity, but that a mass of coal is heated from within rather than from without.

IN the electric process a mass of 30 tons or more of coal is placed in a retort, with a "starting fuse" as a core. The fuse, consisting of coke particles, is necessary because soft coal is not a good conductor of electricity. Carbonization is begun by passing electricity through this fuse, thus heating it and the surrounding coal to drive off the gas and tar.

The coal immediately surrounding the fuse which thus becomes coke is a better conductor of electricity than the starting fuse. In the starting fuse the resistance to electricity is high because of poor contact between loose coke particles, but the newly formed ring of coke is melted together and makes a continuous path for the electric current. On further heating, this ring of coke shrinks and cracks, but not until a new outer layer of coal is carbonized. Each newly formed tubular ring of coke offers easier passage for the current. In this manner, the heat travels radially outward, always being electrically generated adjacent to the raw coal. This growth continues until the entire mass of coal is carbonized.

The main product of carbonization is coke. The by-products—gas and tar—can be recovered when coal is heated in a retort from which air is excluded. The electric carbonization retort is air-tight, cylindrical in shape, and set up vertically on a steel base raised on concrete piers. The steel retort shell is lined with fire clay brick. Circular steel plates, also fire clay lined, serve as top and bottom covers through which pass the electrodes carrying the current. Only the upper electrode is electrically insulated. Current is supplied to these electrodes through a transformer, and they, in turn, make contact with the starting fuse, establishing an electric circuit.



Detroit Edison gas retort which is also a laboratory for determining the economics of the new process

In actual operation, the bottom cover is first put into place, and the starting fuse of coke particles in a metal pipe is set on the bottom electrode. Then the retort is entirely filled with coal, after which the metal pipe is withdrawn and the top electrode is placed in position. The top cover seals the retort. Electricity is then turned on and the evolution of gas follows immediately. This gas passes through the mass of coal and leaves the retort by suitable outlets, passing into collecting mains. After the coal is carbonized, the top cover is raised and any residual gas is ignited as it escapes. The bottom cover is then opened and the hot coke falls by gravity into the conveyor where it is quenched and loaded directly into railroad cars.

RESULTS from a typical 20-hour run of the 30-ton retort built by The Detroit Edison Company show that from one short ton of moist Pittsburgh seam coal there were obtained 10,000 cubic feet of gas with a heating value of 525 B.t.u. per cubic foot, 15 gallons of tar, and 1400 pounds of coke. These yields are slightly better than the results of tests made by The American Gas Association on Pittsburgh seam coal carbonized in by-product ovens.

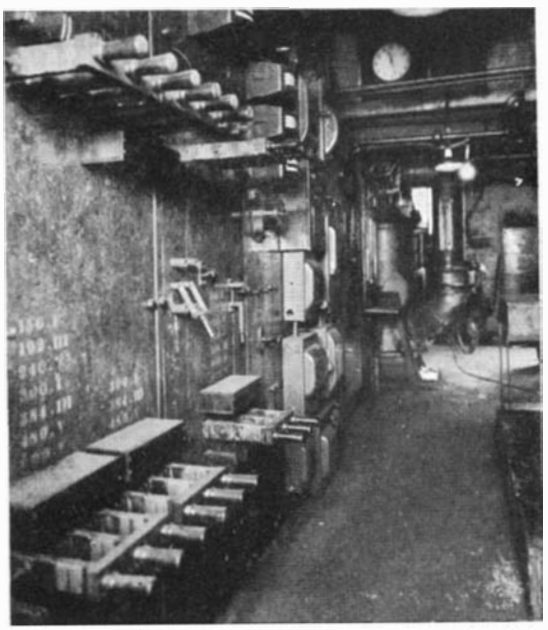
There are several outstanding differences between electric carbonizing and the by-product method now in general use. The main advantage of the electric process is that it utilizes the principle of heating a mass of coal directly from within, whereas in the by-product method the heating is done from the outside. Mass production of coke, gas, and tar is possible in electric carbonizing on a scale many times greater than that of the by-product oven. The electric process uses large-capacity retorts built with a small initial investment. In the by-product method, smaller capacity ovens require greater capital

outlay. In the electric process, maintenance and operating costs are lower and the temperature and rate of heat travel are readily controlled, making for greater flexibility in operation to meet consumers' demands. The advantages of the electric process promises to increase the market for coal.

Nearly all soft coal is burned in one form or another. About one sixth of a normal year's production is carbonized. Practically all of this is done in ovens which permit the recovery of gas and tar, and hence are known as by-product ovens. These originated in Germany 50 years ago, but the principle on which they operate today is basically the same as it was originally. In this system, coal is charged in narrow prismatic ovens. The heat for carbonization is obtained from the combustion of gas and air in flues outside the walls of the ovens. In the by-product method, then, the coal is heated indirectly and from the outside, heat having to travel through heavy brick walls before reaching the coal. The disadvantage as compared with electric carbonization is obvious.

The readily noted differences in the principle of heat generation and application lead to a difference in the capacity of the ovens and retorts. The by-product oven operates most efficiently with its present capacity of 15 tons of coal. The retort of the electric process has a capacity of 30 tons and can be made much larger.

The electric process also has the advantage of requiring a much smaller initial investment. In the first place, the design of the plant is very simple. The electric process does not use the complicated system of vertical and horizontal flues, heat regenerators, burners, and valves required for the by-product oven. Nor is a mechanical pusher necessary for discharging the electric retort. Such a pusher is indispensable with by-product ovens. The elaborateness of these latter ovens may be shown by the fact that over 500 different shapes of brick are needed in their construction, whereas in the electric retort only a dozen different shapes are required. Then there is the matter of ground area to consider. In the by-product oven plant, one eighth of the area is occupied by coal, the balance being taken by the pusher, brick walls, flue, stack, and so on. In the electric process plant, the coal occupies about half the area, the balance being used for retort wall and electrical equipment.



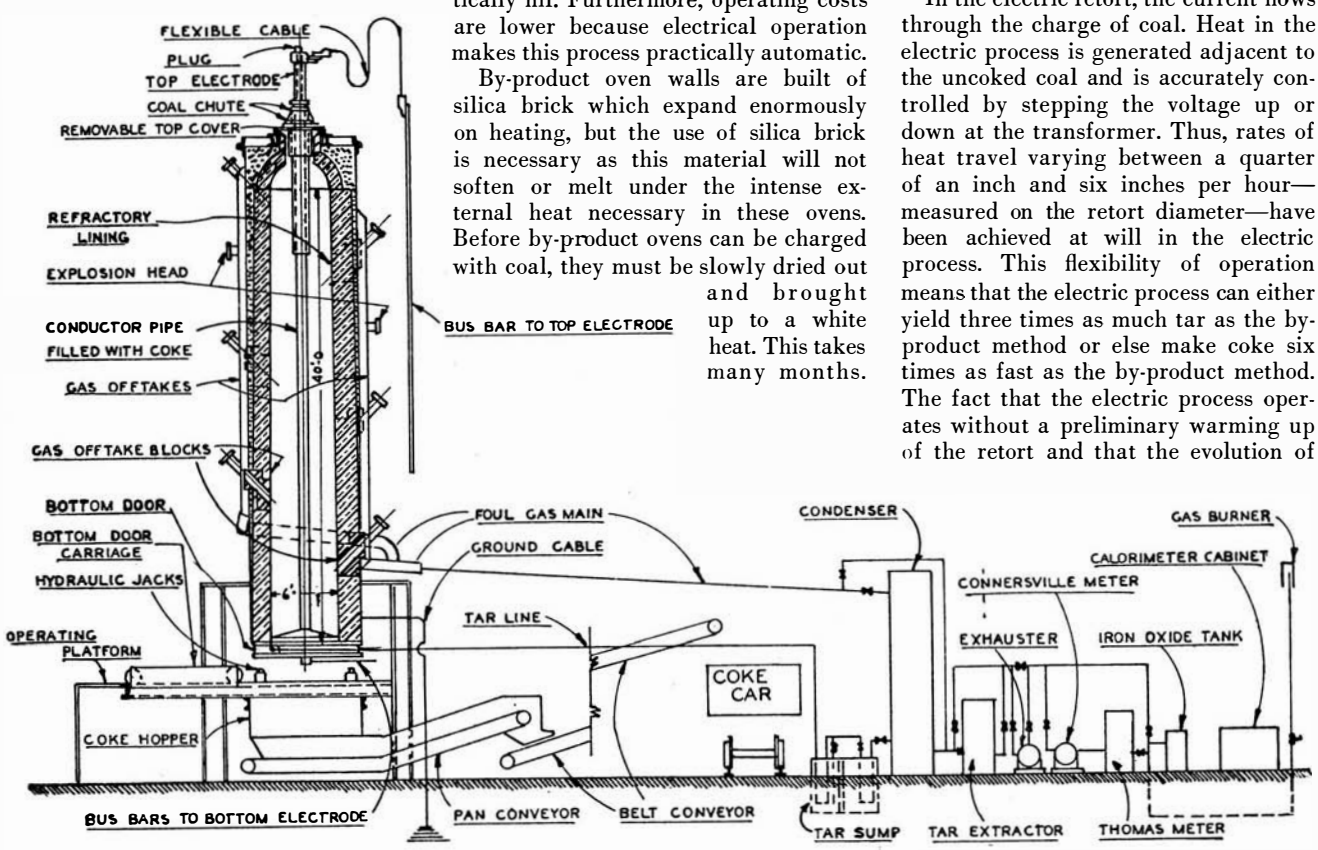
Part of the equipment needed for operating the electrical gas retort: the switchboard

THE maintenance costs are lower in the electric process, because the equipment is not subjected to high temperatures, and the wear and tear on the fire clay brick and electrodes are practically nil. Furthermore, operating costs are lower because electrical operation makes this process practically automatic.

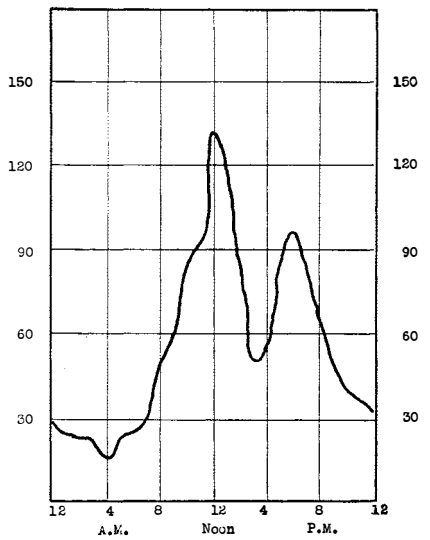
By-product oven walls are built of silica brick which expand enormously on heating, but the use of silica brick is necessary as this material will not soften or melt under the intense external heat necessary in these ovens. Before by-product ovens can be charged with coal, they must be slowly dried out and brought up to a white heat. This takes many months.

The rate of heat travel in the by-product oven depends very largely on the thermal conductivity of the silica brick. After the heat passes through the wall, the rate of heat travel in the coal charge averages about one inch per hour—measured on the oven width. The fixed character of the thermal conductivity of silica permits of little control over the rate of heat travel. Also, the enormous mass of brick work will not allow of ready changes in its temperature.

In the electric retort, the current flows through the charge of coal. Heat in the electric process is generated adjacent to the uncoked coal and is accurately controlled by stepping the voltage up or down at the transformer. Thus, rates of heat travel varying between a quarter of an inch and six inches per hour—measured on the retort diameter—have been achieved at will in the electric process. This flexibility of operation means that the electric process can either yield three times as much tar as the by-product method or else make coke six times as fast as the by-product method. The fact that the electric process operates without a preliminary warming up of the retort and that the evolution of



Schematic diagram of the electrical coke plant, with a cross-section of the retort. In charging the retort, a metal pipe filled with coke particles is inserted, the surrounding space is filled with coal, and the pipe withdrawn, leaving the coke behind



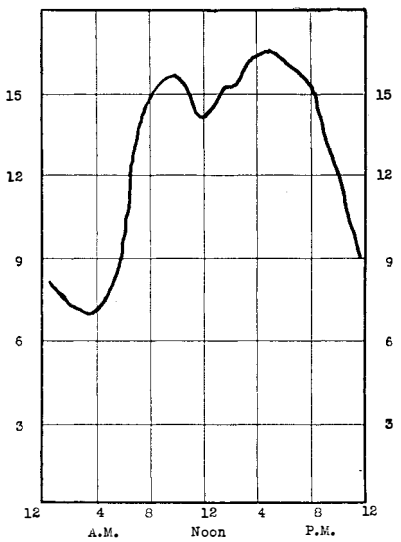
Hourly use of gas in metropolitan areas, *above;* and *right,* hourly use of electricity in U. S. These graphs indicate that the peak of one is in the valley of the other

gas can be started or stopped as often as occasion demands enables the electric process to meet hourly, daily, or seasonal demands of the consumer for gas.

Gas from by-product ovens is contaminated by flue gas leaking into the oven. Generally more than 10 percent (by weight) of by-product oven gas consists of inert gases—carbon dioxide and nitrogen. This dead material affects adversely many qualities of the gas. It also adds to the cost of distributing it. The electric process makes unadulterated coal gas since the retort has a gas-tight welded steel casing and infiltration of air is impossible. Electric process gas can, therefore, be distributed at a lower cost and be used more efficiently than by-product oven gas as it does not carry the excess baggage of burned gas from oven flues.

WITH all these advantages, the electric process requires less fuel to do the carbonizing than is required in the by-product method. Tests made by The American Gas Association showed that, in the by-product method, 292 pounds of *coke* were required to carbonize a ton of Pittsburgh seam coal. To do the same work, the electric process used 350 kilowatt-hours of electricity, the generation of which by steam power requires about 290 pounds of *coal,* a less valuable fuel than coke.

What possibilities does the electrical carbonization of coal offer for future development? Ultimately all technological advancements must be evaluated from the standpoint of the consumer. At present the principal household fuel is coal. The Research Department of the National Coal Association has determined that the user of coal in hand-fired furnaces gets only 45 percent of the heat in the coal. It also determined that the user of coke gets 70 percent of the heat in coke. On a heat value basis, therefore, the consumer should not pay for coke more than one and a half times what he pays for coal. If the use of coke is developed, the change will react to the advantage of both consumer and community since the burning of coke in household furnaces stops the pollution of air by the smoke and soot of soft coal. However, such widespread use depends on market price, which in turn depends on manufacturing costs, and this



in turn depends on mass production. By-product ovens have reached their maximum efficiency in this respect. Mass production in the electric process is achieved by simply using more starting fuses.

Another method for achieving greater mass production and reducing costs in the electric process lies in pre-heating the coal before carbonizing. Pre-heating drives off only moisture from coal, thereby increasing its density which in turn increases the mass of coal that can be charged in the retort. Further heating causes coal to become plastic and swell. Swelling of coal in by-product ovens during carbonization causes grave injury to oven walls, hence pre-heating is not done. However, in the electric process the retort wall is bound with a steel shell which is not distorted from the pressure exerted by swelling coal. Furthermore, such pre-heating reduces the amount of electricity so that only 250 kilowatt-hours are required to carbonize a ton of dried and pre-heated coal. No additional energy is required for pre-heating since this is done by heat now wasted in the steam power electric plant.

Finally, the electric process introduces a feature the significance of which as a means of reducing costs in the manufacture of gas and electricity will become obvious on a moment's consideration. The accompanying graphs show the hourly use of gas and electricity on a week day in winter. Graphs for summer days display lower peaks but the pattern is the same. Graphs for Sundays and holidays show even greater contrast between the use of electricity and gas because these are days of minimum use of electricity and maximum use of gas. All graphs show that with electricity there is a valley at noon when there is a corresponding peak in the use of gas. Despite the midday valley in the demand for electricity, coal must still be burned to keep boilers and turbines ready to carry the afternoon generator load. Therefore, generating equipment stands idle that could otherwise, with but little more coal, generate electricity for making gas the use of which, at midday, amounts to one third of the total used during the day. A reduction in power-plant overhead would naturally follow use of electricity during plant stand-by periods for carbonization of coal.

THE serious defect of electricity is that it cannot be economically stored. Therefore enough generating capacity is needed in power plants to meet peak demands. When the plant is not operating at peak, generating capacity is in disuse. Thus the electric generating capacity of the United States has stood in disuse two thirds of every year for the past 35 years. It is this idle generating capacity, enough to make three times the amount of gas now used, that the electric process seeks to use for the production of coke, tar, and gas.

Gas can be stored commercially to advantage and when hourly consumption is less than production, gas *is* stored. When consumption is greater, the stored gas supplements production. When the seasonal consumption of gas falls off, the electric process would make less gas and more tar. It is by this flexibility of operation that the electric process can make tar and gas to meet the consumer's changing demands. These products will at least partially supplant petroleum from its present secondary use as a heating fuel and return, in like ratio, quantities of petroleum to its primary purpose of supplying motor fuel. This would enable coal to regain at least part of the market it has lost to petroleum.

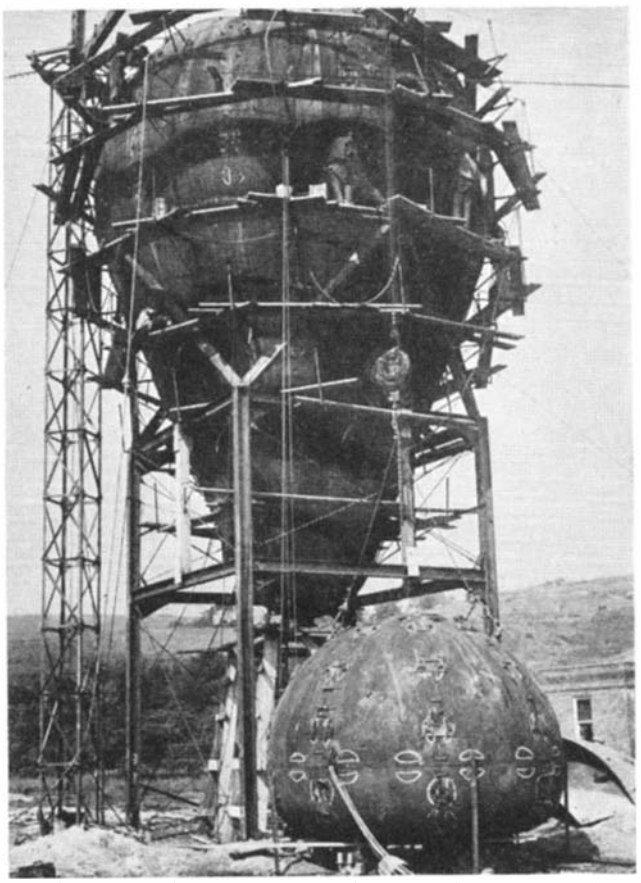
The electric process has potential significance for several agencies. For the coal industry, it promises additional use for coal by recapturing part of the fuel market from natural gas and petroleum. For the utilities, it offers possibilities of more efficient use of equipment, thereby reducing costs. For the community, it holds the prospect of less polluted environment by encouraging the use of cheap, smokeless fuel. Should these agencies pursue thoroughly the potentialities of the electric process, the results can only react to the advantage of all consumers.

The Electrical Shotgun

IN these days when everything else gets bigger and bigger, scientific instruments are growing too. Champion for size, of course, is the 200-inch telescope, which on a weight-for-weight basis probably exceeds by several times the mass of any other instrument intended for pure scientific research. Its total weight will be in the neighborhood of 500 tons.

One of the closest runners-up is the "atom smasher" that research engineers of the Westinghouse Electric & Manufacturing Company are building at the company's East Pittsburgh research laboratories. It will stand 65 feet high, atop a two-story laboratory building, and will weigh about 100 tons.

The atom smasher, though one of the biggest scientific instruments, will be engaged in picking apart some of the world's smallest bits of matter. About 500,000 atoms, laid side by side, would be needed to span the breadth of a human hair (of .002 inch diameter). There are about 10^{21} (1000 billion billion) atoms in the head of an ordinary metal pin.



The Westinghouse "atom smasher." In the foreground is the mushroom-shaped electrode which was placed inside the big shell just before the cap piece was welded on

These minute motes of matter will be investigated by bombardment with even smaller particles, traveling at velocities of from 30 to 100 million miles an hour. Producing such enormous speeds is the job of the atom smasher, which in reality is an electrical shotgun. The charged bombarding pellets are the "shot"; electricity at extremely high voltage is the "powder."

The outside of the atom smasher is a pear-shaped dome of welded iron, a pressure vessel into which dry air will be pumped at 120 pounds pressure per square inch to serve as insulation.

Nestled within the pear-shaped dome is a mushroom-like metal electrode, on which will be stored a positive electrical charge ranging up to 5,000,000 volts. Extending vertically downward into the laboratory from the electrode is a 30-foot porcelain vacuum tube, in which a series of electrical "lenses" will focus the beam of high-speed particles. Through this tube will stream the bombarding pellets, pushed by the tremendous electrical pressure upon the electrode. Starting at zero velocity, they will fall 30 feet through 5,000,000 volts potential, ending with a speed more than a hundredth that of light.

The discharge of particles will be continuous, the total current being in the neighborhood of a few microamperes. At the lower end of the vacuum tube the particles will pass through an analyser capable of sorting them magnetically into separate beams according to velocity. The material to be bombarded will be placed on the surface of small targets about the size of a five-cent piece at the lower end of the analyser, where thin windows will permit the bombarding pellets to pass from the vacuum into the air.

But why do scientists do all this? What are the results expected? In all probability, no results of immediate commercial value. But worlds of new knowledge, already glimpsed through the nuclear discoveries of Lord Rutherford, Chadwick, the Joliots, and many others, are probably just around the corner for atomic explorers equipped with adequate apparatus, courage, and persistence.

It is impossible to predict today what may come from this research tomorrow. Of immediate interest is the production of "artificial radioactivity" in common substances in sufficient quantity to permit bio-chemical and medical experiments. This can undoubtedly be accomplished now.

THE release of usable energy from the atom, and the transmutation of elements in marketable quantity have been subjects of intense speculation. For, although nuclear reactions seem sufficient to explain the source of energy within star interiors as heavier elements are built up from lighter ones, nevertheless atomic power and transmutation in commercial quantity are doubtful indeed, at least now.

"In the present state of our knowledge, available equipment, and experimentally determined efficiencies for nuclear reaction," said a Westinghouse statement recently, "it seems that hope of obtaining atomic or nuclear power, or of obtaining transmutations of one substance into another on a commercial scale, are practically excluded."

This "pessimistic view" is based on a simple little calculation:

1: The efficiency of transmutation is of the order of 1 in 10^7 bombarding particles. 2: In the beam of the atom smasher (at about one microampere) there are about 10^{12} particles per second. 3: Therefore, bombarding a target produces 10^5 hits per second. 4: One gram (molecular weight) of matter contains 10^{23} particles. 5: Consequently, it will require 10^{18} seconds to transmute a gram of one element into another—or release the energy in a gram of atoms.

And 10^{18} seconds works out to be 31 billion years—too long to wait around!

RADIATION PRESSURE

How the Sun and the Stars, Due to the Pressure of Their Light, Ultimately Clean Up the Smaller Particles in Their Own Immediate Neighborhoods

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University. Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington. President of the American Astronomical Society

IT is remarkable that the forces which play almost an exclusive part in controlling the motions of the heavenly bodies appear on earth as feeble influences, which can only be detected, much less measured, with delicate apparatus.

Gravitation itself—though it holds us to the earth with a force which can hardly escape our notice—is so weak, when measured as an attraction between two masses in the laboratory, that its real nature would probably have long gone undetected, were it not for its influence on the motions of the planets and the moon. The reason for this is, of course, that gravitation is really a rather weak force, but the attracting masses dealt with in astronomy are so very big that its influence becomes predominant.

The only other force which has an important influence on motions in our system is so minute that its very existence was first recognized by deduction from theory a generation before laboratory technique became equal to detecting and finally measuring it. This force is radiation pressure. When Maxwell, two generations ago, developed the electromagnetic theory of light, it followed, as a necessary consequence, that a surface upon which a beam of light fell and was absorbed, was subject to a pressure driving it in the direction in which the light moved. But the computed pressure was almost ridiculously small. For full, unobstructed sunlight at the earth's distance, its value, expressed in engineering units, came out 2½ pounds (weight) per square *mile*. Under terrestrial gravity, this pressure would be found at the bottom of a layer of water less than $\frac{1}{50,000,000}$ part of an inch thick. No wonder this pressure is hard to measure! Why, indeed, should it produce any observable effects in the heavens above, or the earth beneath?

Photo by Wilson Hole

Already built, before the 200-inch, and in use on Mt. Polomar, is an observatory with an *f*/2 Schmidt

Well, we have hardly started with a fair case. We should have exposed our imaginary layer of water to the attraction of the sun at the earth's distance—which is only $\frac{1}{1659}$ as great as that of the earth for a particle at its surface. This increases the thickness of our layer to $\frac{1}{33,000}$ of an inch. Such a film of water—about thick enough to show good colors in a soap-bubble—would be pushed away from the sun by the pressure of its light as strongly as it was attracted by the sun's gravitation, and would move through space as if the sun were not there.

Of course a soap-bubble could not exist in interplanetary space—it would evaporate and vanish into vapor in the twinkling of an eye. But a sufficiently thin film of glass or metal might last indefinitely—and the sun would not appear to attract it. Break the film into fragments and each separate bit would behave in the same way (unless by ill luck it turned edgewise to the sunlight). Grind it into fine dust and the particles would be buoyed up by the light, no matter which way they faced. Indeed, the finer fragments, smaller than the original thickness, would be repelled by the sun's radiation more than they were attracted by its gravitation, and would be blown away into interstellar space.

Individual molecules, or atoms of gas, would be even more strongly repelled, provided that their absorption lines lay in a part of the spectrum where sunlight is strong.

It is an old story how this repulsive force drives the material of a comet's tail away from the head, and dissipates it into space, in the form of a long streamer. Similar forces probably bear a great part in the ejection of the eruptive prominences which are often observed to escape from the sun.

These familiar effects of radiation pressure are at times very conspicuous; but it should be emphasized that they operate only on exceedingly minute particles. A speck of dust too small to be felt as grit between the teeth might still be so large that, if it were set moving around the sun, gravitation would greatly exceed radiation pressure, and it would have an orbit of quite the familiar sort. To pursue the possibilities we must apply more delicate tests. One of these has long been known.

