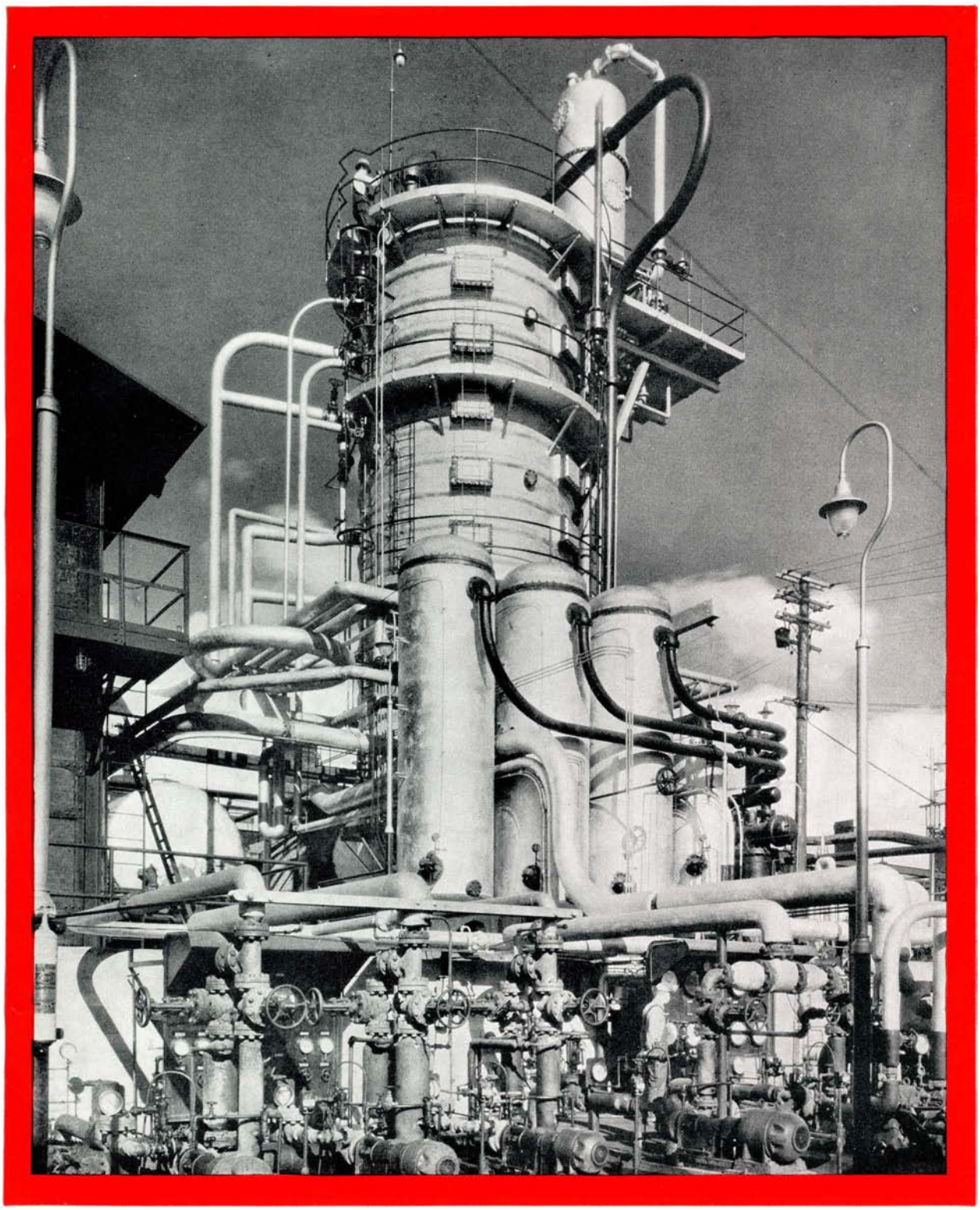
SCIENTIFIC AMERICAN



New Refinery for Better Motor Oils (See page 1)

VOLUME 152
•
NUMBER 1

QUINTUPLETS

By Prof. H. H. Newman

JANUARY 1935
•
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Your Hearing

By W. C. PHILLIPS and H. G. ROWELL

How to preserve and aid hearing by facts from the experiences of two outstanding authorities. The mechanism of hearing, the varieties and causes of hearing trouble, with a careful statement on the possibilities of remedial medical treatments, are all carefully explained, as well as lip reading, mechanical aids, and systematic hygiene for the conservation of hearing. This is a constructive attempt to supply the lack of knowledge which results in making a disaster out of a mishap.—$2.15 postpaid.

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By J. H. HOWARD

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By C. M. HOKE

THE present deep interest in gold and silver makes this small book of special value. Written by a