For a spherical particle of ordinary rock, a millimeter in diameter, the sun's radiation pressure is $\frac{1}{2400}$ as great as gravity. (It does not matter what the distance is; the two change in the same proportion.) A swarm of such particles might pursue an elliptical orbit around the sun, like any planet or comet; but the sun's attraction on it would be weakened, and hence, in order to complete its circuit in the observed period, it would have to be nearer the sun by $\frac{1}{7200}$ part than the distance calcu-

lated by Kepler's Law. A difference as large as this could easily be detected, if we had good observations covering several revolutions. Nothing of the sort has been found for any actual comet, and it may therefore be concluded that the separate particles of the swarm composing the comets' heads average at least a considerable fraction of an inch in diameter.

A much more recondite, but very interesting, result of radiation pressure has recently been discussed by H. P. Robertson. In 1903, Poynting, discussing "radiation pressure in the solar system," concluded that, in the course of ages, it would cause the orbits of small bodies (such as those just discussed) to shrink, and approach the sun.

Poynting's calculations antedated the theory of relativity. They have been reexamined by Professor Robertson (an expert in the field) and the older conclusions are confirmed (with numerical modifications). He finds that the nature of the process can be understood by quite simple reasoning (which leads to the same result as the precise methods of advanced analysis).

One of the fundamental principles of relativity is that energy possesses mass. A particle near the sun, and revolving about it in an orbit, is continually receiving energy from the sun's light and heat. It would therefore grow more massive, if it were not radiating this energy away again into space from its own warm surface. Actually, a balance is soon struck, and the mass of the particle remains unchanged. But the moving energy also carries momentum; and we must account for this too. Absorbed by the particle, it impels it away from the sun—and this is exactly what produces the radiation pressure which we have been discussing. For a particle moving in a circular orbit, the whole effect is to diminish slightly the sun's effective gravitation. In an elliptical orbit, when the particle is receding from the sun, it is running away from the light-source, and gets less energy per second, and hence a little less radiation pressure. Gravitation is unaltered; hence the net attraction is very slightly greater when the body is receding—and correspondingly greater when it is approaching the sun. The effect of this is to cause the eccentric orbit, very slowly, to become more nearly circular.

BUT this is not the whole story. The particle is radiating energy away into space as fast as it receives it, and therefore getting rid of momentum too. If—as is reasonable to suppose—it is radiating energy equally in all directions, this would not by itself alter either the direction or rate of its motion. After the loss of (say) a billionth part of its mass, it would have lost a billionth part of its own momentum, and the velocity of the remaining portion would be unaltered. But during this time it has got back the same amount of mass by radiation from the sun, so that its mass is the same as at the start, but its momentum a billionth part less. Its orbital velocity will therefore be decreased by a billionth part. We must remember that the effect of the momentum communicated to the particle by the incident sunlight has already been fully allowed for.

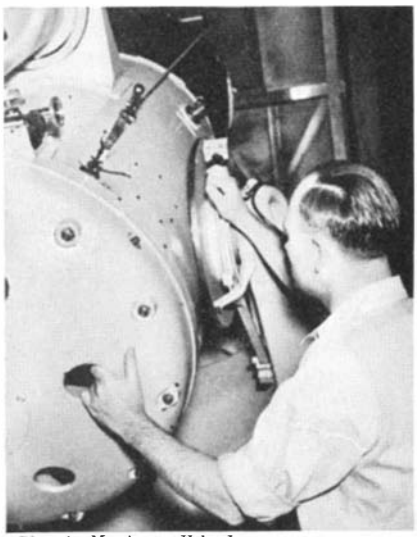


Photo by Macpherson Hole, Jr.

Dr. Joseph J. Johnson, of the California Institute of Technology, and the new 18-inch Schmidt camera housed in the observatory opposite. The Schmidt camera is a purely photographic telescope—that is, it could not be used visually even if this were desired—having a very short focal ratio and therefore a high "speed." The focal ratio of the one shown is f/2, and its aperture 18 inches. To make an objective lens of this diameter, and ordinary focal ratio, is not unusually difficult but it would be surpassingly difficult to make it in very short focal ratio. Therefore a mirror is substituted. However, a paraboloidal mirror distorts except at its center but, by adding a thin correcting plate, Schmidt overcame this

This additional effect is of great importance, because it is cumulative with advancing time. Its influence on the orbit is similar to the long-familiar one of a resisting medium.

The orbit slowly diminishes in radius, and the particle approaches the sun along a very closely-wound spiral. At the same time the eccentricity diminishes—this effect being added to the one previously described. As the particle approaches the sun, it moves faster—having gained more energy from falling toward the sun than it has lost along with its momentum—and the changes in its orbit become more rapid. Finally it falls into the sun—there is no escape.

The rate at which all these things happen depends, of course, on the rate at which mass and momentum "flow through" the particle. At first, one might expect it to be excessively slow. One gram of energy is c^2 ergs (where c is the velocity of light), or 9×10^{20} ergs. Sunlight at the earth's distance carries 1.35×10^6 ergs per second through one square centimeter. To get one gram at this rate would require 6.67×10^{14} seconds, or 21,200,000 years. A particle of one gram mass, and one square centimeter cross-section, at the earth's distance, would therefore have an amount of energy equal to its whole mass flow through it in 21,000,000 years; and we should expect very radical changes in its orbit within this time.

Allowing for the more rapid changes near the sun, Robertson finds that a particle of rock (density 2.7) one centimeter in diameter, started at the earth's distance, would fall into the sun in 10,000,000 years. The time of fall is proportional jointly to the diameter of the particle, its density, and to the square of the initial distance. This has important consequences. The earth has been in existence for at least 2,000,000,000 years. In this time, any masses of rock less than six feet in diameter, originally circulating within the earth's orbit, would have been cast into the sun by the slow but unceasing influence of its radiation pressure. This cleaning-up process would, in the same time, get rid of anything less than three inches in diameter, as far as Jupiter's orbit, and clean out stuff a tenth of an inch in diameter as far as Neptune.

THIS seems inconsistent with the existence of the vast numbers of shooting stars which fall daily upon the earth; but many of these have high velocities and have entered the solar system from outside, while others have elongated orbits and, like the comets of short period, may have been deviated into these, by planetary perturbations, from much larger orbits, within a few millions of years.

The particles which reflect the zodiacal light are grouped around the sun in such a way as to suggest that they are moving in orbits of small eccentricity. If so, they must either be fairly large, or of more recent origin than the planets.

At greater distances, such as the dimensions of the diffuse nebulae, this process would be too slow to be effective, so that there is no difficulty in the observed existence of reflecting and obscuring clouds "near" bright stars—that is, at distances of a small fraction of a light-year. Each star should clean up a small hole in the dust-clouds, in its immediate neighborhood—and this fits the facts, since otherwise the nebulae would brighten up greatly close to the stars—which they do not.

–Jamestown, Rhode Island, September 1, 1937.

WEATHER AND SUNSPOTS

Though the Skein is Tangled, Long-Range Weather Investigators are Working Toward a Knowledge of the Connection between the Weather and the Sun

By HARLAN T. STETSON, Ph.D.
The Massachusetts Institute of Technology

THE trite remark, often attributed to Mark Twain, that "the weather is something that everybody talks about but nobody does anything about," is perhaps less pertinent today than ever. People are becoming more and more concerned with the weather and its prediction. The impetus given to investigations in meteorology by the exacting demands of air navigation promises to open a new era in meteorology. Weather stations at every airport not only demand trained meteorologists but demand of them powers for predicting weather for which the world finds itself suddenly unprepared.

The conventional weather forecasting of yesterday, which has depended largely upon telegraphic communications from the western states, is not satisfying the need of today. Even well-developed storms in the far west cannot always be counted upon to pursue their prescribed paths eastward. Science is seeking new information about the developments and movements of storm areas. For this reason the last few years have seen the initiation of daily airplane flights into the upper atmosphere to find out the actual conditions off the earth as well as on it; a storm area, after all, is a three-dimensional thing.

THE Weather Bureau for several years has tried to meet the demand for forecasting weather more than a single day in advance, and it now attempts forecasts for a weekly period at a time. Business and transportation lines, however, would like to know, not a week but months and often a year in advance, so that they may judge their demands accordingly. While the United States Government has placed the Weather Bureau on a sound basis and is arranging its program according to the latest developments in meteorological thinking, the Department of Agriculture has been appropriating thousands of dollars during the last few years to investigate the possibilities of long-range weather forecasting along many non-conventional lines. Aside from government agencies, various individuals from time to time have established private forecasting services based on conceptions which are not ordinarily recognized as conventional, but which, according to their own enthusiasm, have proved at least as accurate as others in predicting weather at long range.

The idea that weather may be associated with sunspots is not in itself new. Many investigators have attempted to find relationships between sunspots and weather changes, with the ultimate hope that, since we can predict with reasonable accuracy the main trends in the solar cycle, we shall be able to predict likewise the main trends in the changes of weather. Evidently the relationship between weather and sunspots is not a simple one, else the secret would have been found before now.

THE economic value to the earth's inhabitants of a really dependable method of knowing the weather months in advance, much as we now know we can rely on astronomical prediction, would run *high* into the billions each year. This is one reason why so many have striven to work out systems of long-range weather prediction: it would be an all-time high in practical human attainment. Unfortunately, this task is not as simple as it sometimes seems to some who at first dig into the subject—it is everything that simple is not, in fact. The multiple factors and forces that determine the weather are almost as complex as those which determine the daily events of our lives. Yet, if this vast problem is ever solved, how altered life on this planet will be! The accompanying article is substantially the same as a chapter in the author's book, "Sunspots and Their Effects," shortly to be published.—*The Editor*.

In spite of many conflicting findings, it appears that, in general, the temperature of the world at large is somewhat higher at sunspot minimum than at sunspot maximum. This seems at first paradoxical, since we might well expect that at sunspot maximum the sun would send us somewhat more heat and radiation than at sunspot minimum. Many of the observations of Dr. Abbot, especially during the earlier years, seem to corroborate this. It is not unthinkable, however, that the surface temperature of the globe could be actually cooler in some years, even though the earth is actually receiving more heat from the sun. Increased heat may produce increased evaporation, which, in turn, will result in increased rainfall. The increased rainfall actually lowers the temperature of the earth's surface and, again by evaporation, the air continues to cool immediately above the earth's surface. Then, of course, as the air is warmed near the surface of the earth, it rises and the cold air comes in from northern regions with its chilling effect. So it is entirely possible that even an increase in the heat received by the earth from the sun may result in increased circulation in the earth's atmosphere that, so far as surface conditions are concerned, can actually bring about lower air temperatures in selected regions than would otherwise be the case.

ONE certain thing is that all the weather on the earth is produced by the sun. It is the sun, shining over the tropical region, which heats the large masses of air in the region of the earth's equator. These masses of warm air ascend, while the cold air from the polar regions spreads toward the equator to fill the place occupied by the ever-rising warmed air. Due to the rotation of the earth, whirlpools and eddies are formed in these air currents, which result in winds and storms that bring our variable weather. So far as changes in the sun's radiation affect the general circulation of the atmosphere, it certainly is to be expected that such changes will ultimately affect the formation of the storms and the storm tracks that result. One of the difficulties in establishing any intimate connection between weather and sunspots is that our observations of weather have to be very local.

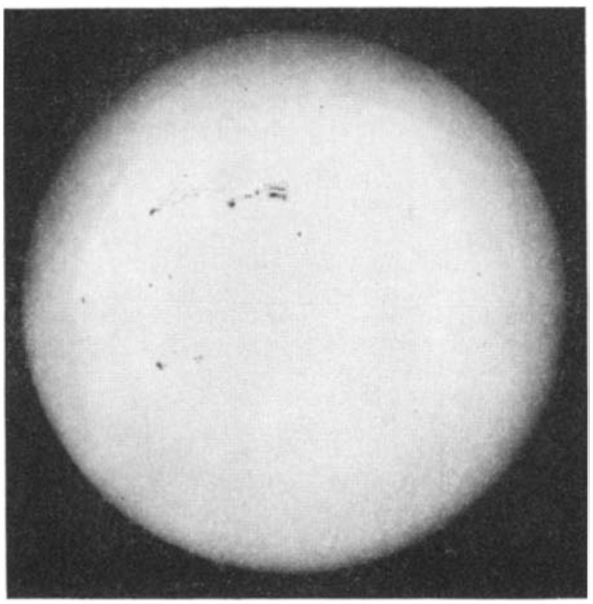
If one averages the weather conditions over the entire globe—as, for example, comparing the average rainfall recorded at observing stations throughout the world—one might at first thought expect

to find some relation with sunspots, assuming that sunspots have anything to do with weather phenomena. Such, however, is far from the case. A storm in one region of the globe means clear weather elsewhere, and a region of excessive rainfall in a given year will usually be offset by one of extreme dryness occurring somewhere else. To average together such effects leads to no definite conclusion. Furthermore, since storms travel over more or less defined tracks, the very migration of these storm centers makes it quite impossible to get significant results even from hundreds of stations scattered from the polar regions to the equator. Yet, if progress is to be made, it will come through a consideration of the distribution of weather as a whole over the entire globe. With a more accurate picture of world weather, indications for weather in a restricted locality for any given time may be more easily understood.

One of the most interesting personalities who has spent a lifetime in the investigation of world weather and its possible relation to the sun, is H. Helm Clayton of Canton, Massachusetts. Mr. Clayton is a well-known scientist who has spent many long years in the Weather Bureau service, and has been remarkably successful in his long-range forecasting. While Mr. Clayton takes cognizance of all the usual meteorological data employed by the government officials, he has utilized his long years of fundamental study of world weather in analyzing certain well-defined cycles which his keen perception has noted as fundamental in the recurrence of storms, rainfall, clear weather, and cold waves.

MR. Clayton is a firm believer that changes in the sun are accompanied by the fundamental changes in the earth's atmosphere, and has found certain definite indications that changes in the earth's atmosphere in different parts of the world accompany the appearance and disappearance of sunspots throughout the 11-year cycle. He has not only shown certain definite relations between temperatures and sunspots over definite areas of the globe, but he has shown why many investigators have failed to find such a relationship.

Looking at the weather on a world-wide scale, Clayton has found not only that pressures see-saw from one region to another, but he has noted that the way in which they see-saw depends upon sunspots. He finds that there is an opposite trend over the continents and oceans in summer as compared with winter, and that the trend is different in the equatorial regions from what it is in extra-tropical belts. In the equatorial region, the temperatures are distinctly lower at sunspot maximum and higher at sunspot minimum. The same is true in the north and south temperate zones, but in the arid sub-tropical regions, the temperature actually averages a little higher around a sunspot maximum than around a sunspot minimum.



Photograph of the sun, made at the Cook Observatory, by means of the 40-foot photo-heliograph

Mr. Clayton has examined the snowfall records at the Blue Hill Observatory in Massachusetts, and finds 40 percent more snow at sunspot maxima than at sunspot minima. He has traced the records of ice from the Arctic and Antarctic, and finds two to three times as many icebergs at sunspot maximum as compared with sunspot minimum. This corroborates the findings of other investigators who have come to the conclusion that temperatures, at least in the temperate zones, are colder when sunspots are most numerous.

From a careful study of precipitation records selected over the whole globe, he has mapped the world into regions which show greater rainfall when sunspots are most numerous, and regions where rainfall is actually deficient at the same time. While the North Atlantic shows 10 to 20 percent more precipitation in years of greater sunspots, the eastern half of the United States is in the region where the rainfall is actually less during maximum activity on the sun.

South America, Africa, India, and Australia all show again 10 to 20 percent more rainfall during sunspot maxima than during sunspot minima. From a survey of world weather Mr. Clayton has drawn the conclusion that at sunspot maximum the atmospheric pressure is less at the equator than it is during the years when sunspots are infrequent. But this area of lessened atmospheric pressure at the equator is compensated by a zone of greater pressure at sunspot maximum than at sunspot minimum in the northern hemisphere. Any wholesale change in the distribution of atmospheric pressure or barometer readings over the globe, which follows the sunspot cycle, must ultimately affect the number, intensity, and the nature of the storm tracks over the United States or other typical regions of the globe.

This has led Professor Kullmer of Syracuse University to investigate the tracks of storms over the United States during the years when sunspots were in evidence, as compared with the years when sunspots were lacking. On the basis of five solar cycles he has found that there appears to be a shift in the storm tracks of the United States which corresponds very much to the shift in the location of sunspots on the surface of the sun. Furthermore, examining years of solar and meteorological data, he has found on the average 40 percent more storms passing over the fundamental storm track of North America during sunspot maxima than pass over this same region during years of sunspot minima. He based his studies on records extending from 1883 to 1913.

MANY investigations have been made of the relationship between sunspots and tropical hurricanes on the earth. Wolf, who was one of the earliest investigators of sunspots, has shown that, during years of maximum sunspots, there has been an average of six to eight violent hurricanes per year, while the average during sunspot minimum is only one or two per year. During the years of sunspots more than three times as many hurricanes have visited the Bay of Bengal in the Arabian Sea. The South Indian Ocean in the same period showed an increase of 65 percent in the numbers of such hurricanes. Reverse conditions, however, were indicated for the South Pacific Ocean, where the number of tropical hurricanes was twice as many during the years of low sunspots as during the years of high sunspots. Other investigations have indicated that, as the sunspot cycle progresses, the longitude of the West Indian hurricanes drifts from 59° W. to that of 88° W.

All of this shows that weather is a highly complex phenomenon which depends upon turbulent air currents traveling in different directions, influenced by continents and oceans, equatorial heat and arctic cold. To upset the balance of one

of these regions may change the character and sequence of any of these phenomena in any of the other regions.

Mr. Clayton concludes that all our weather is the result of progressive, wave-like movements of certain disturbed areas originating in different parts of the world. He finds that, during each cycle of change in solar activity, the centers of high barometric pressure move from high latitudes to low latitudes and back again. The speed with which these waves progress appears to be inversely proportional to the length of the period of oscillation.

This noted investigator finds there will be several years when the differences in barometric pressure between the equatorial region and the north temperate zone become greater than normal, and this period will be followed by several years when the pressure differences become less than normal. The shifting of these centers of action is found to be definitely associated with sunspots. His conclusions are based on so large an amount of data and upon such a wide experience in meteorology that no one interested in weather and weather prediction can overlook the important contributions which Mr. Clayton has made.

Dr. Abbot of the Smithsonian Institution, whose painstaking work of measuring solar radiation we have already discussed, concurs with Mr. Clayton in the belief that, if there are no variations in the sun's radiation, atmospheric movements would soon be reduced to a stable system with periodic exchanges of air between the equator and the pole, and between the ocean and the land. Without variation in the sun, these exchanges would depend mainly upon the variation of the heat received by the earth due to day and night, and to the seasons. These would be set into operation merely by the relative motions of the earth as it turns on its axis and journeys about the sun. Both Abbot and Clayton firmly believe that the existing abnormal changes in weather which we experience have their chief source of origin in variations of the sun itself.

DR. ABBOT'S long investigations of solar variations and weather at the Smithsonian Institution have convinced him that the sunspot period is an important factor in untangling the vagaries of the weather. He finds that the variations in the sun's heat and in the weather really appear to comprise 12 or more regular periods, the most conspicuous of which is a period of 23 years, equal to twice the average sunspot cycle. Observations show that when we are concerned with the electrical nature of sunspots, 23 years really elapse between the recurrence of sunspot cycles of the same kind. The examination of weather records at strategic points, Dr. Abbot says, shows very definitely this long period of weather variation covering 23 years.

One puzzling difficulty in all these investigations has been that a definite relationship between sunspots and weather appears to persist for a considerable number of years, then the relationship gets out of step and changes its phase. Then, for one reason or another, over a considerable time, the weather effects will run just opposite to the expected.

Dr. Abbot now has new light on this puzzling difficulty. In examining weather records from 1875 to 1925, he has discovered that in the 11-month variations of temperature at a selected station the temperature rises with increasing sunspots if the numbers of sunspots are not large. When, however, sunspots approach a maximum, the increase in temperature follows the increase in sunspots less markedly. During the years when sunspots are very large and most numerous, the temperature actually appears to fall with increasing numbers of sunspots. We might interpret this as meaning that there is a certain optimum of sunspots for normal weather conditions. If sunspots are less than this amount, we get one effect, whereas if they are more than this amount, the opposite effect results.

We might take as an example the dependence of one's working efficiency upon temperature. Let us say that your optimum working room temperature is 68 degrees, Fahrenheit. You come into the office some winter morning and find it is only 60 degrees, with the thermometer slowly climbing. As the thermometer rises, you literally warm up to your work, and perform it more efficiently. If, however, through lack of proper heat control, the thermometer continues to rise to 80 degrees and above, you begin to slow down again. If your experience with temperature and working efficiency had been limited entirely to a range between, say, 50 and 70 degrees Fahrenheit, you would have derived the law that, as temperature increases, your working efficiency increases. It might have been a bit of a jolt the first time you were subjected to temperatures of 80 degrees, 90 degrees, or above, to discover that, as the thermometer continued to rise, your ability to perform your duties and create new ideas actually diminished.

This may serve as an example of the relationships between sunspots and the weather. With sunspots below some critical value, temperatures on the earth seem to go up with increasing sunspots. With sunspots above this critical and optimum level, temperatures on the earth react in the opposite manner, very much as your mental efficiency ran opposite with the thermometer in the illustration we have used.

DR. ABBOT has traced the 23-year variation in the weather, with many of the minor fluctuations which occur at greater and less intervals, in the tree-ring data studied by Dr. Douglass; also in the flow of the Nile River, the level of the Great Lakes, the rainfall in southern New England, and even in the abundance of cod and mackerel.

Another independent record of the 23-year cycle is evident, according to Dr. Abbot, from the records of varves, those curious laminated markings on sedimentary deposits that may be traced through geologic time. The annual character of the layers of these clay-like deposits aroused Professor Douglass' interest in analyzing the spacings. So he studied their records, very much as he analyzed the rings in the trees of the forests of the Southwest. Professor Douglass finds a very prominent cycle in varves of 11.4 years, which is practically the sunspot cycle. Of course, two of these so-called "Hellman cycles" are the equivalent of Dr. Abbot's 23-year period. Various other cycles have been traced in sedimentary deposits extending back over 1400 years.

It is the 23-year period which Dr. Abbot believes is particularly important in weather and climate forecasts. He finds departures both in temperature and rainfall which have repeated themselves remarkably in these intervals. Dr. Abbot says the United States is now nearing the close of a period of considerable drought which, according to his best estimate, will not return until the year 1975. He bases his prediction

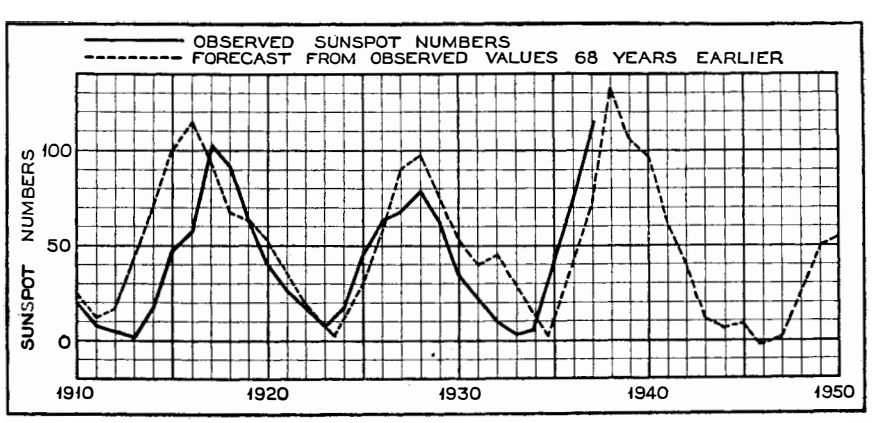


Figure 1: **A forecast of sunspots, from Clayton's 68-year period (see the text)**

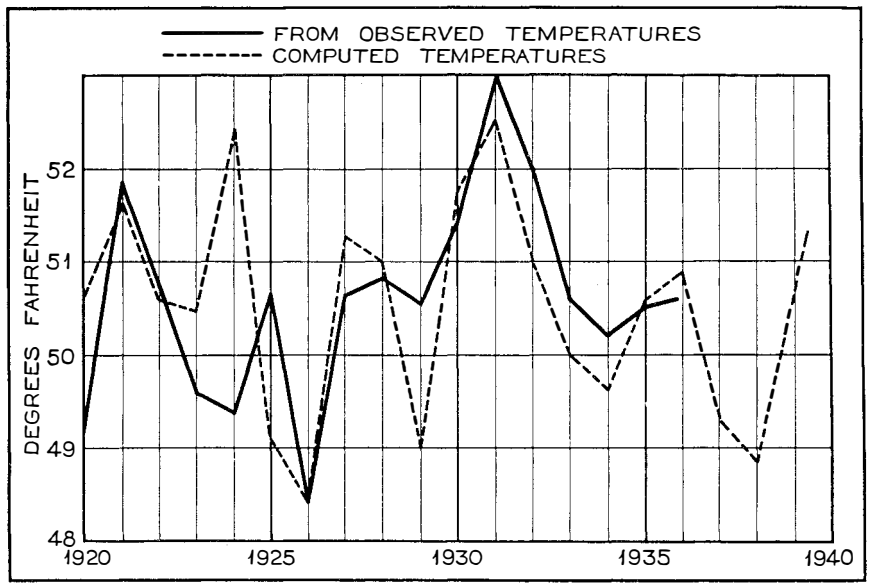


Figure 2: **Clayton's forecast of mean annual temperatures at New Haven, Conn.**

on twice the solar cycle in records of both solar activity and weather. He finds this double period particularly important to precipitation.

Both the 23-year and the 46-year cycles are traced in temperature departures from normal, not only in the United States, but in western Europe, southern Africa, and Australia. On the basis of the past, he has at several times made forecasts which subsequent experience has shown to be remarkably well verified. If more observing stations could be established for the exact measurements of solar radiation—particularly if recorders could be sent into the stratosphere regularly every day by means of balloons, in accordance with his suggestion—it appears that so much more satisfactory observations of solar radiation would be obtained as to advance materially the whole subject of long-range weather prediction.

IF weather depends upon sunspots, then the desirability of predicting coming maxima and minima of solar activity becomes of the greatest public interest. The question of the moment is, when is the next sunspot maximum due?

If the answer to this question were as simple as adding the 11 years—the *average* length of the solar cycle—to the date of the last maximum, the answer would be as easy as two and two. The next sunspot maximum would then be due in 1939.

There are good reasons, however, for believing that this is not the best prediction. I have just been examining the records of the last 180 years of sunspots. In this interval there have been 16 completed cycles since the well-determined minimum of 1755. The average length of time from one sunspot maximum to the next over this interval is 11.13 years. It is a surprise, and a bit disconcerting, to find only four maxima of the last 16 have fallen within 11 years of each other. Three have been spaced 13 years apart, three 10 years apart, and two at 12-year intervals. Two others were separated by eight years, and there was one instance of 16 years elapsing between two adjacent sunspot maxima.

On these grounds alone there would be a chance that the next sunspot maximum might follow anywhere from eight to 16 years after the last maximum, which occurred in July, 1928. There is only one chance in four that the 11-year interval will work for predicting the present coming maximum.

Someone with a gambling instinct may like to put stakes on the year of the coming sunspot peak. Surely the exciting variations in spots from one week to the next, as they surge up and down on the way to the top, should give one all the thrills of watching a favorite horse go over the line.

Years have been spent by numerous investigators in analyzing sunspot curves to discover the various periodicities that may enter into the question. When we examine the sunspot numbers month by month rather than year by year, it is important to note that there are secondary fluctuations that occur at more or less irregular intervals. These secondary or minor fluctuations have an important bearing on the prediction of the maxima. Some of these intervals of variation are much longer than the 11-year cycle. Others are shorter.

The most recent and fruitful results which I have yet seen in an attempt to analyze the sunspot cycle into workable periods which may be used for prediction are those recently shown me by Mr. Clayton. By a rather novel trick he has treated the long record of sunspot numbers from 1750, and has determined significant periods of 8½ years, 10 years, 11⅓ years, 14 years, 17 years, 23 years, 34 years, and 68 years. He finds that, from 1750 to 1910, an interval of 68 years gives a close approximation to sunspot changes. Utilizing the dates of all the well-determined sunspot maxima and minima published by Wolf and his successor at Zürich, he finds that the mean interval between nine minima is 68.0 years and that the mean interval between nine maxima is 67.3 years. Using these intervals of about 68 years, and utilizing only data up until 1910, he has made a forecast of sunspot numbers from 1910 to 1954 (Figure 1). This curve agrees so remarkably with the observed values from 1910 to date that it merits more confidence than any prediction which I have yet seen.

ON the basis of his idea that weather is linked with sunspots, Mr. Clayton has treated the annual mean temperatures and rainfall for intervals of 68 years and the fractions of this period previously mentioned. Owing to the great variability of weather changes, he has found it necessary to make frequent corrections to the weather period, in order to obtain detailed correspondence between forecasted and observed temperatures. Utilizing the method of smoothing outlined by him in a recent number of the *United States Weather Review*, he has made a forecast of New Haven temperatures from 1920-1940 (Figure 2). The remarkable correspondence between the forecast temperatures and those actually observed, from 1920 to date, certainly merits some confidence for the prediction of the next decade. Evidently New England is in for some below-normal temperatures for the next two or three years.

However complex and conflicting the results of various investigators who have attempted to link weather with sunspots, it appears that enough evidence has been presented so that one may feel fairly confident that future investigations will bring to light more and more support for the hypothesis of a connection between the weather and the sun. We may hope for the justification of the statement made 40 years ago by the pioneer investigator of the sun, Professor Langley, in his report of the Mount Whitney expedition:

"If the observation of the amount of heat the sun sends the earth is among the most important and difficult in astronomical physics, it may also be termed the fundamental problem of meteorology, nearly all of whose phenomena would become predictable if we knew both the original quantity and kind of this heat; how it affects the constituents of the atmosphere on its passage earthward; how much of it reaches the soil; how through the aid of the atmosphere it maintains the surface temperature of this planet, and how in diminished quantity and altered kind it is finally returned to outer space."

Platinum in Overalls

Noble Metal Is Industrial Worker . . . So Are Its Five Relatives . . . Resistance to Corrosion and to Spark Erosion . . . Has Excellent Machinability

By A. J. WADHAMS
Vice President and Manager of Development and Research Department, The International Nickel Company, Inc.*

PLATINUM is no newcomer; although the ancients, with the possible exception of the Peruvians, knew nothing of platinum, a strange ore of unknown nature was found in the New World, about 1538, in what is now Colombia. It was not until 1741, however, when William Wood carried a sample of the new ore to England, that much was learned about it. Even now, the young man who takes his fiancée to the jeweler to select her platinum engagement ring little guesses that on this rare precious metal, the destinies of nations depend. This same young man, unless by chance he is a metallurgist, would probably be surprised to know that the metal with which he binds his troth and with which just this year a queen has been crowned, has for several years been used in alloys to crown many a tooth, is a friend to the farmer, and a vital necessity to the whole world's aircraft, its telephones, its radios, and even to much of its clothing.

But it is only after centuries of ignorance and years of searching in quest of its true nature, that platinum has attained this remarkably useful position. For many years after its discovery in South America the metal was little known in Europe, largely because the Spanish government would not permit its exportation from Colombia. It was first named "platina del Pinto," platina being the diminutive of plata, the Spanish for silver, and Pinto being the name of the river in the sands of which the metal was first found. Now platinum is found widely dispersed but in only minute quantities in ore bodies as well as in river bottoms, and it still remains one of the rarer elements of the earth's surface, being a hundred times rarer than gold.

IN 1752, Sheffer found that platinum could be dissolved in aqua regia, a mixture of one part nitric acid and three parts hydrochloric acid. Then, in 1757, Margraff discovered that the metal could be precipitated from this solution by adding ammonium chloride. Both these processes are still used today.

As time went on, metallurgists began to realize that this metal consisted of an entire family rather than just one element. They found it to be a group of six members: platinum, palladium, iridium, rhodium, osmium, and ruthenium. Though all these metals possess notable resistance to corrosion and high melting points, they differ in structure and various other properties. All are white in color, resist tarnish and other types of corrosion. Platinum itself is readily workable, melting only at the high temperature of 3223 degrees, Fahrenheit. Taken as a group, the platinum family has proved itself versatile and invaluable to the varying needs of our complex civilization.

Platinum alloys are of enormous importance to chemists. Here platinum electrodes are used in testing

We have come to take electricity for granted. Yet without platinum this important possession of civilization might not have been put to such wide use. The development of electrical contacts, standard resistors, and primary battery electrodes was greatly assisted by platinum and, in some cases, made possible only by it and its sister metal palladium. In these uses platinum was valuable because of its high resistance to spark erosion, its staple thermo-electric behavior, and its excellent machining characteristics.

The use of platinum lead-ins in Edison's carbon-filament lamps created a tremendous demand for the metal eased only by the development of platinum-clad and later, copper-clad, nickel-iron lead-ins. But for platinum, the invention of the incandescent lamp, the X-ray tube, and certain equipment necessary for radio broadcasting would have been delayed several decades and the electrical art might still be in its infancy.

Every time we make a long distance telephone call, platinum and palladium are put into service as contact points along the line. They assure a clear connection. These two sister metals are employed in telephony and radio wherever longevity and infallibility of service are requisite.

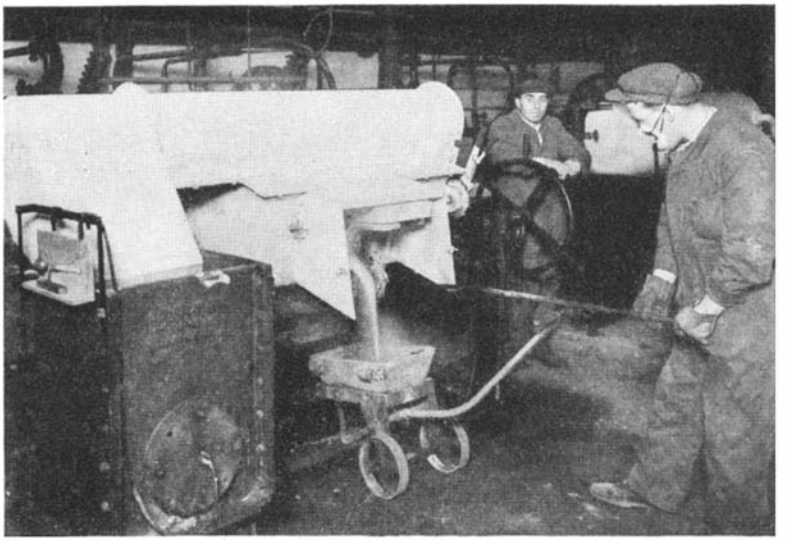
A WIDE variety of relays, thermostats, and electrical measuring instruments employ platinum to insure low resistance and constant contact for reliable operation. A new use for the metal in this field is for fuses to protect sensitive instruments from overloads. These fuses are made of an iridium-platinum wire drawn to a practically invisible fineness. They can be designed to blow out with a current of a few milliamperes, functioning so rapidly that the instrument they protect cannot be damaged by overloading. Because of resistance to corrosion, similar wire is used for detonating caps.

High and maintained reflectivity is another important property of the platinum metals. The United States military forces rely on this property when they use rhodium to surface the great all-metal reflectors in the 60-inch searchlights which are maintained for coast defense. A new use in this field is for the rhodium-plated, all-metal reflectors which are being substituted for glass reflectors in moving-picture projectors.

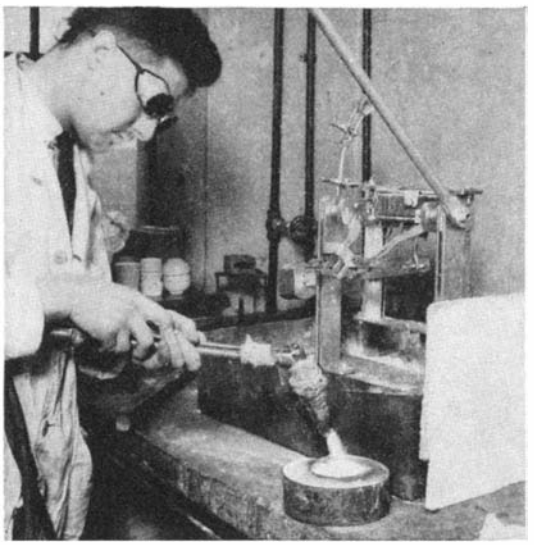
When gas and gasoline engines were invented, platinum was again summoned: first for hot-tube ignitors, later for the contacts in make-and-break ignitors, and even later still for the contacts in high-tension spark coils and magnetos. The

*World's largest producer of the platinum metals.

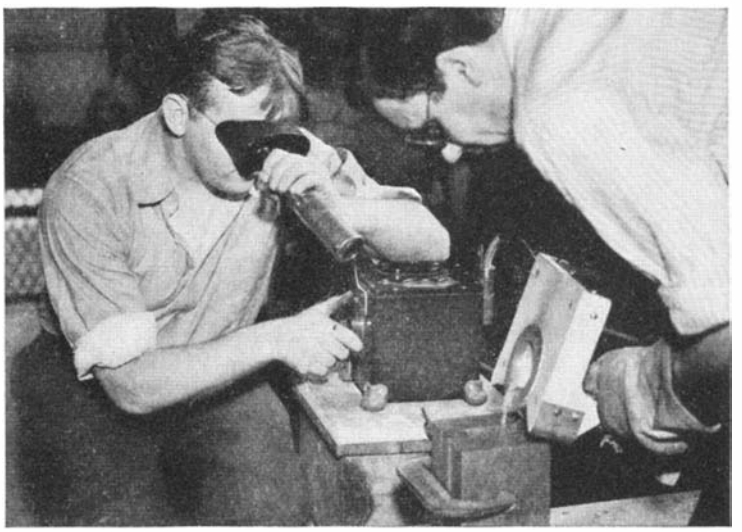
Platinum solution being poured from the dissolver via trough into the filter top



In the refinery it is necessary for workers to wear masks against poison gases as platinum solution is poured from concentrate solution



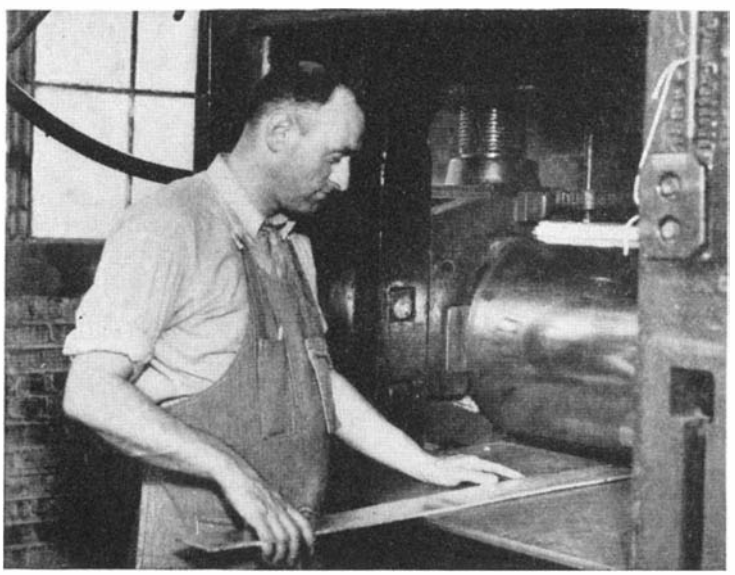
Above: Remelting platinum in a crucible with a hand torch prior to casting it in a delicate mold

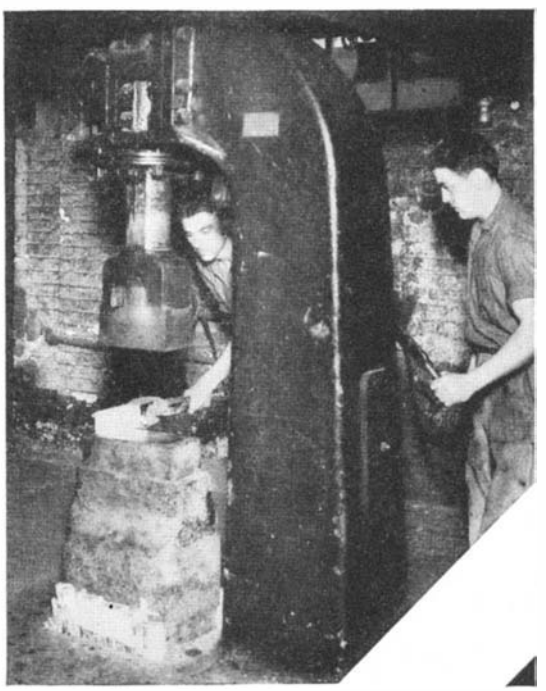


Above: Casting an alloy melted by induction. Temperature is determined by optical pyrometer

Below: Forging a bar of palladium in a precious metals refinery with a heavy drop forge

Below: No delicate jewelers' tools here—heavy machinery rolling out platinum sheet into workable strips

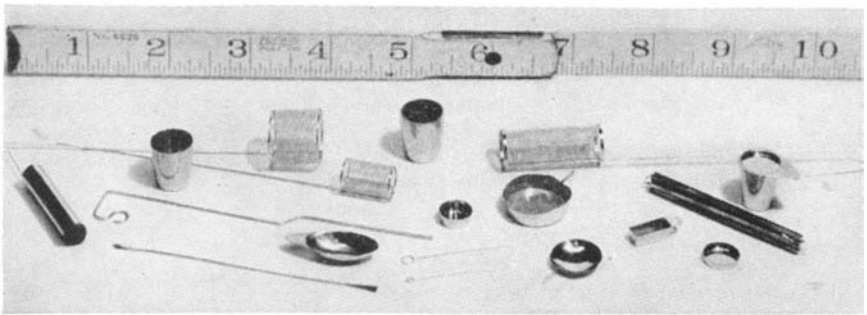




advent of single-spark battery ignition permitted the use of tungsten for contacts, but in aircraft and other high-tension magnetos, where reliability is a primary requirement, platinum alloys are currently employed.

It is in reducing the cost of fertilizer that platinum has become one of the farmer's best friends. In this instance, the ability of the platinum metals to promote, or catalyze, various reactions between chemicals makes possible the synthetic production of nitric acid from ammonia. This application uses a rhodium-platinum alloy in the form of very fine gauze. Besides being valuable as a fertilizer base, nitric acid is vital to other industries—to the manufacture of explosives used in mining and construction, for example. A large portion of the world's sulfuric acid is produced with platinum catalysts.

Most reactions of importance in metallurgy, glass technology, and many other fields proceed best, and often only, at high temperatures. The study of such reactions requires a material to hold the substance being investigated and a means for securing and maintaining the requisite temperature and for measuring the temperature. As it turns out, the platinum metals, because of high resistance to corrosion, resistance to oxidation, and high strength at elevated temperatures, coupled with resistance to molten oxides and silicates, are generally the most suitable for performing these functions. In this field of research, a recent development has been the making of miniature laboratory equipment for micro-analysis.



Micro chemists, analyzing minute samples, use solid platinum crucibles, pans, wires, and so on, so small that a set of 26 items weighs less than 60 grams

IT is in the recent vast improvement in rayon that platinum and its alloys have played so vital a part. Manufacture of the fiber requires thousands of spinnerets—small cups pierced with a multitude of hair-fine and often invisible holes through which the cellulose solution is forced to make the tiny threads. The minute holes in these spinnerets must be so fine and of so precise a uniformity that platinum is the one metal having sufficiently high mechanical properties and good machining characteristics for this application. Furthermore, platinum is not affected by the strong acid solutions used in cleaning the spinnerets which must be kept entirely free from plugging to permit easy flow of the cellulose solution.

There is great excitement in the glass industry today and several innovations have already come out of it in which platinum is playing a vital part. One of these, the manufacture of glass fiber, employs platinum for the jets or nozzles through which the molten glass is forced. There is nothing new about glass fiber for German manufacturers have been making glass fiber since before 1878 but their product has been a coarse, impure, imperfect one, the result of a slow, expensive process. By means of the new process which owes a large measure of its success to this use of the platinum alloys, it is possible to produce perfect fibers of varying lengths and thicknesses.

It was only at the beginning of the present century that the use of platinum in jewelry, its best known application, became at all widespread. Since 1906 the jewelry industry has been the largest purchaser of platinum. Diamonds look much whiter and are held more securely when mounted in platinum. The excellent strength and high ductility of platinum alloys have also made possible the production of fine wire and minute stampings, thus revolutionizing jewelry design and resulting in a lighter, more graceful, and more delicate construction than was possible with gold. The State Crown of the Queen of England, which Queen Elizabeth wore at the coronation ceremony on May 12, was mounted entirely in platinum.

Less histrionic but just as important in its own way is the part that platinum and palladium play in the daily drama of the dentist's chair, for dentistry is another field in which these two have now become invaluable. In the medical field, platinum and platinum-iridium are used for radium containers—needles, cells, and tubes for the treatment of cancer. In this use, platinum's density, making possible the filtering of certain unwanted radium rays, and its excellent machining properties, allow the fabrication of containers of more minute size than is possible with other metals.

It would be futile to attempt to describe the multitude of other applications in which the platinum family has become useful. Platinum is used for fine medals, trophies, and cups for which a metal with a high degree of plasticity is required to reproduce the high relief and fine detail cut into the die. Palladium has been developed in leaf form for decorating fine books and art objects as well as for interior decoration. Rhodium, widely used for plating silver in order to protect it from tarnish, is finding a new use in road signs which reflect a warning at night under automobile headlights. Platinum can be drawn into wire as fine as 50 millionths of an inch in diameter. This property of the precious metal was recently employed in a laboratory for clinical pathology when platinum-iridium wire was used for measuring the degree of nervous tension in human beings. By means of this development, a delicate instrument, fitted with wires so fine that they can be inserted into a muscle or nerve without causing pain, reduces the "jitters" to terms of electric voltage.

THE principal source of supply of the world's platinum metals is in the copper and nickel ores of Canada. These precious metals, with gold and silver, are recovered as by-products of the nickel and copper in sludges or precipitates at the bottoms of the refining tanks. The sludges are then shipped to the precious metal refinery in England to undergo an initial smelting operation in which lead is used as a collector of the precious metals. Subsequent cupellation removes the lead and a silver-rich precious metal alloy remains. This alloy is then parted with sulfuric acid after which an aqua regia treatment dissolves most of the platinum, palladium, and gold. Platinum is then precipitated as platinic-chloride which, on ignition, yields pure platinum sponge. Palladium is precipitated as palladosamine chloride, yielding palladium sponge. The silver and gold are purified by electrolysis. The final insolubles and reduction residues are re-melted to concentrate the rhodium, ruthenium, and iridium which are later separated.

Platinum is not only produced by processes little short of alchemy, but it is being put to work by modern industry in processes which are equally startling. The traditional distinction between commercially pure and chemically pure products is disappearing in one industrial process after another, and in this progress towards purity platinum is providing the material out of which is made equipment which otherwise would contaminate the product. Herein lies the growing importance of the metal's contribution to industry and of industry's contribution to an expanding use of platinum.

Speed Awing

Traditional Speeds of Birds are Often Greatly Exaggerated . . . Determining Flight Speeds with a Stop-watch . . . The Plover Makes a Falcon Look Silly

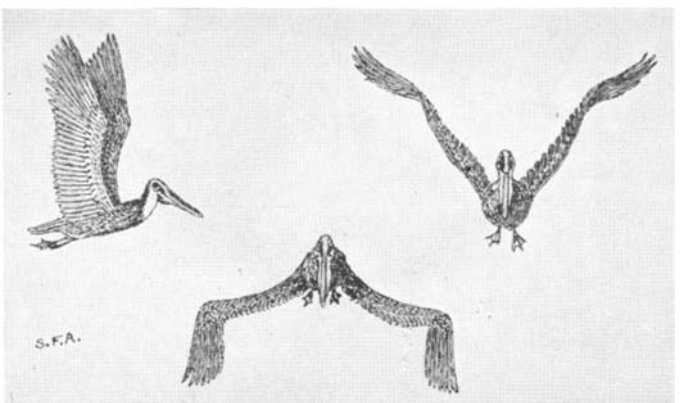
By S. F. AARON

Drawings by the author

IT is high time to correct some of the traditional assertions respecting the flying speeds of birds; this article has been written only after careful and continued observations. Nothing is more opportune for conjecture, nor offers wider chance for miscalculation, than bird speed. Some of our very best and most reliable bird books, and many oft-quoted statements by writers of scientific acumen, indulge the very common and eagerly received notions of flying speeds that are proverbially exaggerated. Audubon, by no means always accurate, yielded to the same tendency.

Quite commonly the 100 miles an hour rate is claimed for a number of species, from the frigate-bird to the hummingbird, and from the swallow and the swift to the swan. The falcons also share in these exaggerations.

Now, it is very possible that the great sea pirate called the man-o'-war bird, with the aid of a high wind and after a long-continued momentum in one direction, can attain a very high velocity; but that the creature can eat breakfast in New York and take a late dinner in London, as has been claimed, is altogether absurd.



Brown pelicans. In the lower figure the downward stroke is at its limit and the lift about to begin. Drawn from memory

It cannot be denied that the chimney-birds, with any members of the true swallow family, seem to excel in wing speed almost any other species, and that they *may* at times reach a rate that would, if recorded, clip many seconds off what they usually attain. That wild ducks, geese, swans, terns, hawks or falcons—the great company of waders or sea birds—can attain speeds of more than 60 miles an hour for short or long distances is very decidedly doubtful and the accurate study which follows discloses this fact.

ACCURATELY determining the average flight of birds over measured distances with a stop-watch is less difficult than merely painstaking. It demands more patience than brains, and it affords much pleasure and satisfaction. Selecting the season counts largely. The method employed was by no means original.

With a companion who knew less about birds than he did of surveying, but whose still youthful interest in any subject related to his own work stirred his enthusiasm, a test was made of the flying speed of several species. The selection of the place for the experiment was fortunate, and the season was that of the spring migrations of birds toward the north, when those species that left southern localities were in an evident hurry and those that remained to nest nearby were restless, mating and trading about.

By triangulation the distance between two points on the bluff-bordered Corpus Christi Bay, some five or six miles below the city of Corpus Christi on the southern Texas coast was found to be just one third mile, and to extend nearly north and south. This course faced a wide expanse of the bay, with a shallow beach upon which many birds came to spend the winter and from which they started to their far northern nesting places.

Out from the short, straight line of measured coast an unfortunate coastal sloop had foundered; its rotting mast stump was at direct right angles to the course from the position where my fellow investigator took his stand. He had a shotgun, the shells especially loaded only with black powder so that the smoke of the discharge could be seen.

From my position on the top of the long bluff I could watch an area of about 90 degrees from the shore line between us. There we waited not five minutes before a reddish egret winged its way past my collaborator and headed toward my position.

As the bird crossed the line between the bluff and the old wreck I saw the smoke belch forth from the gun, the noise hurrying the bird—as we had intended. On the instant I pressed the release of my stop-watch. When the heron came opposite my stand, I again pressed the stop-watch and noted the elapsed time—one minute, one second—or at the rate of a little less than 20 miles per hour.

This was an auspicious beginning, but what followed was more like missing a train at a one-track way station without a time table. What would come next and, if ever, when? Had the world suddenly become bereft of birds? Was that egret the last representative of a vanishing class? Not quite, for—how long afterward I do not know—I was stirred from something bordering a dream by the distant boom of that gun and again I pressed my stop-watch. This time it was another egret of the same species, but snow-white—the young of the first or second year.

On came that spot of white with regular beat of wings and the watch showed one minute, four seconds; perhaps about two additional seconds had elapsed between the actual firing of the gun and my finger action. The near coincidence in flight time was not at all remarkable, for once we had watched two of these birds winging their parallel way across the water and they kept truly together for the full half a mile that we could note them.

And then we had occasion to be alert, for soon there followed several brown pelicans. These also kept pretty well together; for exactness, the leader was selected and timed. These brown pelicans fell behind the record of the egrets by only four seconds. Perhaps the report

of the gun had not hurried those big-billed, homely specimens at all. Almost immediately afterward, however, the report did hasten a bunch of four mallards—three emerald-headed drakes and one hen. They veered out a little, not flying exactly parallel to the coast, making the distance traversed a little longer, so I snapped the watch about two seconds before they came opposite my stand and the time was 46 seconds—not nearly as fast as the swiftest horse could cover the same space and only a little better than 26 miles an hour, even allowing for possible errors.

Next came two egrets that turned in, however, and alighted about half way on the beach; a flock of bald-pates that turned out and flew wide of my stand; several Caspian terns that indulged in erratic flight, after their manner; a number of birds that turned south instead of north, or flew crosswise from the land. Then, after another long wait, came the hoped-for opportunity of timing a black skimmer, one of a group of three.

THIS swallow-like fellow, in ease and seeming rapidity of flight, did not make the distance straight-away, but approached at an angle after making a wide turn, and afterward we had to calculate the distance it covered. We were greatly disappointed, the elapsed time being 47 seconds; for, with the turn, this was just a little slower than the mallards. Nevertheless, we were firmly of the opinion that these wonderful birds can, if need be, pretty nearly challenge the world of wings. We may have made an error in that angle, or the group of skimmers that kept well bunched were not doing their level best, as they are not hunted and do not fear a gun.

A long wait followed, with many birds going both ways, but none straight nor parallel, nor making the full distance. Finally we signaled to quit for the day.

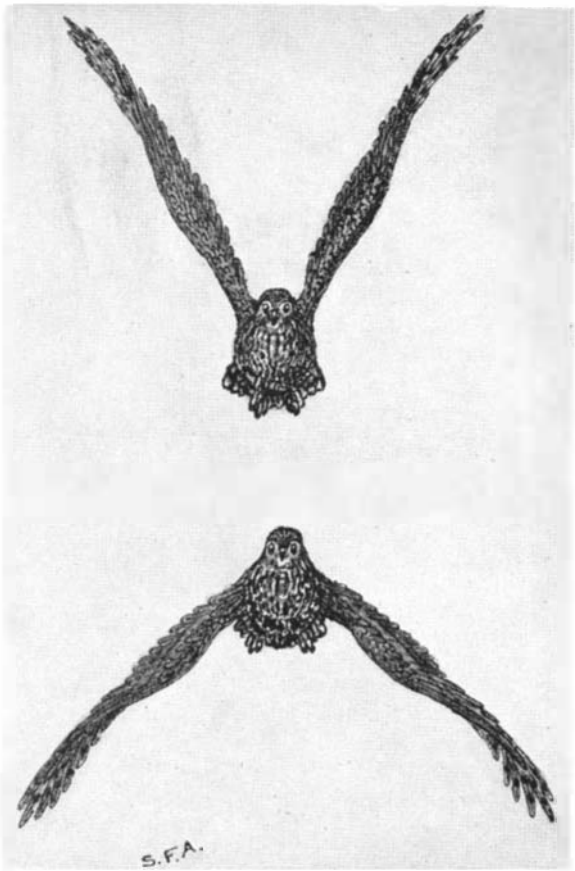
On the following morning we again took up our positions, without a single satisfactory result, for four long hours.

On the third day, with a so-called "norther" blowing—which means a cold, foggy spell—we decided not to attempt the test, but gazing out to sea we discovered myriads of birds on the wing, low and passing overhead, flying across a stout wind. It is indeed difficult to account for the whims of migrants. Thereupon, right gladly, we regained our positions and soon observed a flock of seven or eight black ducks skirting the coast northward, apparently bent upon getting somewhere quickly. Their time was 40 seconds, and their speed therefore was at the rate of 30 miles an hour—a little faster than the mallards of a few days before, but the wind may have somewhat aided the blacks.

Again, after a long wait and several failures, a half dozen bald-pates negotiated the straight line of coast at a rate corresponding to that of the mallards, and very shortly afterward we were delighted when four blue-winged teals gave us an equally fine test. There were two drakes and two hens, probably long mated, and they were in the usual hurry that all the teals seem constantly to practice. Again we were disappointed, for these small ducks always had appeared to us the speediest of their family, and I believe they have commonly received that distinction. Their time was only 38 seconds, or 31½ miles an hour—by no means phenomenal and far below the reputed 100 miles an hour.

This job was a long and delightfully tiresome one, full of disappointments, but fascinating for a time. In the further seven half-day trials that we made in the next ten days we obtained the speed of one golden-eye duck, which equaled that of the teal; one south-southerly (duck) that, allowing for possible error due to a swerve, probably bettered the teal by a fraction; a small company of gadwalls that fell slightly behind the 26-mile mallards; a glossy ibis that did not do quite as well as the egrets; and two willets that considerably exceeded all the rest while making, we believed, a fair average speed of their kind. I think these last were in a big hurry, for their time was only 33 seconds—a trifle more than 36 miles an hour.

I have always, following other observations (though these may have been of a less careful nature) believed the snipe, plover, and shore bird species to be, with very minor exceptions, among the swiftest of all birds awing, and here was partial proof of this notion. I suspect it will have to be admitted that they are in the 50-miles-an-hour class, with doves and homing pigeons if these are hurried, and probably the flycatchers and warblers during migrations.



Cooper's hawk. Wing stroke is 105 degrees and the number of strokes nine per second at best speed

ONE possible weak point in these tests consists of the certainty that all birds commonly fly with the least possible effort and that, when necessary, they can and do improve their speeds [though the velocities claimed by tradition apparently are not based on the speeds at which birds can fly, but those at which they do fly. For example, "Wild ducks fly at 100 miles an hour."—farmers' almanacs (compiled, by the way, in city offices).—*Ed.*]. But I think the birds which we observed on the Texas coast indicated that they were at least in somewhat of a hurry. Another fault is that so few representative tests were made.

The speeds of waterfowl have been tested by airplanes. One statement makes the heavy, comparatively slow canvas-back duck fly faster than the pin-tail, which is generally considered swift; it also gives the canvas-back a speed 25 percent faster than the mallards, which is altogether absurd.

Automobiles, the speedometers of which are quite accurate, meet the need of even more convincing tests of bird flights, if by rather rare chance while touring country highways birds will fly parallel with the road, even for short distances. Some few such tests that were made agreed with those made on the Texas coast and complement them. With the car going at about 20 miles an hour along a creek road, a little green heron kept with it for a short distance, and I doubt whether it could have improved its speed. Traveling parallel to a wide slough at about the same rate permitted two wild ducks of a species not ascertained, because they were beyond a line of trees and 50 yards away, easily to exceed the speed of the car.

On a road at over 40 miles an hour we kept right along with a lone duck,

probably a black duck, flying overhead. A driving speed of 30 miles an hour between meadows in southern New Jersey permitted a kildeer plover to draw ahead of the car, and only at a 45-mile speed could the bird's rate be equaled. The kildeer is built like the willet and probably few birds can fly faster. At this same place and speed a spotted sandpiper, springing from a ditch beside the road, kept easily with the car for several yards before veering off.

At a 30-mile speed, sparrows, bluebirds, meadowlarks, and robins are passed. Flickers and red-headed woodpeckers can barely keep up with a 25-mile rate. Once, going at 35, a sparrow hawk, while making an effort to surprise a flock of domestic sparrows dusting in the road far ahead, raced the car. The falcon kept about 40 or 50 feet in front of us, dashed over a hedge, seized a sparrow and went on. An acceleration to 40 miles an hour caused a slow gain on the bird of prey until it turned suddenly off. This is the most complete test I have made.

GOING at a 50-mile speed keeps pace for a few yards with chimney swifts skimming rapidly over fields and with barn swallows passing back and forth across the road and low beside the car. But such tests are somewhat uncertain because of erratic flights and the short distances in which the birds, often frightened, really race with the car.

The speed of certain birds of prey is greatly exaggerated. I have seen across a narrow mountain valley a ruffed grouse keeping well ahead of a pursuing goshawk until a thicket of laurel was reached into which the grouse dived safely. In exactly the same manner I have seen a bobwhite hold its own against a sharp-shinned hawk until bob dropped into some briars.

I once saw a duck hawk stoop from a very short distance overhead that gave it little momentum and dash at a running plover. The plover started from scratch and with comparatively great speed made that falcon, the boasted "speed king of the air" (of the nature fakirs) look silly. It is only when falcons dive from a great height that they attain tremendous velocity. But I have twice observed duck hawks stoop at ducks and fail to strike; the bird of prey did not follow when the intended victim made off at right angles to the hawk's direction. In one instance the missed meal was a black duck, in another a green-winged teal. I have also seen the duck hawk employ the same method in an attempt to punish a crow that, a few minutes before, with several companions, had harassed the hawk. Failing at this, the hawk tried to overtake the crow in a straight-away, but again failed. I believe the hawk knew in each case that the chase would be futile. Contrary to common impression, the crow is by no means slow; it commonly overtakes the buzzard hawks in the air, and even the kingbird has to speed up to overtake a crow. [It seems quite probable that some birds which fly with rapid wing strokes may thereby create a misleading impression of speed, while some with deliberate strokes may thus give the impression of low velocity. Possibly this has even been the largest factor involved in the traditional mis-estimation of bird speeds.—*Ed.*]

As does the puma, hawks generally depend upon a swift dash from behind, that is not at once observed by the intended victim which is often pursuing its deliberate way within a flock of its fellows. Domestic pigeons are sometimes captured in this manner. I am convinced that it is safe to say that in a straight-away flight no hawk is swifter, nor indeed as swift, as the mourning-dove, nor any of the snipe and sandpiper family. This statement is derived from numerous personal observations.

When Professor Fisher found the remains of chimney-swifts, juncos, warblers, and doves in the stomachs of falcons it can be safely asserted that the victims were either young or injured birds. I have seen a sharp-shinned hawk—and I would wager it was an inexperienced young one—dive to intercept a barn swallow and be avoided with the greatest ease.

But if we wish to seek for the swiftest of all birds, I beg that the hummingbirds be considered. It is but necessary to note their straight-away dart across a sunlit meadow as far as the tiny creature may be seen for this opinion to be held.

I THINK that rapidity of wing stroke, combined with the length of the stroke, commonly determines speed. A variation in individuals may be observed, as with the kingbird and the meadowlark. The average stroke of such larger, slower birds as the herons, pelicans, spoonbills, gulls, ibises, and the buzzard hawks, as far as can be ascertained from many dim photographs, is between 70 and 80 degrees, and the strokes may vary in number from three to four per second—perhaps four or five in crows which, because of their better speed, are alone an exception to this rule.

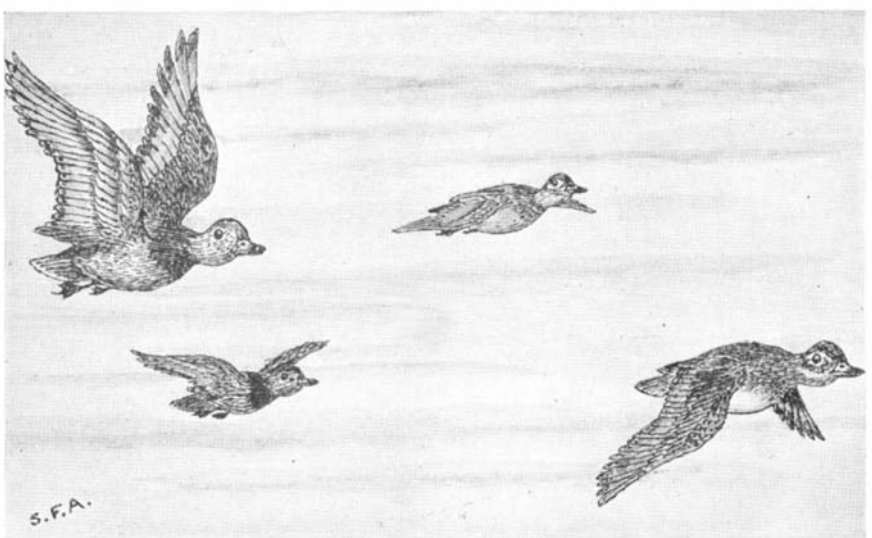
With the faster ducks, geese, and swans the wing stroke is at least 100 degrees and more rapid than five or six per second. In the true swallows the strokes are slow, as compared with most other small birds, but consist of very great and powerful sweeps apparently all of 150 degrees in vertical extent. With the shore birds and plovers, all apparently much alike, the rate of the strokes is not countable, but they cover at least 120 degrees, often greater.

Yes, bird flight speed has perhaps been exaggerated; further study of the subject is indeed indicated.

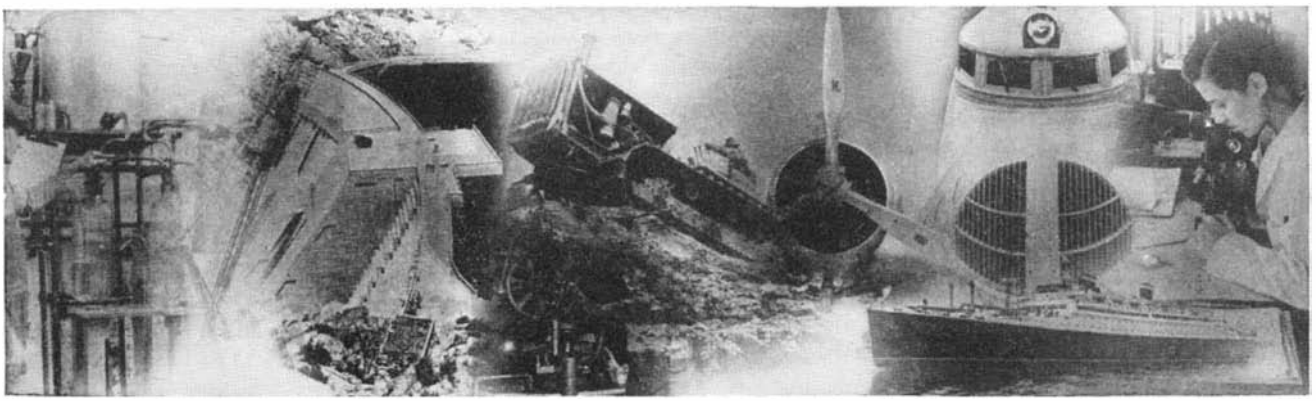
●

As so aptly put forth in "Flight Speed of Birds," Circular Number 428, United States Department of Agriculture, the often over-estimated speeds of game birds in particular may be at least partly laid at the door of the gunner who, to assuage his wounded vanity, estimates that the bird he missed must have been flying at a speed "of 100 or even 150 miles an hour."

Readers who desire to pursue farther the absorbing subject of the speed at which birds fly, having had their appetites whetted by the foregoing article, will do well to obtain a copy of the above mentioned circular, procurable from the Superintendent of Documents, Washington, D. C., for five cents in coin. Here they will find a careful compilation of data obtained from various sources, some details of the methods of measuring bird speed, and a tabulation of speeds of various birds. The complete bibliography included will be invaluable to the nature student.—The Editor.



Red heads, showing the extent of wing stroke—about 100 degrees



THE SCIENTIFIC AMERICAN DIGEST

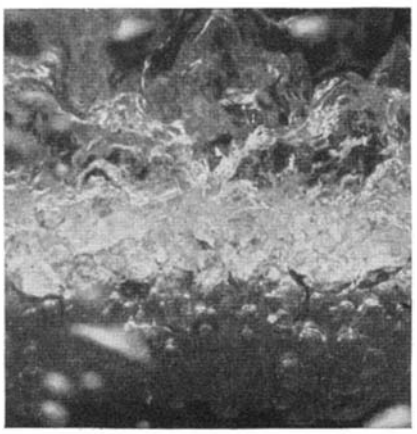
Conducted by F. D. McHUGH

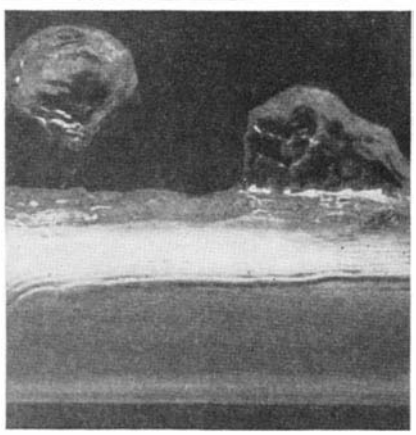
Contributing Editors

ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University
D. H. KILLEFFER
Chemical Engineer

How Hot is Hot Enough?

THE surprising answer to this question is confirmed by the two accompanying, high-speed photographs of ethyl acetate boiling at atmospheric pressure. When a drop of water falls on a red-hot stove and skims merrily over the surface instead of bursting immediately into vapor, it is dancing on an insulating film of steam. If the stove were cooler, the insulation would be less, the vaporization quicker.





Researchers in the Department of Chemical Engineering of Massachusetts Institute of Technology have shown that the same principle applies to the heating of liquids by hot pipes immersed in them; if the pipes are too hot, the heating of the liquid will be less efficient because vapor films form around the pipes, which retard the heat transfer.

In the upper picture the steam-heated aluminum tube is 73 degrees Fahrenheit hotter than the surrounding ethyl acetate, and the heat transfer rate is 41,000 B.t.u. per hour per square foot. In the lower picture the temperature difference is much greater—104 degrees Fahrenheit—but the heat transfer rate is much lower: 5800 B.t.u. The reason is visually apparent: The hotter tube below is coated with an insulating film of vapor. The researchers at Technology, working under the direction of Professor W. H. McAdams, '17, have found that the temperature difference at which maximum rate of boiling occurs is small for many liquids.

An understanding of such principles of heat exchange is important to many industries that employ boiling of liquids—in the separation, for example, of petroleum products by fractional distillation, in the concentration of acids by evaporation, or even in the quenching or tempering of metals by plunging them at red heat into a bath of water or oil.

This data supplied by E. T. Sauer, and the photographs (exposure 1/100,000th second) by W. B. Tucker—used by courtesy of *The Technology Review.*

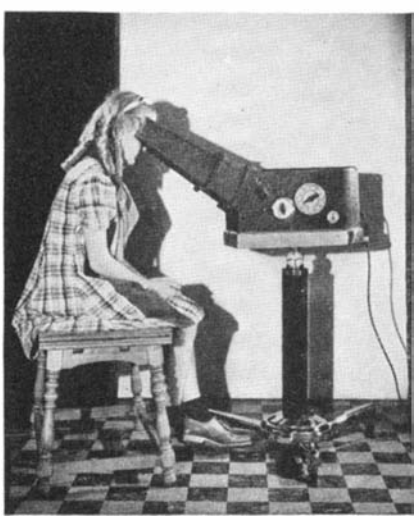
CHROMIUM

THE metal chromium gives to the emerald its rich green color, to the ruby its red, and to the sapphire its blue.

Vitamin A and Dim Vision

IN the retina of the eye there is a substance called visual purple, which is bleached by the light coming from objects at which we look, but is constantly being regenerated. Recently it has been discovered that this regeneration is derived from vitamin A. Persons who are short on vitamin A do not regenerate enough visual purple, and so they see poorly in a dim light. Many of these are motorists whose dim vision has puzzled them. Now comes an instrument for measuring vitamin-A deficiency by means of visual purple. According to the Frober-Faybor Company, Cleveland, manufacturers of scientific instruments, the bio-photometer test for vitamin-A deficiency is based on the well known fact that the reserves of vitamin A in the body influence the rate of regeneration of visual purple. Upon exposure to bright light, visual purple is bleached more rapidly than it is regenerated, accompanied by reduced light threshold. When the eyes are rested in the dark, regeneration of visual purple takes place, the light threshold reaching an optimum level dependent upon the reserves of vitamin A available. Characteristic differences in the rate and extent of regeneration of visual purple in subjects more or less vitamin-A deficient give a clinical test for even mild and progressively more severe vitamin-A deficiency.

In its simplest essentials the bio-photometer test is made as follows: At the beginning of the test, the visual threshold of the patient is determined in millifoot candles with the bio-photometer. Next the patient rests the eyes in the dark for a standardized period of time. These readings are for the purpose of minimizing variables in environmental lighting prior to the test and to familiarize the patient with the procedure of the test and the appear-



Measuring vitamin-A deficiency

ance of the variably illuminated test spots.

Next the eyes are exposed to a bleaching light of standard intensity for a standard length of time. Then the bleach light is shut off and a series of readings is made which indicates the rate and extent of regeneration of visual purple.

Since the rate of regeneration of visual purple is influenced by the availability of vitamin A in the system, it follows that ingestion of vitamin A should result in improvement in the rate of regeneration of visual purple. Such is the observed fact. The ingestion of supplementary vitamin A is followed by improvement in rate of regeneration of visual purple until a level is reached which may be taken as the optimum for the subject.

PEARLS

FOSSIL oyster shells in three collections in Germany have been found to contain three embedded pearls. As the age of the shells is estimated at 150 million years the pearls are probably the oldest in existence in the world.

Rotary Compressor for Air Conditioning

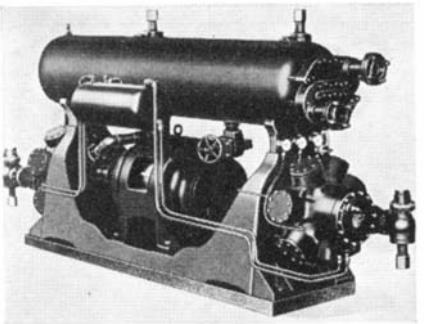
A MAJOR engineering achievement that holds promise of greatly improving air-conditioning practice was announced recently in New York City. The new development is a complete line of high-speed compressors that turn up 1750 revolutions per minute, utilizing for the first time the radial principle of design—cylinders placed in a circle around the crankshaft. The new development was made by Airtemp, Inc., air-conditioning subsidiary of Chrysler Corporation.

The new units incorporate the same principle of design as that adopted by aeronautical engineers to eliminate motor failure in airplanes and to increase the motor capacity in proportion to weight. Exhaustive tests and months of performance under all sorts of operating conditions—in actual commercial air-conditioning installations—confirm the advantages of the new compressor, it was stated.

"The compressor is the heart of any air-conditioning system," it was pointed out by Colonel A. C. Downey, President of Airtemp, who discussed his company's new development. "Upon the efficiency of the compressor depends the efficiency of the entire air-conditioning system.

"These new radial type compressors, which are built in sizes from 10 to 75 horsepower capacity for commercial installation, possess many practical operating advantages. In the first place, they are far more dependable."

The new radial compressors greatly simplify problems of commercial air-conditioning installation because they are light in weight, compact in size, and entirely free from vibration. They can be installed in practically any part of a building, according to C. R. Neeson, Airtemp's Chief Engineer, who directed their development.



"These radial compressors require no special foundations," Mr. Neeson stated. "The ordinary air-conditioning compressor for commercial installation—due to its weight and vibration characteristics—has to be placed in the basement of a building, on a specially constructed foundation. Basement space is valuable, and Airtemp radial compressors are designed for space-saving installation. Another important engineering feature of the new radial compressor is its perfect dynamic balance.

"Another feature of these compressors which contributes to more efficient operation is the use of auxiliary intake ports at the bottom of each cylinder. These ports are opened by the piston itself, as it completes the downward stroke. The use of the auxiliary ports accelerates intake and thus increases efficiency."

Above: **A close-up of the rotary air compressor, and,** *left,* **the compressor assembled with the other parts of an air-conditioning installation**

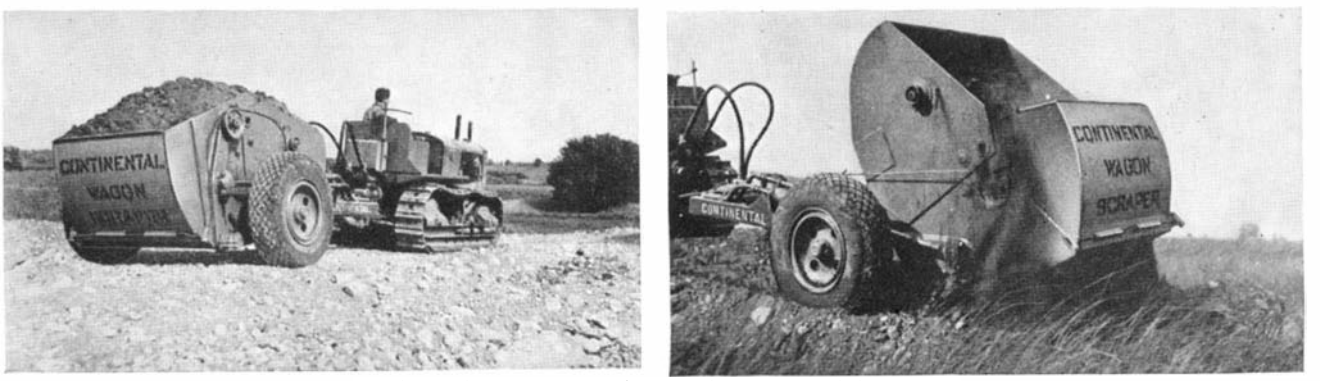
Meringue from Soy Beans

WHEN soy-bean flour which has been completely freed of oil by solvent extraction is dissolved in water, the resulting solution can be whipped into a stiff white foam greatly resembling egg white. Since protein in the form of soy meal costs only about 1/10 as much as protein in the form of eggs or milk, which it resembles dietetically, research has been directed toward its use to replace these more expensive foods. The whipping quality of soy meal is destroyed by the presence of fats and by the treatments used in the past to eliminate its raw bean flavor. Complete removal of the fat or oil by ethyl ether or petroleum ether and deflavoring by heating in a vacuum to 130 degress, Centigrade, leaves the meal with a high whipping characteristic. Advantages of the extracted soy meal over egg white are its cheapness, its keeping qualities, its ease of standardization, and its high concentration as compared with egg white, so that it may be whipped with many liquids. Its use is suggested in frozen desserts made in the electric refrigerator, with gelatin and cooked starch in whips, sponges, and molded desserts, and with cooked sugar in confectionery. Replacing egg white in baked dishes which depend upon the ease of coagulation of egg protein seems yet doubtful until new methods for using the soy protein are developed.—*D. H. K.*

New Four-Yard Scraper

A NEW four-yard wagon scraper known as the "Junior Continental" has been announced by the Continental Roll & Steel Foundry Company. Designed for use with smaller 35 to 50 horsepower crawler tractors, the new four-yard model is the same in general design and operation as the larger Continental models.

The manufacturers claim that their new four-yard wagon scraper is light in weight without sacrificing the ruggedness necessary to dig, load, and haul capacity loads of



Hauling a load in the new four-yard scraper, and dumping it

tough clay, rock and tree root imbedded soil, shale, hardpan, and so on.

Other features of this Junior Continental are high axle clearance, a large fast-dumping rear gate, the new Continental BE-GE hydraulic power-control unit with adaptors for all tractors of 35 to 50 horsepower, shorter overall length for easier turning, and a wide cutting blade, the width of cut being the same as that of the five-yard size.

Resins for Water Softening

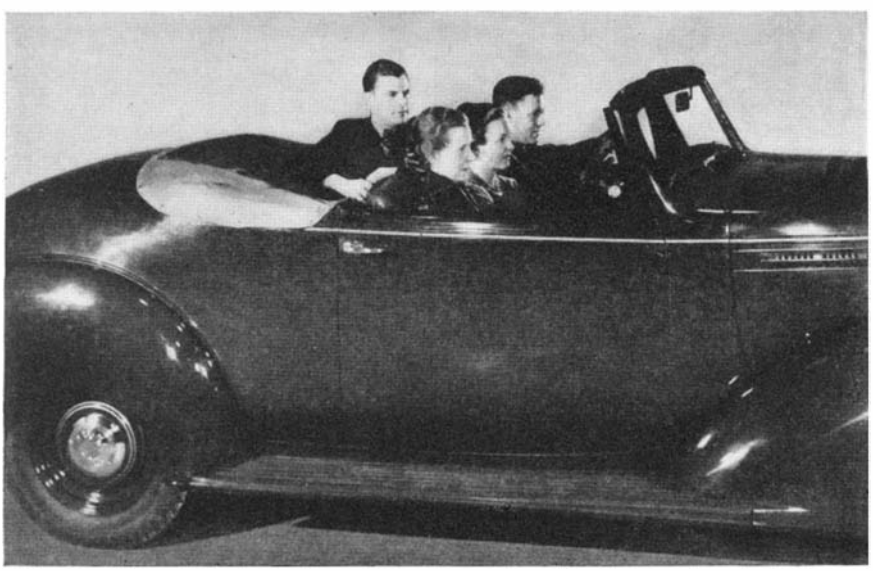
SYNTHETIC resinoids having the property of exchanging sodium for calcium and magnesium in water are being increasingly used for softening hard water in Great Britain. The resinoids are made by the reaction of phenols of the tannin group with an excess of formaldehyde. When these resinoids are placed in water containing lime and magnesia they combine chemically with these elements, thus softening the water. The resin is regenerated by passing a strong solution of salt over it. Tannin resinoids leave the water acid in character and to offset this a second treatment with a basic resin made by condensing polyamines with formaldehyde is applied. This water-softening property of resinoids is similar to that of the mineral zeolite used in the United States for a similar purpose. —*D. H. K.*

ELECTRICITY

AIR passengers may, in the future, find that they can use on airplanes standard household electrical appliances. This is in line with the prediction that airplanes will be equipped with 110-volt service soon.

Transverse Seat

THE transverse extra seat as used in several models of the Hudson line of motor cars is reported to be proving very popular. Introduction of the extra seat behind the regular front seat does not cut down the baggage space at this point, for when the seat is unoccupied there is room for large parcels and even a couple of suitcases or golf bags. All in all the seat is a success from every standpoint and the passenger who rides in it is really "one of the party."



The transverse seat behind the front seat has many advantages

TRANSPORTATION SECTION

Fire-proof and safe is this new all-steel ferry

65 Foot Greenwich Ferry Boat

THE Town of Greenwich, Connecticut, is the fortunate owner of Little Captains Island, a wooded sand bar about two miles off the Greenwich shore in the open waters of Long Island Sound. The town has a municipal park on this island, with numerous bath houses, restaurants, and other concessions that go to make up the success of such a recreation spot.

From 2000 or 3000 people visit the island daily during the pleasant summer weather and it is quite a problem to transfer these people from the mainland to the island and back again with safety and dispatch, yet at reasonable cost. For many years the town used a 65-foot wooden ferry boat but the demands of the service have become so great that last winter town officials advertised for competitive plans and designs for a boat not over 65 feet in length to meet the growing needs of this traffic. The result of the competition was that the Luders Marine Construction Company, of Stamford, built a unique craft, quite different from the orthodox type of ferry boat. The principal feature, of course, was safety and the designers elected to offer an all-steel vessel of arc-welded construction, 65 feet long, 26 feet beam over the guards, 5 feet draft, and subdivided into 10 watertight non-communicating compartments to insure the last degree of safety.

The contour of the boat is like that of a blunt sadiron, the bow circular and the stern almost square. With the numerous subdivisions in the hull, it is almost inconceivable that grounding or collision could damage the boat to the extent that would prevent her from making shore in safety.

To eliminate the fire hazard, it was decided to make the boat Diesel-propelled, and a twin-screw installation of Superior Diesel engines is used, each engine developing about 45 horsepower which gives the boat a speed of about 8½ knots. A reduction gear on the motors with a ratio of nearly 4 to 1 permits the use of large propellers so that backing and maneuvering is most positive. To improve the handling, the boat is equipped with two rudders which enable her to dock in the extremely small spaces available at the Greenwich end of the run.

This little boat with her unique design unquestionably marks a distinct step forward in the art of designing small passenger vessels. It has what is called a modified Vee bottom, on the shape and details of which the designers have applied for a patent. The model is not only an unusually seaworthy craft but is easily driven and lends itself to inexpensive construction.

Parking Meters

THERE are approximately 14,300 parking meters now installed along the streets of 28 United States cities. While metered parking is new, the principles involved in decisions concerning its legality are of long standing. One type of city street

benefit to abutting property is in the provision of access, light, and air. The other use is for movement of people and vehicles, water, light and other utilities. Parking, therefore, or the right of access, must be so regulated that other rights are not infringed upon. Several decisions have been rendered in recent cases involving municipal ordinances which provide for the setting up of permanent meters at street curbs and the collection in this way of a small fee for the use of these spaces for limited parking privilege.

Cases in Oklahoma, Texas, and Florida involving claims of the motorist that parking meters create an illegal obstruction to traffic were overruled. In Alabama the owner of land abutting on such a parking space brought suit on the grounds that the right of access to his property from the street was obstructed, and the ordinance was held void. The Alabama Supreme Court outlawed parking meters on the grounds that they constitute "an unauthorized use of the taxing power." A thorough study by the justices of the Massachusetts Supreme Court, however, has resulted in the opinion that a parking meter statute properly worded would be valid, and valid ordinances might well be passed under it. This opinion is expected to be of influence in other states.

To date legal opinion indicates that parking meter ordinances are reasonable if properly drawn: the spaces allotted must be suited to the streets, the traffic, and the needs of the abutter, and the charge must be no more than sufficient for the purpose of regulation; it cannot be imposed as a source of general revenue.—*Highway Research Abstracts.*

FUTURE CARS

THERE will be just as many improvements made on automobiles in the future as there have been in the past, Charles F. Kettering believes. These improvements must come slowly, however, for, he says, "if we knew what the car of 10 or 25 years ahead was going to look like, I believe we would be making it now."

AUTOMATIC INSPECTION MACHINE SEES, HEARS, FEELS

A TIRELESS automatic machine, which "sees" better than a hawk, "hears" better than a hare, and with a sense of "touch" infinitely acute, has been placed in operation at the Ford Rouge plant for inspection of the valve push rods—small, accurately finished engine parts.

The uncanny device, which utilizes photoelectric cells and radio amplification to work its wonders, inspects valve push rods for hardness, hidden fissures, and accuracy of dimension. Ford V-8 standards demand precision to one ten-thousandth of an inch. The machine performs 11 distinct operations so rapidly that 42 push rods are inspected each minute. Those which do not meet rigid specifications are rejected.

First the push rods are checked for hardness. An automatic scleroscope works in connection with an "electric eye." A diamond tipped weight drops on the push rod.

If the hardness is correct, the weight rebounds to a predetermined height, intercepts a light beam, and the electric eye actuates a mechanism which passes the push rod. Push rods that are not hard enough are rejected.

In the second operation, a hammer strikes the side of the valve push rod. By "listening" to the pitch and duration of the resulting sound, the machine determines instantly whether the push rod structure is without defect. A hidden fissure will curtail the period of sound vibration. A microphone and amplifier are part of the inspection mechanism at this test station.

Then follow nine other successive inspections to determine accuracy of manufacture. The first is for squareness of the bottom face of the push rod. Here the maximum variation permitted is one thousandth of an inch. Next the part is measured for roundness, with variation held within three ten-thousandths of an inch. Squareness of the top is gaged and, in this case, the limit is five ten-thousandths of an inch. Following this, automatic fingers enter the slots in the sides of the push rod to check for minimum wall thickness. Two steps gage the diameter, first at the center and then at both ends. These measurements must be within five ten-thousandths, the specified dimensions. In the final three stations, the parts are measured for length and sorted automatically into seven groups, with only one thousandth of an inch variation between groups. The seven groups are classified and stacked in boxes as follows: First group, undersize below allowable limit and are scrapped; second group, under standard size .002 of an inch; third group, under standard size .001 of an inch; fourth group, the standard or mean length; fifth group, over standard .001 of an inch; sixth group, over standard .002 of an inch; and the seventh group is over allowable limit and is reground. Approximately 85 percent or better run to the standard or mean length.

(End of Transportation Section)

Insulin Saving Mental Cases

NOT many months ago, the mental disorder known as dementia præcox, responsible for a large share of the sick minds of the world, was a hopeless condition. Now, thanks to researches here and abroad, medicine seems on the verge of curing this ill in a large majority of the cases if they are caught early enough.

Insulin, the gland extract that makes life possible for thousands of persons suffering from diabetes, is the stuff that is rescuing other thousands from the living death of insanity. The total number of such cures is now well over 1000, and apparently is increasing every month, reports *Science Service*.

The new method of treating dementia præcox was discovered by Dr. Manfred Sakel of Vienna, Austria. It consists in giving large doses of insulin to produce a state of shock. In treating diabetes, small doses of insulin are given, and the physician is careful to avoid producing shock or coma, which may end fatally.

A fatal outcome is the chief danger of the insulin shock treatment for mental disease. Physicians and nurses stand by while the patient is undergoing treatment, ready to give sugar at just the right moment to

snatch the patient from death and back to sanity. The shock is allowed to continue from one to three hours, depending on the effects produced, and a series of insulin shocks are necessary to achieve the cure of the mental disease.

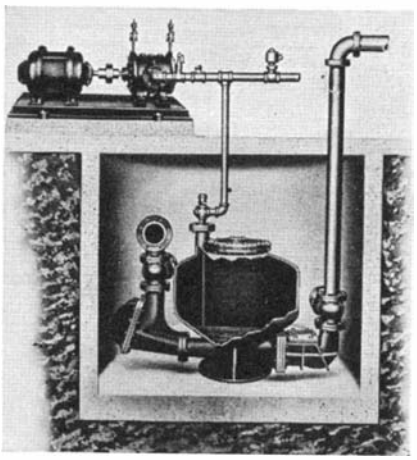
Why insulin shock restores sanity in some cases is not as yet definitely known. In diabetes, insulin saves lives by enabling the patient's body to burn sugar from food in a normal manner. In dementia præcox, Dr. Sakel believes the gland extract acts by isolating short circuits in the brain which are responsible for the mental disease. When scientists finally discover how insulin shock works to cure the mental disease, they will, it is hoped, have an explanation of what causes this mental ailment.

INSECTS

CERTAIN insects know the position of their limbs by tiny hairs on the leg joints which are bent as the insect moves. Human beings and other vertebrates "feel" the position of legs and arms by muscle position.

COMPRESSED AIR SEWAGE PUMPS

PNEUMATIC ejectors for pumping sewage or the sludge from manufacturing operations from low points into higher drainage canals or pipes are not new. The first such machine using compressed air as the lifting agent was built some 50 years ago by Sir Isaac Shone. In principle this is remarkably simple. Essentially such an ejector consists of a tank into which the sewage or sludge is poured; as its level



Electrodes in the sewage tank operate a relay which starts a pump

rises, metal bells rise and when the pot is filled these bells open a valve to admit compressed air. This pushes the sewage down and out of the pot, up the discharge pipe, and past special check valves which prevent it from flowing back into the inlet pipe.

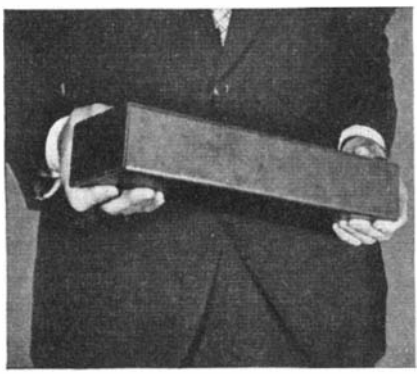
A new pneumatic sewage ejector developed by Yeomans Brothers Company does away with all moving parts within the collecting tank. The design is basically the same as others that have been used for years except that two stationary electrodes set into the sewage tank control a relay which actuates an air valve allowing the proper air volume and pressure to enter the pot. All

moving parts have been removed from the pot. Such an arrangement obviates entirely the possibility of clogging; the device literally "works without works."

Modern cities, in addition to industrial plants, often have use for such equipment. The deep basements under all large buildings are practically always lower than the sewer mains and in such cases it is necessary to use pumps or ejectors of some kind to lift the sewage up into the mains whence it will flow by gravity to the sewage disposal plant.

Life of Furnaces Aided By Steel-Jacketed Brick

METALLURGICAL furnace walls subjected to corrosive slags at temperatures as high as 3000 degrees, Fahrenheit, are said to gain added strength and service



One of the steel-jacketed bricks

life when constructed of an improved refractory brick known as H-W Improved Metalkase Brick. After being molded to accurate size under very heavy pressure each of these bricks is encased (on three sides) in a form-fitting jacket of mild steel.

In the furnace wall or lining, the bricks are laid as "headers," so that each brick is steel enclosed, except at the ends, to form a complete lattice of steel interlining the wall. At operating temperatures, the edges of the steel jackets adjacent to the heated face oxidize and melt, fusing with the brick itself to form a solid, highly-resistant interior surface. However, a short distance back from the heated face, the steel remains intact, adding greatly to the spalling resistance of the brick, and to the internal strength of the entire structure.

Formerly, the high temperature limits permissible and great resistance to corrosive slags obtainable with magnesite brick could not be freely utilized in many furnace applications, because of the limited physical strength of magnesite. The new brick is said to overcome this weakness, meeting "slag-line" conditions in open hearth and electric steel furnace walls, as well as the severe requirements of linings for cement and dolomite kilns, and the like.

"Printing" Fabrics

FUTURE textile fabrics may be truly synthetic from the beginning, not simply made by the disintegration and reformation of fibers of plants, and the process of weaving itself may take second place as a method of making these synthetic fibers into useful clothing, according to Joseph F. X. Harold, writing in *Industrial and Engineering Chemistry*. Tomorrow's

clothing may even be made, from synthetic resins, by the aid of a process of photo-engraving which will avoid the tedious processes involved in present textile methods.

"Much is being done in developing fibers from synthetic resins that shall have the required strength and elasticity for enduring wear," Dr. Harold said. "It is highly probable that in the near future we shall have rayons that are truly synthetic, that do not require the destruction of wood or cotton to make fibers, and that rely on no vegetable or animal sources but are chemical in all phases involved in their manufacture."

As showing the way to tomorrow's textiles, Dr. Harold described a method of making continuously a web simulative of the woven fabric known as tulle, which has been applied in the past, and points out how improvements in other directions may make this art feasible for broader application in the future. "Viscose or other rayon-making solution was poured upon a copper cylinder in which a mesh was deeply engraved. The cylinder rotated past a scraper knife and met a coagulating spray. On further turning, the weak but continuous net was doffed, carried off on a belt, washed, and dried. A good volume of business was done in the article. By suitable engraving of the cylinders the most attractive patterns in fabrics with lace and embroidery effects were possible, and by incorporating conductive graphite in the rayon mixture the entire fabric could be plated until the textile was a firm, metallic mesh of any weight desired or of any metallic composition. One can well imagine the beauty of Irish or Valenciennes lace given the adornment of three or four contrasting metals and a new endurance and solidity for fire or window screens, wall dadoes, or wainscotting. When the ideal synthetic resin comes, there may be the suggestion of the fabric of the future, made on the instant, as fast as textiles are printed. It would need no loom with its troublesome tedious beaming, drawing in, arranging the box motion, or cutting the Jacquard cards. With the speed of the photo-engraver which the American hunger for news has rendered unsurpassed, milady's dress would not only boast of beauty but of the actuality of news itself. She would be clothed not merely in the *dernier cri* but in the 9 o'clock edition!"—*D. H. K.*

EXPLODING OFF THE BARK

AN ingenious new use for explosives has been reported by foresters who have developed a quick and easy means of stripping insect-infested bark from pine trees. It was a slow and laborious process to strip such trees of their bark by hand until an explosive blasting fuse known as Cordeau was brought into play. Now, however, by a method as simple as it is effective, the task has been facilitated greatly.

Cordeau is a pliable lead tube about one quarter of an inch in diameter in which is enclosed a core of trinitrotoluene (TNT). For many blasting purposes it often is used in place of an electric current to explode practically simultaneously successive charges of dynamite. When a line of Cordeau is detonated at one end, the explosive impulse is transmitted through the entire length of this lead-enclosed fuse at a speed of about three and one-third miles a second.

Although the speed of Cordeau establishes

it as one of the fastest transmitters of controlled impulse, next to light and electricity, its core of TNT cannot, however, be set off by friction, fire, or by any ordinary shock. This factor of complete safety has made Cordeau of extraordinary value in the preservation of bark-infested pine forests.

Any woodsman, however unaccustomed to the handling of explosives, can be entrusted with the spiralling of a Cordeau tube about an affected tree. Later, when the spiral of Cordeau has been detonated by a blasting cap, the bark of the tree will be scored and peeled off in strips which can be burned to prevent the breeding of such insect life and eggs as were not destroyed by the blast itself.

"DOGS"

ONE and a half billion hot dogs —wienies—frankfurters—or whatever you call them—are produced annually in the United States alone. This production calls for over 100,000 miles of natural sausage casings.

Diesel Engine Jet Injury

AN entirely new type of industrial injury may be charged against certain types of Diesel engines. The danger is due to the very high cylinder pressures at which Diesel engines operate.

A California motor mechanic has recently had to have one finger amputated following an accident in which fuel oil escaping under high pressure penetrated the skin and led to dry gangrene.

The *Journal of the American Medical Association* tells of the industrial hazards caused by the introduction of high pressures in industry. The severity of these accidents is dependent upon the character and quantity of oil and upon the pressure under which it is introduced into the tissues, states Dr. C. E. Rees of San Diego.

The case Dr. Rees reports is that of a mechanic who was testing the jet of a Diesel engine. He was holding the jet, which he had removed from the cylinder head, about one inch from the tip of his right middle finger when he tripped the valve. Oil was forced from the jet into his finger at a pressure estimated to be about 4000 pounds. Intense pain, high temperature, hospitalization, gangrene, amputation—these were the aftermath of the accident. It was eight weeks before the hand healed.

Dr. Rees is of the opinion that, in the case of such accidents, a liberal incision should be made over the injured area to permit the irritant oil to escape.—*Science Service.*

Crackproof, Ever-Plastic Caulking Compounds

IT is easy to realize how viciously destructive water can be if we recall the destructive floods of recent years. But few stop to think of the untold damage resulting from almost trivial and intermittent leakage through minor fissures, cracks, joints, and seams. For centuries, nature has defied man's efforts to protect and give long life to the structures he builds.

(*Please turn to page* 306)

TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

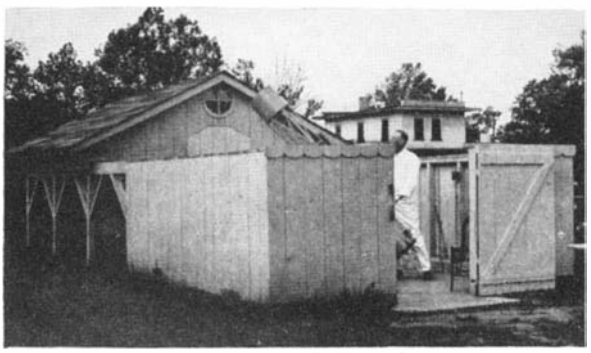


Figure 1: **Jones' straight-line observatory**

OBSERVATORIES built by amateur astronomers who have also made their own telescopes is the main course of this month's fare. They are all neat and attractive additions to the yards, landscapes, and house tops to which they have been added—therefore sure to impress the assessor on his next round and win a rise in tax assessment. Perhaps we seem cynical.

The first two are the straight-line type listed by Scanlon in the table of types at the end of his chapter on observatories, in the new book "Amateur Telescope Making—Advanced."

THE one in Figure 1 was built by Clarence T. Jones, architect, 210 Glenwood Drive, Chattanooga, Tenn., to house his 12″ Newtonian. Two months ago we also published a description of a 20¾″ Cass and observatory built by Jones and his sons Arthur and Bruce, with Paul Lewis, secretary of the local Barnard Astronomical Society. It now appears that Barnard was a native, not of Chattanooga, as was then stated, but Nashville, but that there are Barnard Astronomical Societies in both cities.

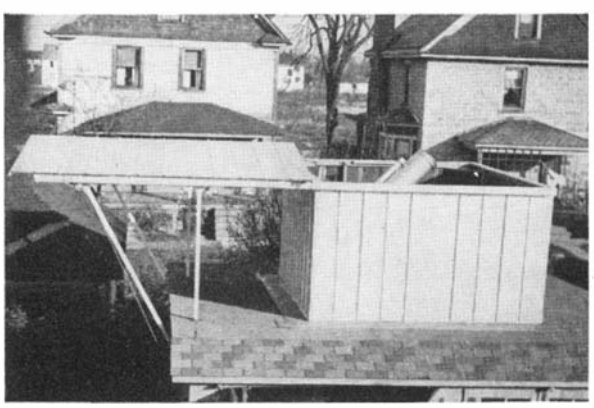


Figure 2: **Mason's garage roof garden**

ASCENDING one flight we reach the "penthouse" observatories, the one in Figure 2 being the work of William Mason, 1303 Lakeview Ave., Lorain, Ohio, author, by the way, of the chapter in ATMA on molding and casting forks for telescope mountings (p. 361). Mason says of his observatory: "I built it for my 12″ telescope [the one shown in ATMA, same page—*Ed.*], and it is 10′ by 10′ by 6′2″ and 6′8″—the two heights given being due to the slope of the garage roof on which it is built. The covering is '3V' sheet iron painted with aluminum paint. The telescope is mounted on a base of 12″ seamless pipe filled with sand to lower the vibration period. No part of the garage or observatory touches it. Before I built it I thought I would like this type better than a dome; now I *know* I like it better."

ANOTHER penthouse observatory atop a garage is that of Charles A. Morrison, 39 Radcliffe Road, Rochester, N. Y. (Figure 3). He sends no description but the photograph suffices. The dome is 7′ in diameter and is made of galvanized iron.

AMONG the trials and tribulations of an amateur astronomer, moving an observatory is not a common difficulty. However, B. Topham, 105 Regent St., West Toronto 9, Ontario, Canada, moved a second-hand one by truck across Toronto. It measured 10′6″ in height and 10′3″ in diameter and appears to have proved about as difficult to transport as an armful of eels. First, it had to be hoisted in two parts over a 10′ fence and deposited on the truck. Next, before it was scarcely started, it encountered two houses bordering a driveway, which gave a space only 9′ wide. This impossibility was surmounted and then came an underpass which proved to have just 2″ too little headroom. To beat this hazard, the air was let out of the truck tires. Arriving at its destination the observatory could not be set in place as shown in Figure 4 until the sloping roof of a wing of the residence was removed and a flat roof substituted. Topham had heard so much about heat insulation, he says, that he packed the ceiling timbers beneath with "rock wool," then laid his observatory floor as a separate entity upon the roof beneath. Then with a chain block attached to a scaffold, he pulled the observatory up—another penthouse type—and there it sits—permanently, he hopes, after all the adventures mentioned. Perhaps it would have been easier to move the house to the observatory, but hindsight is usually easier than foresight. The dome is rotated by means of a gear working on a complete inner circle of Link-Belt chain. A ⅛ h.p. motor does the revolving.

SOMEWHERE in earth there is a Dr. Frank Welcher who built the dome shown in Figure 5. On the back of the photograph he sent are the statements that the dome is electrically revolved and houses a 6″ Newtonian, but the address does not appear. (A great many persons put their addresses only on the outside of the envelope containing their communications, but in large offices incoming mail is opened by machine and only the contents are distributed by clerks to various desks. We occasionally receive an item which, because it bears no address, cannot be acknowledged. If we failed to answer *your* letter, that may be the explanation.)

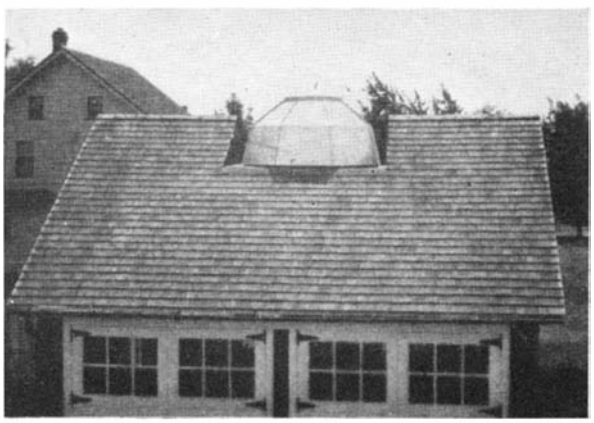


Figure 3: **Morrison's penthouse observatory**

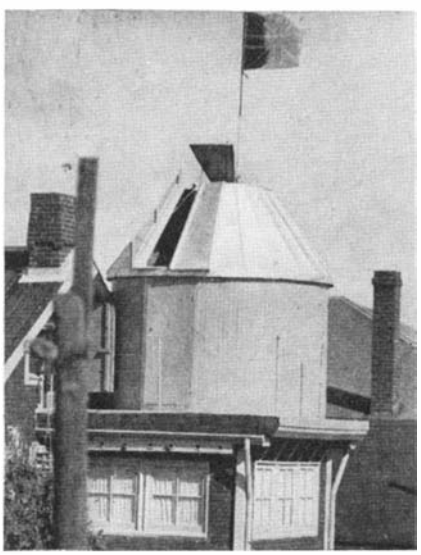


Figure 4: **Topham's top**

Figure 5: Welcher

ITS surroundings add to the attractiveness of the observatory shown in Figure 6, made by Henry E. Obermanns, 401 Hammermill Road, Erie, Pa., which he describes as follows: "It is 11′ outside diameter and 12′ total height. The dome rotates on old roller skates, with individual skate wheels to take up the side play. The shutter is in two sections, rolling back on the other half of the

Figure 6: Obermanns

roof instead of opening sidewise. Thus I can expose the apex of the roof. The slot width is 24″. The telescope is mounted on a concrete post and base weighing two tons, and is steady notwithstanding the presence of a paper mill and railroad within one block. The cost was about $100 for materials (concrete, wood, 26-gage sheet metal for roof)."

A BRIEF description and photographs of an observatory operated by two Jamestown, N. Y., amateurs who are said to be too modest to blow their own horn, is sent us by Leon Laskaris of Warren, Pa. Figure 7 shows the exterior of the dome and Figure 8 the interior. Bert Hansen, 530 Stowe St., and Marshall Hedstrom, 519 Stowe St., both of Jamestown, are the two. The observatory is that of the Jamestown Astronomers' Guild, which has about 25 members, but the local public has the use of it two nights a week. "The aforementioned pair of hardworking Swedes," Laskaris writes, "made the 10″ telescope." Microscopic examination of the original photographs of the above seems to indicate a metal roof with seams both inside and outside. The porthole in the door is interesting, and this might be a good way to dispose of astigmatized disks of glass.

THE dome in Figure 9 was made by Harold W. and Lawrence A. Cox, 47

Figure 7: Jamestown Guild

Upper Green, Mitcham, Surrey, England. "It is 10′ in diameter," Harold Cox writes, "and is built of ash hoops, slats and canvas. The opening, when the doors are fully pushed back, is 66″ wide. In the picture the doors are shown half open. We had this opening made this width owing to the spread of our camera and telescope, and if you know of anyone who is looking for fun, get him to make a dome with an opening more than half the total diameter. With such wide doors we had to make them curved in both directions, for the sake of appearance, and we also had to fit special outriggers to carry the run-off track." The illustration is dark in the lower parts but close study of the original photograph with a magnifier shows, first, the lattices which are seen in front: this is apparently a fence and gate well outside the observatory building, with a walk

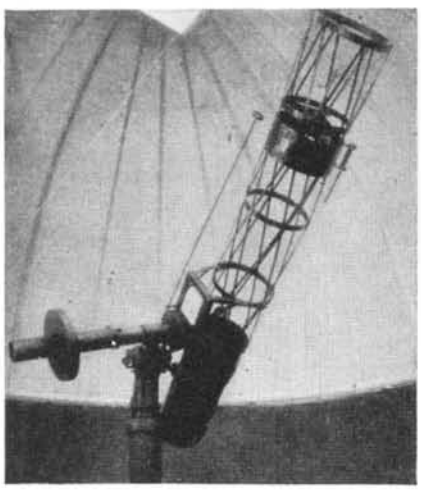


Figure 8: Jamestown, interior

between it and the building. Next, beyond this opened gate, is the low hinged door to the observatory proper and, as the dome ring above it is apparently not cut, the users evidently duck under. The 'scope mounted inside is the 12″ that was shown in these columns last month.

IN Milwaukee, at 807 East Otjen St., lives a man named Walter Houston who sends the photograph shown in Figure 10. Minikani Observatory is the property, evidently, of the Milwaukee Y.M.C.A. Houston omits to say whether he built it or not. Let's assume that he did, but was too modest to claim credit. He writes: "Dome 13′ diameter: covered with 28-gage iron. Dome frame of ¾″ pipe bent to curve; wood strips steamed to fit pipe and held with pipe clamps; iron nailed to wood strips. Wooden ring at bottom built of two layers, 16 blocks to a layer; pipe fastened to this ring with floor flanges. Building octagonal; 10″ beveled siding; eight 6″ posts set in concrete; 2″ x 6″ sill on top; stone foundation for looks alone. Horizontal strip of 18-gage iron around dome ring and extending 5″ below. Rotation afforded by roller-skate assemblies. Two sets bolted to 3″ angle iron, one for vertical thrust and one for horizontal thrust, make up an assembly. Vertical thrust against lower surface of dome ring, horizontal thrust against lower portion of the aforementioned horizontal strip of

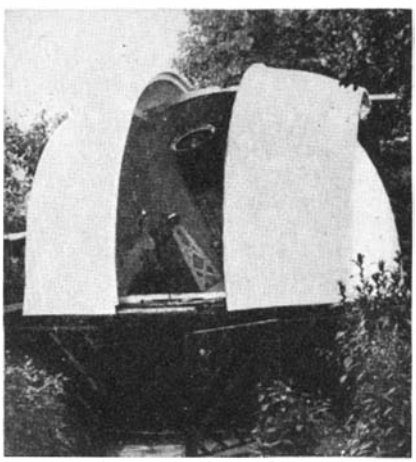


Figure 9: Cox and Cox

iron. Eight assemblies support dome. They are fastened to sill on top of posts.

"Floor 2′ off ground. Shutters operate conveniently; rollers in angle iron on bottom; barn door hanger system on top. Cost of observatory, a little over $50. Instrument, 10″ reflector; reaches 15.4 magnitude on the Harvard scale. Outside, 4″ Harvard refractor; 4″ f/16 reflector by George Knott (13 years old, the boy)."

FROM Fred Shunk, 923 Birch St., Scranton, Pa., we have the following communication. "You have repeatedly called attention to the necessity of designing rigid telescope mountings. Here is one mounting you cannot criticize on that score (Figure 11). It was devised after long and bitter experience with the usual flimsy type, and was meant to be absolutely rigid—and is; yet, in your own words, it still is none too stable.

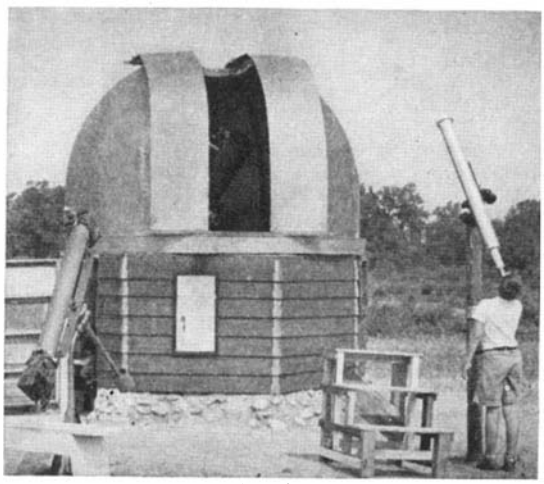


Figure 10: Milwaukee Y. M. C. A.

This photograph shows our 6″, short-focus Newtonian, driven by a concealed Diesel engine. Partly sincerely yours——" Commenting on this picture, R. W. Porter says, "I couldn't drive the idea home better myself." But we still think the tube a shade too flexible—though if used as an RFT and held in the arms, this might not matter so much.

FROM C. A. S. Howlett, 127 Lawnside Ave., Collingswood, N. J., we have the descriptive outline of a "proposed non-stop

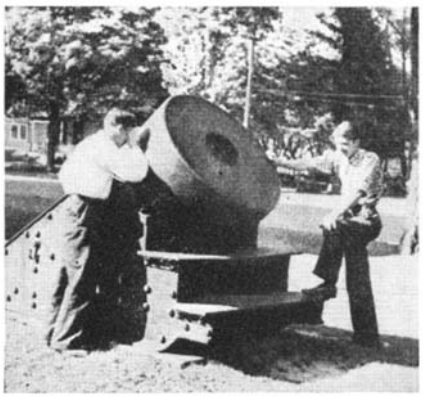
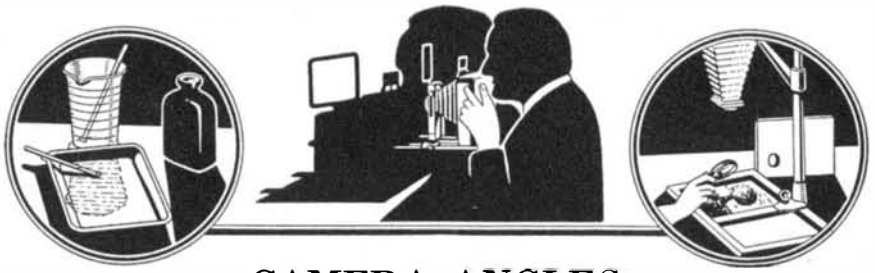


Figure 11: **The Scranton mounting**

round trip to the moon," with drawings, and with it the request that we mention it here. It turns out that Mr. Howlett, who gives illustrated talks to "resort hotels, women's clubs, student assemblies, parent-teacher associations and technical organizations" (thus saith the circular he sends) holds that the earth is a hollow sphere with the moon at the center, and he proposes an 8000-mile "stratosphere" flight encircling the moon and back to earth. In his lectures he will discuss the question of establishment of right of ownership of the moon, to increase our nation's public domain and provide fat profit for the promoters of such a trip. He suggests that the moon may be surcharged with valuable minerals. Here is a chance for the overworked secretaries of amateur astronomical clubs to date up a lecture that would, no doubt, provide *considerable* interest before the evening was over, especially if discussion followed the lecture! With a good telescope, on this system, it ought to be quite easy to watch the war in China, just across on the opposite side of the earth.

TWO items swept up in our reading: "Emery consists of minute crystals of naturally fused aluminum oxide held together by a matrix consisting largely of iron oxide."—D. H. Killeffer, "Sandpaper Grows Up," in *Industrial and Engineering Chemistry*, August, 1937. "On a clear still night the temperature trace from sunset to sunrise approximates very closely to a parabola."—Prof. D. Brunt in *Journal of Geography* (London).

THIS month we re-christen this department with a composite name. There has been no single word that would describe the telescope making hobby. The word "optics" is broader and, moreover, persons not scientifically minded usually accept this word in the special connotation of eyeglass optics. We wish some reader would cook up a brand new word that would connote the real McKay—the tenth-of-a-fringe kind of optics. (This kind superfluous in eye work.)



CAMERA ANGLES

Conducted by JACOB DESCHIN

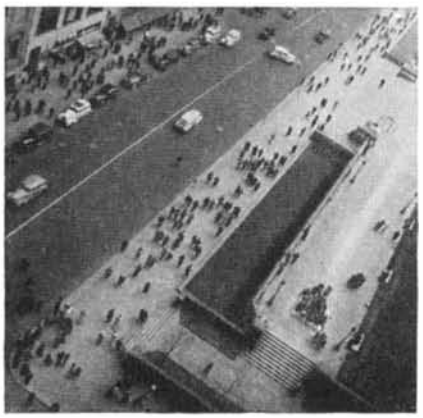
Streets Have Character, Too

IN the poetic sense, at least, there is no such thing as a dull street. If it is dull at the noon hour, when the high sun bathes the sidewalks in a monotone of harsh light, none but the impatient and unimaginative will fail to study it at other times of the day, before giving it up as a bad job, and to observe at leisure the manifold transformations of which it is capable. The photographer in search of the pictorial is often struck with pleasure and surprise at the unexpected beauty revealed in a street after many previous fruitless attempts to find something worth photographing.

You may have observed on your own street how different it looks in the morning as you leave home for the office from the picture it presents in the middle of a Sunday morning, and how varied are its aspects at different times of the year, under the influence of the various seasons and under varied lighting conditions, both by day and by night. Do not condemn your own street as lacking altogether in pictorial appeal. The grass may be greener than you first imagined.

"Old Quarter"

To grasp the essential character of a street or corner, avenue or thoroughfare, you must see it many times and observe it studiously. It is a slow, contemplative labor of love, not for the man in a hurry but for him who sees more than the surface of things. It is for him, indeed, who wishes to record in the most attractive, understandable way, an interpretation of how he feels about certain aspects of life. For what, after all, is a photograph if it is not a way of speech, speech through the medium of a picture? A writer turns out a beautiful piece of prose and we are touched deeply by thoughts and feelings transmitted to us through the medium of words unusually well put together; the painter, the musician, the playwright each in his own way, through his own particular medium, makes us think his thoughts, feel his emotions, see old things in new ways, ways we had never experienced before.



"Fifth Avenue"

A few attempts to indicate the possibilities of street photography from the point of view of the street or thoroughfare itself and not, necessarily, the activities that transpire in it, accompany this article.

In "Old Quarter," which was taken in a thoroughfare near the piers late in the afternoon, the low sun shooting through an aperture created by jutting buildings and other structures gives the effect of a soft spotlight sweeping across the worn cobbles, suggesting the atmosphere of the title which we have given the picture. This is one of these fortunate circumstances when a subject, at other times dull and pointless, assumes possibilities by virtue of unusual lighting.

"Streets Paved With Gold"

DON'T FORGET

to enter the new

PHOTO CONTEST

that Scientific American is conducting.

Closing date is December 1, 1937
See our September Issue
for full details

"Fifth Avenue" is an example of a street picture without shadows. Taken from the 15th floor of a New York skyscraper, it illustrates what can be done even when the sky is dull. On the particular day when this photograph was made, the sky was overcast and it almost seemed as if the day were lost for street pictures, where shadows are ordinarily a great aid. But, on the contrary, this particular picture seems better without shadows. The people stand out where they might have almost merged with their cast shadows, one gains a clearer impression of pedestrians on their way up and down the avenue, and there is a general cheerfulness pervading the scene

"The Park"

that often is associated with the street famous throughout the world as Fifth Avenue.

"Streets Paved with Gold" is a phrase familiar to persons who have come to America from foreign countries. There the legend used to persist and it may even today, for all we know, that in the Land of Opportunity such prosperity reigned that even the streets were paved with gold. At a particular corner which this department frequently passes, we noticed, both at night and during the middle of a sunny day that when standing at a certain angle in relation to the light, sparkles like stars or brilliant diamonds appeared in the sidewalk. The Old World legend came to mind and the picture was the result.

"The Park" depicts the familiar wide walk created for the leisurely stroll; the long shadows cast by the empty benches, together with the benches themselves, support the impression of a park walk. The picture was taken in late afternoon, of course, and without people. It was intended that the park walk should speak for itself.

Introducing Infinol

HERALDED as "the result of years of ceaseless experimentation, study, and research," and "not the inspiration of an evening's mixing of chemicals," a new fine-grain developer called Infinol is now available. The developer is the achievement of G. Bert Ward, widely known in the field of motion-picture processing. This fact should speak volumes for the new developer for everyone knows what an important part fine grain plays in the processing of motion-picture film.

Notwithstanding the fact that practically all recent ultra-fine-grain developer producers have felt it mandatory to include the chemical paraphenylene-diamine in their formulas because of its undoubted fine-grain capacity, the deviser of Infinol disowns this chemical and follows his own counsel. The result is a developer reputed to have the following characteristics:

A grain as fine as the finest working surface developer; quality equal to borax negatives (which have the characteristics of producing good tone values and blocking the highlights only in over-exposure); full density with no additional exposure; will not stain; does not contain irritating poisons; will develop more films per unit volume than other developers; may be compounded with ordinary tap water; is a full control developer, giving contrast control with time; will not block highlights.

In addition, Infinol is said to permit a full 50 percent higher meter rating than other fine-grain developers, since excess exposure is not required to obtain detail in the shadows, and the negatives it produces, according to the claims of the sponsors, are more "meaty" with clean highlights and a wealth of detail.

Leica Exhibit Postponed

THOSE intending to send Leica pictures to the Fourth International Leica Exhibit announced in this department last month now have an additional month in which to submit their entries, namely, to November 30, due to the fact that the date of the exhibition has been deferred to January of next year. The new date is January 8 to 18, inclusive, and the place is the mezzanine floor of the International Building, Rockefeller Center, New York City. E. Leitz, Inc., the sponsors, explain that "this change in schedule was brought about by the fact that a more suitable exhibit hall was available for the later dates, one which would display to better advantage the many outstanding prints selected for this exhibit."

Caveat Emptor

"LET the buyer beware" or "Watch your step"; when a hobby enjoys such tremendous popularity as that now accorded the camera, be on your guard for the dishonest dealer, the "bargain" buy, the "chance of a lifetime." Look with suspicion on the offer of a camera at a much lower price than that usually asked for it. There's probably a nigger in the woodpile somewhere. A camera that may seem a bargain at first glance may actually prove to be the costliest purchase you have ever made.

The vultures prey on the gullible and take wicked advantage of wholesome enthusiasm. There is probably no field today in which sales resistance is so low as in the camera

field. Time and again you hear the statement made that you can sell the amateur photographer anything on sight. This is, of course, considerably exaggerated, but there is an element of truth in it. What this actually means is that the amateur loves his hobby so well that his ordinary buyer's caution is temporarily dormant and he makes his photographic purchases, in a large sense, emotionally.

In the main, photographic dealers, in the smallest as in the largest town, are straight shooters. They want you to be satisfied and they are jealous enough of their reputation to give you a square deal every time. The dealer has other things to sell and obviously he wants you to come back to him and not go to another dealer because he misrepresented some item to you or misled you in some other way. You have to put your trust in the dealer, particularly if you are buying your first camera or your first in a new field, such as a miniature, if you have been used to a larger camera outfit. But be sure your dealer is trustworthy.

Du Pont Spool for Robot

DAYLIGHT loading film spools for use in the Robot camera, the camera designed to take pictures in rapid sequence without rewinding the shutter for each shot, are being made by the Du Pont company, famous for their Superior and Micropan emulsions for miniature cameras.

This is another instance of a co-operative spirit between film and camera manufacturers that redounds eventually to the benefit of the ultimate consumer, the camera user, as well as those commercially involved. As soon as a new camera has made the grade of popular acceptance, some film manufacturer comes along with a helping hand in the matter of film supply, the "cannon fodder" without which the camera is useless. And so it is with the Du Pont-Robot tie-up. May the union prosper.

Lenzal

A NEW lens cleaning fluid has been placed on the market under the trade name Lenzal. The bottle of Lenzal is sold as a unit with a special applicator and Japanese lens paper, and is recommended for use in cleaning camera lenses, eye glasses, binoculars, microscopes, hand lenses, reading lenses, monocles, condensers, telescope lenses, color filters, range finders, exposure meters, and similar items which call for extreme care in cleaning. Lenzal is declared by the makers to be free of "acetone, carbon tetrachrode, alcohol, alkalis, acids, oil of turpentine, benzene, soap, or ether, or such ingredients that are so common in the ordinary lens cleaners."

Man-High Tripod

THE requirements of a good tripod are pretty well known among camera users who have had occasion to employ them in taking pictures requiring greater exposures than snapshots, in making color separation negatives, in delayed action shots, and for other purposes. The tripod must be rigid enough to remain immovable during the time of the exposure, whether for a fraction of a second or several minutes; it must be tall enough when fully extended to allow comfortable viewing on the ground-glass back or through the range finder, yet permit varying

heights for different subjects without the necessity of tilting the camera down; it must have a tilting top for tilting up or down when desired; it must be portable, fairly lightweight, short, and strongly built.

All of these features appear to be embodied in the 79-B All Purpose Tripod. It is unusually long, including seven telescopic sections extending to a maximum height of 62 inches, raising the camera and sights to eye level; it has a built-in swivel top, which

Man-high

means insurance against accidental loss of the swivel top or absent-mindedly leaving it behind somewhere; its tubular brass construction means strength and durability and it is very convenient for carrying about, measuring only 18¼ inches when closed.

The illustration shows the tripod in use. Observe how the operator, employing a range finder camera, the Rollop, is able to work without stooping or strain. Incidentally, the illustration demonstrates the proper way of employing a tripod, one leg forward, the other two legs on each side, permitting the operator the freedom of the space between and thus guarding against accidentally knocking one's legs against the tripod supports and disturbing the focus.

INSURANCE FOR YOUR CAMERA

TIME was when most amateurs were content with cameras costing under 25 dollars or so. Today it is a common thing for a man to spend as much as 200 dollars or more on one or more cameras. Few people, however, seem to realize the importance of protecting them against loss and theft in the same way they would protect any other valuable possession; namely, insurance. Camera thefts are reported quite often these days and what of the hazard of leaving a valuable outfit in a train or in a hotel and never seeing it again?

You can insure your camera possessions, just as you can insure anything else, by a so-called "camera floater" policy, which protects your camera wherever you happen to have it, at home or away on a trip or on the way from home to office and back; in short, anywhere. The cost is two dollars per 100 dollars, insurance being issued for sums not less than 200 dollars. This cost is for the "world-wide" form which protects your camera wherever you happen to be, in this country or out of it, and is fairly reasonable considering the feeling of security one obtains

thereby. For those hardy ones who take to the air for pictures, it will be interesting to know that a special form may be obtained to protect the camera while being used during airplane trips.

Cash Prize Contest

A MONTHLY cash award of 10 dollars for each of the five best photographs submitted during each month is announced by the distributors of Perutz film in this country, the Intercontinental Marketing Company, 10 East 40th Street, New York, N. Y. The awards are to continue indefinitely, the sponsors also being prepared to purchase any negatives worth using for publicity purposes.

The only condition of entry is that the pictures submitted must have been taken on Perutz film during the course of the six months preceding entry.

"Obviously any pictures submitted must be good, both pictorially and technically," the announcement says. "You may enter any time, and you may submit as many pictures as you like. Every type of picture is eligible, and particularly, good snapshots of river scenes; week-end parties; happy people bathing, sailing, and indulging in every kind of sport and games; children; animals—in short, everything that truly and naturally mirrors life."

If you wish further details, it is suggested that you write to the Intercontinental Marketing Company at the above address.

When Nature "Emotes"

GUESS the title "Agony" is a pretty sad one to hand you this fine autumn evening, but that's the way this picture appealed to us as we snapped it. The branches seem to writhe as if in pain, displaying their misery across the sky. Whatever you may think of this particular picture, there are many such opportunities for picture-taking, and whether you are cheerfully inclined or otherwise you, too, would have snapped this tree if you had run across it. Of course, the early spring or late fall or winter, when the leaves have left the trees, are the only times of the year to do justice to this subject. In this particular case, in order to eliminate as much of the background landscape as possible, it was necessary to shoot up from a low vantage point against the sky background, a yellow filter being employed.

Instocine for Movies

WITH the demand for the Instoscope visual extinction exposure meter showing no signs of abatement, a twin Instoscope called the Instocine, for the exclusive use of movie camera owners, has been designed by Joseph M. Bing, F.R.P.S., inventor of the Instoscope.

The Instocine, which is the result of a steady demand on the part of movie makers for a meter of the type and low price of the Instoscope, operates on exactly the same principles as the Instoscope, with the exception that the scale is exclusively cinematic. The Instocine is operated with one hand and quickly shows, for both monotone and color exposures, every cine camera stop for any "number of frames per second" and any "number of frames per second" for every cine camera stop, with the most frequently used "16 per second" row displayed particularly large in red figures on a white ground.

Miniature Cameras Have No Rising Front

THIS title is not a piece of news, but you'd be surprised how many people insist on throwing this fact in the face of miniature camera enthusiasts as one of the serious drawbacks of the minicamerist's art. When it is explained that miniature camera designers have enough problems to contend with in the construction of the midget marvels without worrying their heads about rising fronts and that the lack of this feature is not really so serious a drawback as the rising-front-for-the-miniature propagandist would make it appear, the defense still

"Agony"

proves unconvincing. The fact is that, while a rising front is a really necessary feature of the larger cameras, in the miniature it is not an absolute essential since it is possible to give a slight tilt to the miniature without causing any serious distortion and that even where this occurs it is the simplest thing in the world to correct the distortion under the enlarger by tilting the easel in the direction opposite to that of the tilt in the negative. Another way around the difficulty is the use of a wide-angle lens which relatively covers a greater area in all directions than the normal lens, and then enlarging only the essential part of the picture.

HAZARDS OF BUYING CAMERAS ABROAD

A CAMERA, like any other relatively complicated piece of machinery, needs expert attention occasionally. Things are bound to go slightly wrong now and then, requiring only a small adjustment but requiring that adjustment very badly. Every importer of cameras has facilities, more or less efficient, as the individual case may be, but facilities of which the user of a particular camera may avail himself at any time. The importer of a camera stands back of that camera and will make good any original defect that may later develop in use. Naturally, if the fault is that of the camera owner, the importer cannot be expected to stand the cost of a repair due to the operator's carelessness or failure to follow instructions for use.

However, if you purchase a camera abroad, you have no claim on the importer. He will make adjustments for you and repairs, but he will charge you for the slightest service. After all, it is not his responsibility, even though the camera is made by the same factory. The importer goes to a great deal of expense in advertising the camera throughout the country, in publishing literature, in maintaining a staff. He does all this on the natural and rightful assumption that he will eventually sell some of his importations and thus make a reasonable profit as a result of his investment.

KODACHROME IN ITALY

TOURISTS from the United States may now expose Kodachrome film in Italy and still have it processed in Rochester, despite a long-standing regulation prohibiting the exportation of unprocessed motion picture film, according to a recent ruling.

"No laboratory for processing Kodachrome film is in operation in Italy," the Eastman report says, "and, as Italian authorities require official inspection of all motion picture film before it can be sent out of the country, tourists have been obliged to confine their photography to black and white film which can be processed in the Milan laboratory.

"Those desiring to make Kodachrome pictures in Italy should apply to the Italian Tourist Information Office, Rockefeller Center, 626 Fifth Avenue, New York City, where they will be given a letter to the proper authorities in Rome. After the film has been exposed it should be delivered to the official designated in the letter who will forward it to Rochester for processing. The processed film will be inspected by the Italian consul and then mailed to the owner's home address in the United States."

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page 295*)

The value of a crackproof putty and a non-hardening caulking compound which are permanently plastic, adhesive, and waterproof can readily be appreciated. Consider those stubborn joints where the kitchen sink meets the wall and drainboards, where the bathtubs touch wall tiles or plaster, where window and door frames set into building walls. Think of the dried out and cracked putty on windows, of leaky flashings, of linoleum which refuses to stay put on damp cellar floors or on dried-out wood floors, of the ugly openings between the fireplace and walls and between the hearth and floor, of the loose tiles in the kitchen and bathroom.

A series of ever-plastic compounds has recently been made commercially available by Ever-Plastics Corporation, for the express purpose of putting an end to these various troubles. The compounds are based upon a plastic carrier in combination with an adhesive resin and asbestos and mineral fillers. Certain variations and adjustments in formulation fit each compound to a specific use. For special purposes a large user can obtain a compound especially adjusted to his requirements. For general distribution, five compounds have been standardized so far. One of these, named Tilon, is white and particularly adaptable to bathroom and kitchen uses in setting tile and filling cracks and joints. It is extremely adhesive and being permanently plastic, expands and contracts, thereby keeping the joint filled at all times. Within a week, a tough, smooth, elastic skin forms, which can be painted or lacquered to match adjoining colors. For glazing and filling exposed cracks another compound called Putite is furnished. For regular caulking, a softer material, Caulktex, is made which can be used with either knife or gun. For horticultural work another compound named Graftex is proving valuable because of its property of adhering to damp wood surfaces and bleeding wounds, giving perfect protection through winter cold and summer heat despite continual flexing and bending.

A concise, authoritative description of these materials is found in the specification used by certain departments of the Government when buying the company's compound for setting sanitary fixtures. The specification reads as follows: "An asbestos composition filler which is a germicide, absolutely gas- and fume-proof, water-tight, stainproof, containing neither oil nor asphaltum, and which will not rot, harden or dry under any extreme of climatic change. It will adhere on a damp surface."

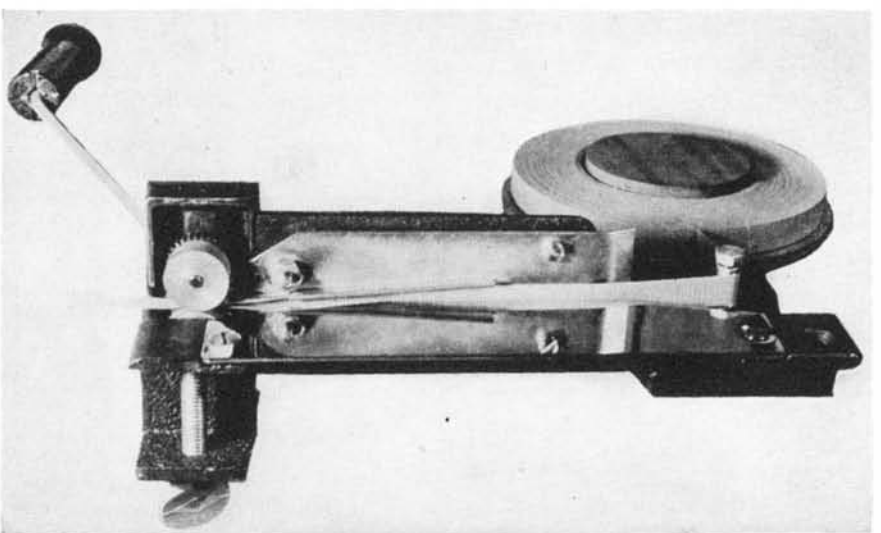
PURIFYING MINERALS

APPLICATION of the process of froth flotation to low grade barytes eliminates iron and silica impurities and substantially increases the value of the mineral. By this method certain deposits in Tennessee and South Carolina, which are too impure to be of commercial value without treatment, are made useful sources of this mineral. The process was developed by the U. S. Bureau of Mines. Barytes is a widely used white pigment and a source of barium. —*D. H. K.*

BINDING TO PROTECT VALUABLE PAPERS

A SIMPLE crank-operated device has just been placed on the market as a means of protecting the edges of valuable papers, drawings, maps, and the like. The edge of the paper to be protected is passed between two rollers while a tape of gummed heavy paper or of gummed vari-colored Cellophane is pressed tightly over the edge

Above: **Applying a gummed binding to valuable papers with the device that is shown, close up, in the photo reproduced directly below**



Artist's drawing of the multi-place XFM-I, described below

to make a quarter-inch border. This effectively prevents tearing of the edge. No heat or moisture is needed and the machine will tape outside curves or disks.

The Vertex Company that makes this device recommends it for architects, engineers, lawyers, insurance companies, and many others, including orchestra leaders who may wish to protect the edges of much-handled music sheets.

A Formidable Multi-Place Fighter

A SINGLE-SEATER pursuit plane, no matter how fast, is no longer a match for the formidable flying fortress that the modern bomber has become. Accordingly the Army Air Corps has given encouragement to the experimental construction of a radically novel, more powerfully manned and armed multi-place fighter, the XFM-I, which has been designed and built by the Bell Aircraft Corporation. The artist's sketch gives a very faithful presentation of this new and dangerous craft.

The first important departure from convention lies in the fact that the machine is a pusher, with both propellers behind the wings. The builders claim greater efficiency for this arrangement, but that is debatable. What is indeed gained by the pusher arrangement is that the wing gunners, one ahead of the wing on each side, have a free field of observation and fire in front, unimpeded by engine or propeller. Also, the gunners do not have to work in the blast of the propeller, a serious handicap to efficiency.

Our somewhat romantic idea of a pursuit pilot is that he is a lone fighter flying a relatively small airplane, yet capable of bringing down single-handed a huge bomber or a giant airship. When the bomber itself is sufficiently fast and mounts enough guns the task becomes too formidable even for a Bishop or a Rickenbacker. Therefore, the new fighter accommodates a crew of five—pilot, co-pilot-navigator, radio-operator-gunner and two outboard wing gunners. Another innovation which is looked on with favor in military circles is the complete interchangeability of any or all members of the crew. The wing gunners can move from their stations to the main fuselage while in flight; the co-pilot can change places with the pilot; the radio operator can man the guns; and all stations have means of inter-communication. The ship carries a total of six guns. No information is given as to speed, but the Air Corps rightly says that a flying machine must be faster than its target and that the XFM-I is considerably faster than the bombers it is to encounter. Hence we can guess at a speed of more than 300 miles an hour.

There is an auxiliary power plant on board which drives nine electric motors for such duties as retracting the landing gear, lighting, radio transmission, and starting. The possibility of continuing radio transmission after a forced landing has obvious advantages.

It is significant that the twin-engine power plant comprises the new Allison liquid cooled motor (see page 308), which delivers 1000 horsepower. We have predicted that as soon as a really modern liquid cooled engine was available, it would be eagerly put into service. The new fighter is a confirmation of this prognostication.

It is hardly necessary to say that the machine is aerodynamically clean, the landing gear and tail gear are retractable, flaps are used, the cabins are heated, and so on. Many things in the construction of aircraft are now taken for granted that would once upon a time have created excitement by their novelty.—*A. K.*

What the Test Pilot Does

A REMARKABLE young man who undertakes the hazardous duties of a military test pilot (that they are hazardous those of our readers will agree who remember the death of Jimmy Collins in a dive test some two years ago) not because of the pay and not because of the glory, but because of his great love of flying and his immense interest in aircraft development work, is James B. Taylor, Jr.

His latest test work was putting through its paces an all-metal Seversky low-wing monoplane, developed for the Navy as a single seater pursuit for service on board the aircraft carriers.

One of the series of tests is to dive from an altitude of about 16,000 feet to about 8000 feet and in pulling out to develop safely 7½ times *g*, the acceleration due to gravity. That is to say, the strain on the air-

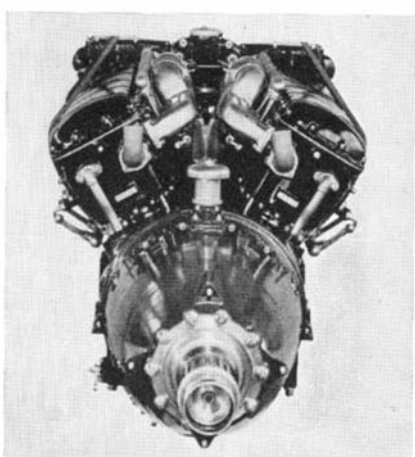
craft must be seven and a half times its normal weight. Mr. Taylor has successfully completed these tests and newspaper reports have it that a speed of 530 miles an hour was attained during one of the dives; instead of the required 7½ *g*, the load measured by the accelerometer was actually 8½ *g*. It must be remembered that it is not only the ship which is subjected to this tremendous strain. The flesh-and-blood pilot is also subjected to the same dynamic forces. At the final instant of recovery he may be forced down into his seat with a momentary weight of three quarters of a ton. We congratulate Mr. Taylor and the constructors of the Seversky ship on satisfying the Navy observers and we sincerely hope that Mr. Taylor's freedom from mishaps will continue.—*A. K.*

A Splendid Liquid-Cooled Engine

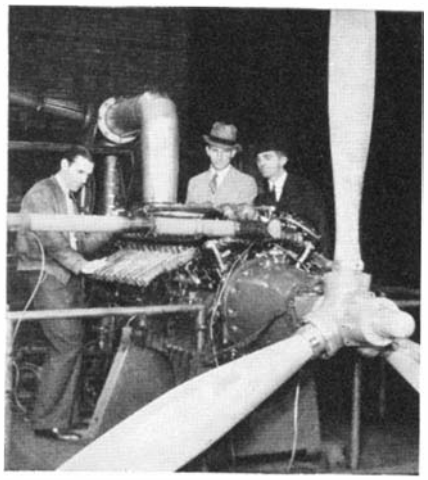
HITHERTO American aviation has led in the development of air-cooled engines —Europe (particularly Great Britain) in liquid-cooled engines. Such a situation has been a constant source of irritation both to the government services and to the designers of military and naval aircraft. With the passing of the Army's 150-hour type test by the V-1710 aircraft engine, built by the Allison Engineering Company, we are at least on a par with foreign development in the liquid-cooled field.

Perhaps the most striking feature of the V-1710 is its successful use of ethylene glycol as the cooling agent; it is undoubtedly the first motor designed specifically for use with this synthetic coolant. Ethylene glycol (sometimes called by the trade name Prestone) has a low freezing point, and at the same time a much higher boiling point than water; namely, 387 degrees, Fahrenheit, as compared with the 212 degrees of the latter. Hence the Prestone radiator can work at a much higher temperature with Prestone than with water. And if the radiator works at a higher temperature, then it delivers heat much more effectively to the air passing through its cells, and can be made smaller and lighter. Since it is smaller, it has less head resistance.

Coupled with the radiator of less head resistance, the new engine, a 12-cylinder V-type, has a remarkably small frontal area—less than six and one quarter square feet. Air-cooled engines of similar power have a frontal area of about 16 square feet.



The V-1710 liquid-cooled engine



Engineers inspecting the Allison liquid-cooled engine while on test

It is true that air-cooled engines, skilfully enclosed by the N. A. C. A. cowl, are lighter than even this latest liquid-cooled motor, more compact, free from 'plumbing,' and of remarkable efficiency. Nevertheless, the availability of such a V-type liquid-cooled engine, with its low frontal area and small radiator, will be most tempting to airplane designers. They will immediately seek to make full use of its possibilities, endeavor to hide the complete engine within the wing, or else seize on its splendid form to give the front end of the fuselage a much better streamline form than is possible with the very large air-cooled motors. They will also, particularly in single seater fighters, grasp the opportunity of giving the pilot much better vision ahead.

We shall in the future see the liveliest competition between the air-cooled and the liquid-cooled types, and competition in aircraft design means progress—just as competition does in every other form of human activity.

Engines employing ethylene glycol have been built before, but have never been entirely successful. The Allison has made good because several years of the most careful experimentation have preceded the final tests. In particular, the rates of flow of the coolant and the temperatures at all points around the cylinders, valve seats, spark plugs, and so on, were very carefully studied. Uniform cylinder and head temperatures were thus secured. This painfully acquired knowledge also gives the engine flexibility in regard to octane ratings of the fuels employed as well as choice of compression ratios. We may conjecture also that due provision has been made for the expansions due to the higher working temperatures than with water cooling, so that pistons do not seize up. Such difficulties were encountered in earlier Prestone-cooled designs.

In other respects the engine is of excellent, but conventional design. Space will not permit a detailed description, but one or two features deserve special mention. Thus, the 2 to 1 reduction gear is built into the engine integrally and gives a very neat front end. The reduction gear consists of an internal spur gear, which meshes with a pinion gear on the crankshaft. The reduction gear, together with the propeller shaft, are encased in a single aluminum casting which forms the nose of the engine. The exhaust-driven turbo supercharger is

also built into the engine and can be located immediately under or to either side of the engine with a short exhaust line and short air pressure lines to the intercooler and carbureter. The accessory housing for the cooling pump, camshafts, fuel pump, vacuum pump, and so on, is also very neat and is mounted directly on the rear of the crankcase.

The neat appearance, relatively small size and small frontal area of the engine can be noted in our two photographs.

A brief summary of the specifications is as follows: Bore, 5.5 inches; stroke, 6.0 inches; displacement, 1710 cubic inches; overall length, 95 inches; overall height, 51 inches; overall width, 29 inches. Normal and take-off rating, 1000 horsepower at 2600 revolutions per minute on 87 octane fuel. Compression ratio, 6 to 1. Blower ratio 6.75 to 1. Reduction gear 2 to 1. Weight with magneto, carbureter, cooling pump, stacks, fuel pump, and so on, 1280 pounds—only 1.28 pounds per horsepower.—*A. K.*

A Single-Blade Variable-Pitch Propeller

THE new Sensenich-Everts single-blade variable-pitch propeller, which is seen in one of our photographs mounted on a Fairchild cabin plane, has given much satisfaction to pilots. Its principle is as ingenious as it is simple and is illustrated by the diagrammatic sketches. The blade is balanced, statically and dynamically, by a counterweight, which is essential for avoiding vibration. The propeller is driven by the engine shaft CC in the usual manner. But, and herein lies the secret of the device, the blade is also free to pivot—within certain limits—about two other axes, BB and AA. The pivoting is by means of pin-hinge mounting of simple character.

In the smaller sketch is shown how this limited freedom about the two axes permits the blade pitch to adjust itself automatically to the correct value. The blade is really free to feather about the intersection of the axes BB and AA. The centrifugal force tends to increase the pitch; the air load or thrust tends to decrease the pitch.

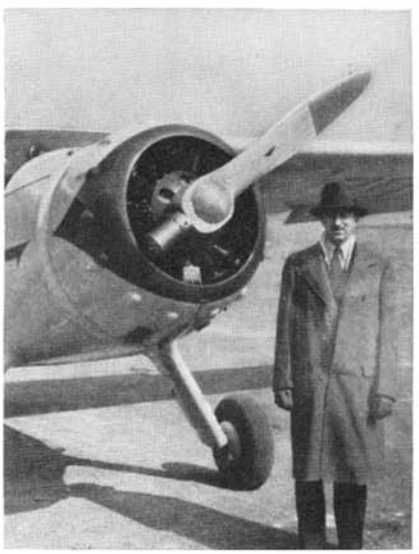
At take-off the thrust is very large, the moment of the air load overcomes the moment of the centrifugal force and the pitch decreases, as it should do.

At high speed, the thrust is much smaller and the centrifugal force moment now takes charge with increase in pitch—which again is as it should be.

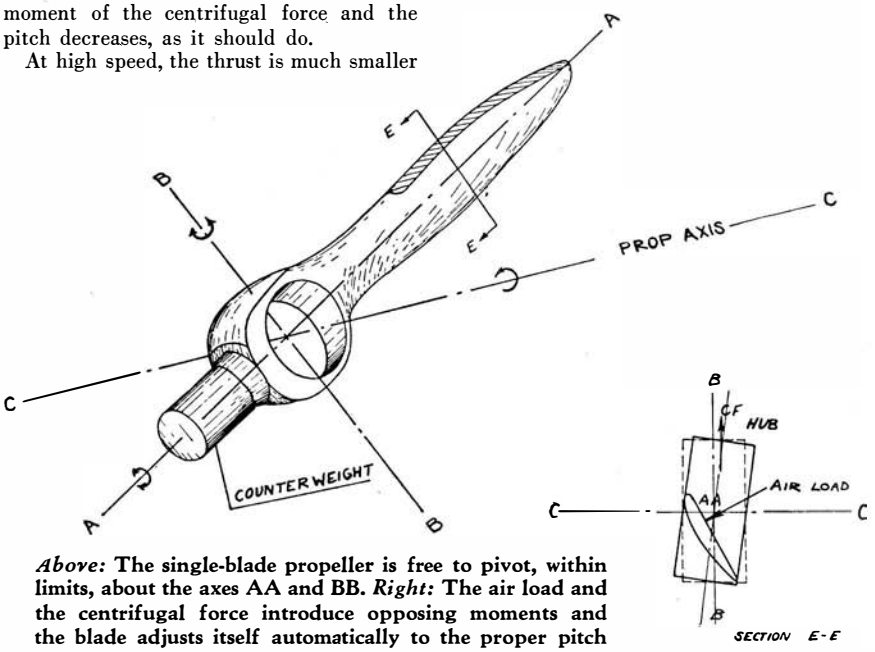
Thus the pilot is provided with an automatically adjustable propeller, which gives him the best efficiency without the bother of any gadgets to operate. As the pilot of even a small plane has many instruments and controls to think about, he will be thankful for a device which is purely automatic in action.—*A. K.*

Quick Starting in Cold Weather

IT takes time to warm up an aircraft engine sufficiently for a take-off to be permissible—particularly if the engine is water-cooled and the weather cold. For commercial flying, to some extent—for military aircraft decidedly so—it is important to be able to take off at the shortest notice no matter what the weather. There may be enemy aircraft to fight off, for example. In the engines built by the Bristol Aeroplane Corporation, a British company, a very simple device has removed all difficulties of cold-weather starting. When the engine



The single-blade variable-pitch propeller on a Fairchild cabin plane



Above: **The single-blade propeller is free to pivot, within limits, about the axes AA and BB.** ***Right:*** **The air load and the centrifugal force introduce opposing moments and the blade adjusts itself automatically to the proper pitch**

first fires, oil under high pressure is delivered to the bearings, and through a special oil by-pass an extra volume of oil is sprayed over the same bearings. As engine and oil warm up, the high-pressure system cuts out automatically and the special spray diminishes in intensity. The device is entirely automatic and needs no attention. Except for one additional external pipe line to the oil tank it adds nothing to the bulk or weight of the engine.—*A. K.*

Light Cell Reflectometer

TO fill a growing need for a practical instrument by which light-reflecting efficiencies of flat surfaces and light-transmission properties of transparent or translucent materials can be measured accurately, General Electric Company's incandescent lamp department has developed a device called the "G-E Light Cell Reflectometer."

As its name implies, this new instrument does its "seeing" with the same kind of photo-cell as that used in the familiar G-E Light Meter. Actually, the new Reflectometer employs two light-sensitive cells. These impart to a meter the relative amounts of light received by material under consideration and amounts redirected or transmitted thereby. A needle and meter scale are used to relay the desired information to the operator.

Heretofore, according to George Baumgartner, Nela Park engineer, under whose

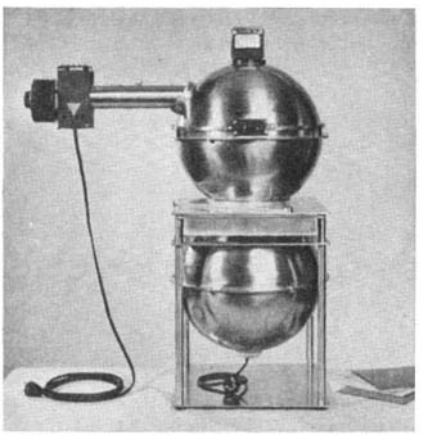
Determining the reflecting factor of a surface with the Reflectometer

supervision the instrument was designed and developed, most observers have had to depend on visual reflectometers, instruments requiring use of the trained human eye. Measurements thus obtained were found to be inaccurate for the most part, particularly when fatigue, caused by subjecting eyes to the strain of numerous observations, greatly increased the chance of error. With the new Reflectometer, however, both the expert and the novice can quickly determine true reflection and transmission values covering a wide range of materials.

The Reflectometer, a 10-inch hollow sphere of metal, is equipped with a movable tubular arm about a foot in length. The inner surface of the ball is painted flat white. The two light-sensitive cells are so embedded in the "equator" of the globe as to face each other. These cells are connected electrically to a micro-ammeter mounted atop the device. Held in the arm attachment is a small projection lamp and reflector by which a shaft of light may be directed into the sphere. The arm may be swung to such a position that the entering beam shines down through a circular opening, three inches in diameter, at the bottom of the globe.

To determine the reflection factor of a flat surface, the Reflectometer is set on or against the sample to be tested in such a way that the opening in the sphere is closed by the sample. The projection lamp is then turned on and a rheostat is adjusted until the needle of the meter rests exactly over the "100" mark on the scale.

Before the light is permitted to strike the



Measuring transparency or translucence by means of the Reflectometer

cells, it is thoroughly diffused by the matt finish of the sphere's inner surface. The operator next swings the arm into such a position that the beam of light falls at an angle of 30 degrees from the normal and directly upon the sample. Two small baffles prevent the reflected light from shining directly upon the cells. The true reflection factor of the surface being tested is registered on the meter scale.

In order to measure the transmission factors of various transparent and translucent materials the Reflectometer requires another sphere of similar size, also developed by Mr. Baumgartner.

A Bridge That Will Disappear

DURING the past summer a huge steel bridge was completed across the Columbia River at the site of the Grand Coulee dam project. It is a mammoth structure on which run the tracks for the constant procession of cement trains that carry the concrete for the dam from the mixing plants to the forms where the pouring is in process.

As great foundations rise, block by block, across the gorge of the Columbia, the steel supports for the bridge are gradually embedded in the concrete. As construction advances, the entire bridge will disappear and will be enclosed with the huge concrete structure's completion.

New Pulp Bleach

ADVANTAGES over the customary process of bleaching mechanical wood pulp are claimed for the use of zinc hydrosulfite, which is being applied successfully in the production of news print paper on the Canadian Pacific coast. The new bleaching agent yields a product which permits the

use of a larger proportion of ground wood in mixed pulps for specialty papers and permits the use of unbleached sulfite pulp in mixtures with bleached ground wood on account of the better color of the latter. —*D. H. K.*

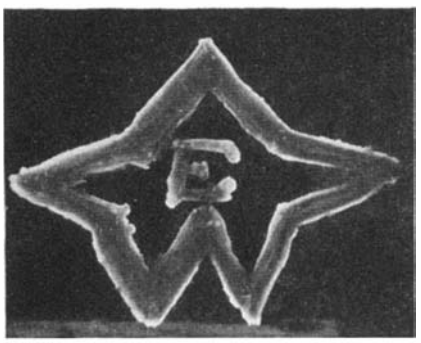
Oriental Textiles

FOLLOWING a "gentlemen's agreement" between the United States and Japan, to limit Japan's sale of cotton textiles to the Philippines, there has been a startling increase in the Filipinos' purchases of textiles labelled "Made in Singapore," "Made in Hong Kong," "Made in China." On examination, much of this stock was found to be actually Japanese-made, complains a writer in *China Weekly Review.*

Bacteria Which Produce Light

SOME forms of bacteria produce light, as is seen in the accompanying photograph. Fireflies over our lawns and luminous one-celled animals seen in the wakes of ships are more familiar but many other organisms including fishes, comb jellies, squids, shrimps, and fungi also produce a cold light of their own.

The bacteria in the photograph were spread on solid nutrient medium, making the form of a star with an E in the center, by the bacteriology class at Earlham College, Earlham, Indiana, according to Hurst Shoemaker, instructor in biology at that institution. After two days' growth in a dark room, the bacteria were distinctly visible by their own light. A camera was



Luminous bacteria

focused on them and in five hours they produced enough light to take their own photograph. The brighter edges are due to the fact that the actively growing and spreading ones give more light as one of the products of metabolism, while the older ones in the center are inactive.

Many species of such bacteria have been described and are most frequently seen in fish markets or on decaying fish along the ocean beach, causing the fish to glow at night with a phosphorescent light.

Skin Cleanliness Best Treatment for Acne

FOR acne—the adolescent's complaint—local skin cleanliness brings the best results. That improperly functioning endocrine glands are probably responsible for acne, medical research workers believe. But no glandular substance found is enough better than local treatment to justify the expense and effort of its administration.

Thirty-nine students at the University of Iowa have recently been treated for acne as a part of a scientific experiment. Dr. Grace E. Williams, medical adviser to women, and Dr. Ruben Nomland, professor of dermatology at the university, report their observations on these students in the *Journal of the American Medical Association.*

With evidence pointing to a deficiency of sex hormone in acne patients, the Iowa physicians began their study. They took 28 women students and 11 men, the average age being 19 years. Of these, 11 had severe, 20 moderately severe, and eight mild acne.

All 39 students were asked to give meticulous attention to details in the care and treatment of their skin. In addition, 28 of them were treated with sex hormones, while the remaining 19 were also given injections but the injections were merely sterile water. The students did not know who were getting hormone substance and who were getting water.

Treatment went on for from four to six months with 85 percent of those given the hormone substance showing moderate to marked improvement and 78 percent of the control group given sterile water showing the same degree of improvement. The Iowa doctors concluded at the end of the experiment that a deficiency of the pituitary-like hormone is not an important factor in causing acne, and that the local treatment is still the best for controlling acne.

Here are the instructions for local treatment of acne given to most of the students: Stop all picking and squeezing. Discontinue the use of all cosmetic creams. Wash with soap and water twice daily, keeping the skin non-greasy almost to the point of scaling. Eat a diet low in carbohydrates. Eat no candy. Remove blackheads by placing hot towels on the face for five minutes, then applying a thin coating of 3 percent resorcinol in cold cream to the face and again applying hot towels for five minutes. The blackheads are then squeezed out with a comedone remover, the face rinsed with cold water and hamamelis water applied. Apply a prescribed lotion two or three times a day. Avoid iodized salt. Shampoo the hair twice a week.—*Science Service.*

Tin Substitutes

CADMIUM, cadmium and copper, and copper alone are being studied in Germany as corrosion resistant coatings to replace tin.—*D. H. K.*

Babylonian Math Sharks 2000 B.C.

BRIGHT people, the Babylonians. A math book written by Babylonians 2000 B.C. has just been deciphered, and scientists are deeply impressed by the amazing early progress of those ancients in higher mathematics.

The math book, written on 44 clay tablets, shows that 15 centuries before Greek math wizards were born, Babylonians were already doing many tricks with figures that Greeks have been credited with discovering. Babylonian mathematics included multiplication tables, a symbol for zero, negative numbers, tables for calculating areas and volumes, tables of squares and cubes and reciprocals.

For 25 years, all but two tablets of the

book have lain un-read in Yale's Babylonian Collection. Now, Prof. O. Neugebauer, of the University of Copenhagen, has deciphered them, working from photographs and hand-made copies of the cuneiform inscriptions. The two missing "pages" of the book have been located in Paris.

Babylonians were more practical in their mathematical science than Greeks, the ancient book shows. Many of their tables would be useful in surveying and building, in digging dykes and constructing walls. But when it came to theoretical problems, the Babylonian math sharks understood quadratic and even higher degree equations and solved them by tables, as they are still solved.

The little old mathematics book, written in clay, clears up for mathematicians the puzzle of how the Greeks made such swift progress in this science.

"It seems now that a large body of facts must have been inherited by the Greeks from Babylonian sources," says Prof. Oystein Ore, Yale mathematician. "The exact manner in which this knowledge was transmitted is not yet altogether clear. The theorem of Pythagoras, for example, was well known to the Babylonians."

Hope that new excavations will bring new material to light was expressed by Prof. Ore, who predicts that the history of mathematics may be carried still further back into the past. So difficult are problems and solutions included in the Babylonian tablets, that Prof. Ore believes they must have been partly inherited from earlier times, perhaps from as far back as 2500 to 3000 B.C.—*Science Service.*

Fever Treatment for Syphilis only Partially Successful

ARTIFICIAL fever treatment for syphilis, widely heralded when first developed, has not stood the test of time as well as the chemicals, arsphenamine and bismuth, Dr. Paul A. O'Leary of the Mayo Clinic, Rochester, Minnesota, recently told members of the American Medical Association.

Even those physicians who were most enthusiastic about machines for inducing fever to rout syphilis from the body, now recommend, as do those who use malaria to induce fever, the use of the arsphenamines and bismuth during or after the fever treatment in all types of syphilis.

Besides malaria and electric fever machines, typhoid vaccine and hot baths have been found helpful in treating some cases of syphilis. No one knows exactly why any of these methods is helpful. Dr. O'Leary himself believes that these treatments cause some fundamental change in the immunity or disease resistance of the body.

The infant death rate in families in which there is syphilis was 75 percent in the days before drugs were discovered that would cure the disease, Dr. Harold N. Cole of Cleveland reported. It is probably from 20 to 30 percent even now.

Babies can be protected from this disease if their mothers are given anti-syphilitic treatment during the months before the birth of the child. If the mothers are not treated, the child of syphilitic parents will either die or within a few weeks after birth show signs of the disease including the "senile, little old man appearance" characteristic of syphilis in infants. These babies are restless, cry feebly, and often have a reddish brown skin eruption. Bones may become involved and the child may act as if paralyzed. Teeth, bones, joints, brain and nervous system, eyesight and hearing may all be affected by congenital syphilis.—*Science Service.*

Non-Poisonous Illuminating Gas

NUMEROUS processes have been suggested for making illuminating gas safe. Lately success has been attained with a method of converting the carbon monoxide in the gas to carbon dioxide and hydrogen by the action of steam in the presence of a contact mass. In this way the heating value of the gas is improved since the carbon dioxide formed in the treatment is removed. The contact mass consists of a mineral ankerite, a natural carbonate of iron, calcium, and magnesium, or it may be a synthetic mixture of these materials. This contact mass is used over and over by regenerating it after each use by heating in a furnace.

Numerous other methods have been suggested from time to time to remove carbon monoxide from gas or to warn of its presence. The method described is reported in use in Germany.—*D. H. K.*

Plant Fossils in the Making

FOSSILS were not all made and stored in the rocks millions of years ago. The first steps in the making of plant fossils have been seen and reported to the Carnegie Institution of Washington by one of its research associates, Dr. Ralph W. Chaney, chairman of the department of paleontology at the University of California.

When the great triple-peaked volcano Katmai in Alaska blew up in 1912, hurling some five cubic miles of ash into the air, part of the finely powdered material settled like snow on the branches of evergreen trees, pulled off billions of their needles, and bore them down to the ground.

Now, a quarter-century after the great eruption, Dr. Chaney has revisited the region and dug down to the bottom of the foot-deep ash. There he found the tree leaves pressed down in a matted layer, mostly in the lower few inches. They looked for all the world like the matted fossilized leaves he has often investigated in the ancient geological deposits in Oregon known as the John Day formation, which were volcano-formed many millions of years ago. [Source of many important mammalian fossils.—*Ed.*]

Of course the single Katmai eruption layer had only a small fraction of the thickness of the John Day formation. Many more eruptions, covering many centuries, would be needed before the Alaska situation would resemble the Oregon beds. But the basic principle is the same; and one man has seen, well within the limits of his working lifetime, the beginnings of a true process of fossilization.—*Science Service.*

Deflating the Inch

A BILL, phrased in "millionths" instead of millions, has recently been submitted to the Secretary of Commerce for transmission to Congress, dealing with proposed legislation to fix the standards of

weights and measures in the United States. It seems strange, 150 years after the founding of the Republic, that legislative action should be necessary to fix the value of the inch and the pound with which we are so familiar. Nevertheless, the fact is that we have never had a statute which defines the way in which these units shall be determined. The National Bureau of Standards is now advocating a minor legislative change to bring the defined value of the inch "into line."

The proposal now calls for the establishment of the United States inch as equal to exactly 25.4 millimeters. The British inch, derived directly from the Imperial yard, is about four parts in a million shorter than the United States inch. The proposed legislation inch falls midway between present values of the British and United States inches.

This reduction of only two parts in a million of the inch will therefore not affect industry, because it falls within the tolerances employed in industrial measurement. Recently the conversion factor, 25.4 millimeters per inch, was adopted for industrial purposes by standardizing groups in 15 countries including the United States and Great Britain.

Only in the most precise measurements of length, as in the making and certifying of precision gage blocks and line standards of length, would this proposed change be of any significance. In fine micrometer screws, lead-screws of lathes, or other industrial equipment, it would not be significant. On the other hand, it puts on a definite basis the status of the fundamental unit of length, and therefore of both area and volume. Furthermore, it specifies exactly how this length shall be measured in terms of one of the immutable spectroscopic standards of length now used, the wavelength of the strong red line in the spectrum of cadmium.—*Industrial Bulletin* of Arthur D. Little, Inc.

TAXES

NEARLY 16 cents out of every dollar of State taxes paid by highway users in 1936 was assigned to non-highway use. Allocations to non-highway purposes amounted to 169,344,000 dollars, an increase of 22,202,000 dollars over the previous year.

Death From Old Age Rare Among Even Wild Animals

FEW wild animals die of old age, in spite of their freedom from the ills of civilization. Food shortage, accidental injuries, diseases, and natural enemies are the principal causes of death in the wild, says the United States Biological Survey.

Pneumonia, or inflammation of the lungs, is one of the common causes of death in the wild, as well as in civilization. Starvation is one of the most important contributing causes.

A number of wildlife diseases also attack human beings with serious and sometimes fatal consequences, and investigators must always be on guard in examining sick or dead animals. Rubber gloves and antiseptics are essential, and also care against bites by ticks and fleas from the animal. Rabies, anthrax, bubonic plague, glanders, tularemia, and undulant fever are among the wildlife diseases that man must guard himself against.

Abandoned Coal Mines Are Sealed

THE sealing of abandoned coal mines in the hills and mountains that form the watershed of the Ohio River and its tributaries is cutting the estimated annual 10,000,000-dollar loss which they create.

How an abandoned mine that no one uses can create this loss is, at first sight, obscure, but the answer is the 3,000,000 tons of corrosive sulfuric acid which these mines pour into the Ohio River each year.

Abandoned coal mines, pointed out Prof. W. W. Hodge of West Virginia University, may have much rock containing sulfur. When ground water seeps into the mine and oxygen from the air is present, the sulfur, hydrogen, and oxygen combine to form sulfuric acid. This acid is carried away by the natural mine drainage until it eventually reaches the rivers. The increased acidity attacks metal surfaces of boats, bridges, and other things and creates the estimated damage.

Sealing some 47,000 mine openings in 13,500 mines has done much to divert surface water, decrease the oxygen content of these mines, and reduce the formation of the corrosive acid. Federal funds have made possible this project, which has already improved streams in the Ohio Valley.

—*Science Service.*

Japan to Synthesize Camphor?

JAPAN'S monopoly of camphor and the price control which it exercises has encouraged the United States and Germany to synthesize camphor for themselves. Now word comes from Japan of the formation of a company to synthesize camphor in Manchuria by the processes used in Germany. The manufacture of synthetic camphor is prohibited in Japan itself as a protection to the industry in Formosa.—*D. H. K.*

Africa Once Covered With Forests

AFRICA was once a vast forest-covered continent and the present great deserts of Sahara and Kalahari are the result of a "drying up" of that part of the world. This is the conclusion of Dr. Herbert Friedmann, Smithsonian Institution curator of birds, after an exhaustive study of bird specimens from Ethiopia and Kenya Colony.

There was a vast and rapid exodus of bird life from the steppes of Asia to the then newly created African grass lands, Dr. Friedmann explained. Present day life of the east African plains is very similar to that which flourished in central and south central Asia during the Pliocene geological era before the great Ice Ages.

The ostrich and other birds, such as the vultures, marabou stork, larks, cranes, and so on, were originally Asiatic and came into Africa when the great forests disappeared. The present dense jungles of Africa are survivals of the primeval wilderness.—*Science Service.*

CURRENT BULLETIN BRIEFS

(Bulletins listed as being obtainable through Scientific American can be supplied only by mail)

ROUND THE WORLD FOR BIRTH CONTROL, with Margaret Sanger and Edith How-Martyn, is an account of the visit of these two noted leaders to Europe and especially the Far East, in the interests of birth control organization. *Birth Control Clinical Research Bureau, 17 West 16th St., New York, N. Y.—25 cents.*

CAST CAMSHAFTS AND CRANKSHAFTS POSSESS MANY ADVANTAGES, by Fred J. Walls, is reprinted from *The Foundry*. This 8-page pamphlet puts forth the advantages of casting these particular machine parts, and presents the case particularly in view of the old conception of cast iron as an unreliable and brittle metal. Illustrated with drawings and photographs, and accompanied by comprehensive tables. *Write for Bulletin 1137A, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

THE AIRSHIP, the world's only airship journal, is published quarterly in London, and is now available for subscription in foreign countries. *The Airship, Wm. Dawson & Sons, Ltd., Cannon House, Pilgrim Street, London, E. C. 4, England.—Subscription price $1.50 per year.*

LAFAYETTE RADIOS AND SOUND SYSTEMS is a thoroughly illustrated catalog of 176 pages, with a complete index, which lists all types of radio receivers from the smallest to the largest, parts for replacement and repair, vacuum tubes, sound system equipment, and many types of electrical supplies. *Write for Bulletin 1137B, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

METHODS OF MAKING THREE-COLOR SEPARATION NEGATIVES is a small booklet that will be invaluable to the serious-minded amateur photographer and to the professional. *Defender Photo Supply Company, Inc., Rochester, New York.—10 cents postpaid. Free to photographers on business letterhead request.*

PIPE REPAIR HANDBOOK. Engineers, superintendents, and maintenance men responsible for pipe line maintenance will be interested in this booklet. It discusses all the various kinds of leaks in pipe lines—holes, splits, pitted or corroded sections; joints of various kinds, such as threaded joints, bell and spigot joints, welded joints, collars, and so on; and discloses how repairs may be made without service interruption. The Handbook is furnished without cost to men responsible for pipe maintenance. *M. B. Skinner Company, South Bend, Indiana.*

BORROWING MONEY is a 22-page pamphlet that will be of particular value to the individual and the small business man. It lays particular stress on the fact that it is no disgrace to borrow money although it is unwise to do so unless it is absolutely necessary. This pamphlet has been prepared to help in just such emergencies. It tells where to go to borrow money, how such loans are secured, and particularly warns against doing business with illegal lenders. The text is straightforward and business-like and does not beat about the bush. *National Better Business Bureau, Inc., Chrysler Building, New York City.—Gratis.*

HANDY CIRCUIT-BREAKER DATA is an 8-page illustrated folder which deals particularly with the electrical circuit protection afforded by a new fully-magnetic, non-thermal circuit breaker, available in instantaneous-trip and time-delay actions. *Write for Bulletin 1137C, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

DRAUCKER PHOTO FLASH CALCULATOR is a small pocket-sized "slide-rule" with which the amateur photographer can determine the type and number of Photoflash lamps to be used for a certain job and the diaphragm openings for synchronized or manual operation of the flash. The device is ruggedly made of celluloid and cardboard. *Munder Electrical Company, Springfield, Massachusetts.—50 cents.*

LOCATION OF FORD MODEL V-8 POWER PLANT TROUBLES MADE EASY, arranged by Victor W. Pagé, M.S.A.E., is a folded chart 22 by 34 inches which illustrates the vital parts of the V-8 motors. It lists the various troubles that may be encountered and gives hints as to how to rectify them. *The Norman W. Henley Publishing Co., 2 West 45th Street, New York City.—35 cents.*

INDUSTRIAL HANDBOOK TO GREAT BRITAIN has been compiled to give preliminary information to manufacturers who are considering the establishment of factories in Great Britain. It tells briefly of facilities available—finance, transportation, insurance, labor conditions and regulations, tariffs, taxation, and so on. *The Travel & Industrial Development Association of Great Britain & Ireland, 620 Fifth Avenue, New York City.—Gratis.*

SCIENCE TURNS TO SHAVING

(*Continued from page* 264)

the waterproof oil that is secreted by the sebaceous glands. The presence of this oil delays the penetration of the water into the hair, and for quickest results it must be removed. It varies in composition with dietary changes. When one's normal lathering process is deficient, this variation may account in part for the observation that shaving is easier on some days than on others. Soap suds or lather (containing over 98 percent water) is, of course, the most universally used detergent, but in the special case of these sebaceous oils the active constituents of brushless shaving creams are

(*Please turn to page* 316)

LEGAL HIGH-LIGHTS

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., LL.B., Sc.D.
New York Bar
Editor, Scientific American

Without License

IN a recent suit between two prominent radio manufacturers for infringement of patents on a radio circuit, the defendant contended, among other things, that he obtained a license to manufacture and sell the patented circuit by purchasing radio tubes for the circuit from a licensee of the plaintiff. The Court found that the defendant was manufacturing radio sets embodying the patented circuit. Defendant purchased in the open market radio tubes which were manufactured by a licensee of the plaintiff. The radio tubes were primarily designed and suited for use in the patented circuit and the defendant claimed that the purchase of licensed radio tubes of this character carried with it a license to manufacture the patented circuit. The Court rejected this contention, however, because it found that the tubes were suited for other uses, and that, furthermore, they were accompanied by a notice restricting the use of the tubes to replacements in apparatus licensed under the patents in suit.

Another interesting defense was involved in the suit. It appeared that each of the patents was drawn to a combination which included the radio tubes in the circuit. The defendant placed tubes in the sockets of the infringing sets, for the purpose of testing the sets. Prior to selling the radio sets, the tubes were removed from the sockets and they were packed separately in the receiver cabinets of the sets at the time of sale. It was contended by the defendant that since the patents included the tubes in the combination, the sale of the sets without the tubes in the sockets did not constitute infringement. The Court disagreed with the defendant, however, and held that there was infringement, stating:

"Where the elements of an infringement are thus sold in substantially unified and combined form, infringement may not be avoided by a separation or division of parts which leaves to the purchaser a simple task of integration."

Interstate Price Fixing

THE Miller-Tydings Act which was passed during the last session of Congress permits the fixing of resale prices, by contract, in interstate transactions where the commodity bears the trade mark, brand, or name of the producer or distributor of the commodity and where the resale is to take place in a state permitting such contracts. Most of the states of the Union have enacted so-called fair trade statutes, validating contracts prescribing the resale prices of trademarked merchandise. On this page in the February, 1937, issue of Scientific American, under the heading of "Price Fixing," we pointed out that while the state fair trade statutes permitted resale price maintenance on trademarked goods in intra-state transactions, the Sherman Anti-Trust Law still prevented price maintenance in interstate transactions.

The purpose of the Miller-Tydings Act was to remove this conflict between state and federal law and to permit contracts in interstate sales for maintaining the resale prices on trademarked commodities in states having fair trade statutes. This is a further example of the growing importance of trade marks, which we have referred to from time to time on this page.

Radioactivity

CAN a hotel receive copyrighted music from a licensed radio broadcasting station on a master receiving set and then transmit it to loudspeakers in the various bedrooms of the hotel without license from the copyright owner? Under a recent decision of a Federal District Court, the hotel would be guilty of copyright infringement.

In this decision the Court found that a large New York hotel was equipped with two master receiving sets which were connected by wires to loudspeakers in each of the bedrooms of the hotel. The master receiving sets were tuned to different stations and each loudspeaker was equipped with a switch whereby the guests could select the program being received on either of the two master receiving sets. One of the master receiving sets of the hotel was tuned to a station which was broadcasting a song copyrighted by the plaintiff in the suit. The broadcasting company was licensed by the plaintiff to broadcast the song, but was specifically forbidden under the license to grant licenses to anyone else. The copyrighted song was duly received on one of the master receiving sets of the hotel, and a guest by turning the switch on the loudspeaker in his room to the proper position would receive the copyrighted song. The plaintiff contended that the action of the hotel in receiving the copyrighted song on the master receiving set and making it available to the guests through the medium of loudspeakers in the several bedrooms amounted to copyright infringement.

The United States Copyright Act provides among other things that the proprietor of a copyright shall have the exclusive right "to perform the copyrighted work *publicly* for *profit* ******." The owner of the hotel contended that they did not publicly perform the copyrighted song for profit and accordingly they were not guilty of copyright infringement. The Court disagreed with this contention, and found the hotel owners guilty of copyright infringement, stating: "The guest personnel of a hotel******* although it shifts constantly, always constitutes a small cross section of the public. Clearly broadcasting within the hotel walls to the cross section of the public****must be as much a public performance as would be broadcasting in theaters."

On the question of profit for the performance, the Court stated:

"That inter-mural broadcasting by the hotel is not only a public performance, but also a performance for profit is obvious because it is one of the considerations given to the guests of the hotel for the rental of its rooms."

Grade Mark

A GRADE mark, as distinguished from a trade mark, cannot be registered in the United States Patent Office. In an interference proceeding recently decided by the United States Court of Customs and Patent Appeals two applicants were seeking to register the trade mark "Buckeye" for gloves. The Court found that the prior user of the word "Buckeye" on gloves was not entitled to register the name because he had used the word as a grade mark rather than a trade mark. The trade mark of the prior user was "Co-Shoc" and this was rather prominently displayed on the glove. In addition to the trade mark, the word "Buckeye" appeared on one type of glove and on other types of gloves different words were associated with the trade mark. The Court held that this use of the word "Buckeye" indicated a type or grade of glove and was not a trade mark entitled to registration under the Federal Trademark Statute.

It is interesting to note that the Court also refused to permit the later user of the word "Buckeye" to register the word as a trade mark, on the grounds that the later user was not entitled to exclusively appropriate the mark in view of the prior use of the word as a grade mark. In this connection the Court stated:

"It is our view that, under the facts developed here, neither party has shown itself entitled to claim ownership and, therefore, exclusive use of the mark. Appellant did not own the mark at the time of filing its application because it had not used it as a technical trade mark. This it did not attempt to do prior to the date claimed by appellee. On the other hand, appellee, at the time it claims to have adopted the mark, had no right to appropriate it to its exclusive use because of appellant's prior use of it to indicate a grade, or model, of its merchandise."

Artless

IN a recent suit between two prominent paper cup manufacturers, it was decided by the court that a paper drinking cup cannot be classified with the fine arts. The plaintiff had obtained a copyright on a pictorial illustration which it used in association with its drinking cups, and charged that the defendant used an illustration which infringed its copyright. The plaintiff's copyright was registered under a Section of the Copyright Law providing for registration of copyrights for pictorial illustrations connected with the fine arts. The court held the copyright registration invalid for the reason that a paper drinking cup was a commercial article and accordingly the illustration was not for use in connection with the fine arts.

SCIENCE TURNS TO SHAVING

(*Continued from page* 314)

also effective (most of them contain 65 to 75 percent water). These creams are often slightly acid in character, and there is a probability that razor-blade service is shortened thereby. The mixing of a little soap lather with such preparations definitely overcomes any possible objection on the grounds of acidity.

Even when vigorous rubbing and hot water are used for lathering, 85 percent progress toward complete softening of the hair is not attained in less than two minutes. In the case of men having grey or white hairs in their beards, this minimum time may be extended to five minutes, because white hair is more resistant to softening than naturally colored hair. The value of a shaving brush lies in its capacity to carry a bulk of hot water that does not cool off quickly, rather than its ability to work up unnecessarily deep lathers. The value of shaving soaps lies to some extent in their appeal to the habit of shaving with deep lathers, but more particularly their freedom from excess alkali and in the slow-drying quality of their lathers. Shaving soaps are probably the purest soaps made for any purpose. It is definitely good practice to wash and rinse the face at least once, preferably twice, with hot water and good toilet soap before applying the lather or a brushless cream. The idea is partly to consume time toward the two-minute softening period, and partly to remove gritty accumulations from the face.

These gritty materials are often harder than razor steel. It is asking too much of the razor maker to expect blades that will resist the ruinous effects of hard grit. These washing operations are frequently omitted by many men, and what a lot of "soft blades" they do find!

Then one's favorite shaving preparation may be applied, still using hot water. If his preference is based on a taste for the perfume in it, that is quite all right. Shaving may be begun at the end of two to five minutes, depending on the diameter and spacing of his hair shafts.

THERE is no known short-cut to this process. Where one's skin is unusually tender, cold water may be used for the final lathering, but in this case the lathering time should be extended to five minutes.

Adequate and effective softening of the hair mitigates both the pulling sensation and skin removal. The skin excisions are more conspicuous in the case of men having coarse, densely distributed hairs than in others, and in every man in those areas at the front collar line where the hair grows out nearly flat with the skin. Individuals differ by more than 4 to 1 in the amount of skin and hair removed by each daily shave; they differ by over 8 to 1 in their capacity to dull razor edges during shaving. One of the features of this variation that does not amuse razor makers is the failure of men at the two extremes of this range to understand each other's shaving problems or to discount properly the other men's shaving experiences. Nearly every man thinks he has about the toughest beard and tenderest skin in his community.

When shaving is carried out with a properly softened beard, and by use of a razor having a sufficiently small tangent angle, skin irritation is at a minimum and there is little need for after-shaving lotions. There are exceptions, of course, in the case of men with unusually coarse, dense beards, particularly when they attempt a very close shave. A shaving lotion does no harm in any case. It should have astringent as well as antiseptic properties. A 50 percent to 70 percent solution of ethyl alcohol is a good example of an agent having such properties. Many commercial lotions consist principally of this reagent; "rubbing alcohol" is a cheaper but less appealing form. The soap should be completely rinsed from the face before using any alcoholic lotion.

Soap makers are progressing in making available soaps and creams that are non-irritating to the skin. One after another, constituents of soaps to which skins may be sensitive or allergic are being eliminated. The present soaps are among the best antiseptic materials for the skin; yet soap technologists may some day produce soaps that are strong disinfectants for every pathogenic organism. Progress has also been remarkable in providing soaps that do not dry out on the face—an important item in dry climates. Shaving-soap makers fail to warn the user, however, that his success in working up a creamy lather on the face does not indicate complete softening of the beard. The presence of a thick lather in no way eliminates the necessity for using time for beard softening; it indicates that hair softening has only just begun, not that softening is complete.

IT is also true that the safety razor and its replaceable blade represent a definite advance in personal hygiene, which will be unquestioned as soon as users learn how to treat their faces properly. The current stage of progress in the razor field itself seems to be one where most manufacturers are taking the best of the razor steels and trying to make them ever sharper and ever more uniform. Some of them have had considerable success according to the writer's measurements. Their success in making uniformly sharp, durable blades is demonstrably greater than that of the user in softening his beard. Science is called upon freely, not only in devising control and inspection instruments for razor factories, but in the collateral fields of metallurgy and abrasive sharpening materials. In the latter field alone the progress has been such as to make quantity production of blades better and cheaper. Here and there a razor manufacturer is using scientific methods to study the newer alloy steels, with results that promise a more durable product than was ever available to the barbers of old.

Suggestions are occasionally made to use as razor materials some of the newer compounds that are harder than steel, such as tungsten carbide, other carbides, nitrided steel, and even glass. To produce a sharp, nick-free edge on such materials is a problem of such magnitude that its advantages might never compensate from an economic viewpoint for the expense involved. Furthermore, the necessity for correct facial treatment, like poverty, will always be with us. It is a safe prediction nevertheless that progress will be made in definite ways by razor makers now in the field who are energetically studying their subject in broad scientific ways.

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—*A. G. I.*

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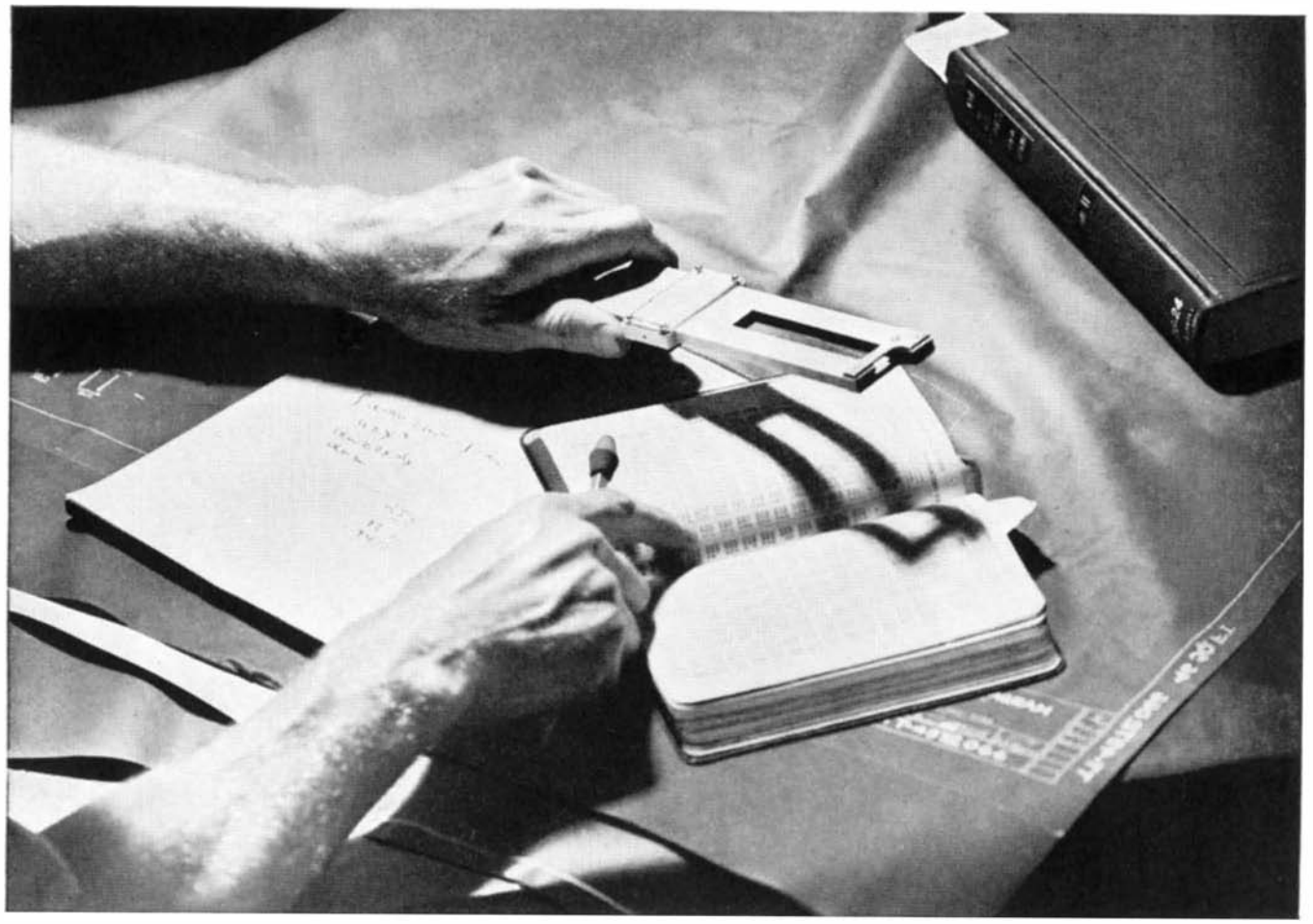

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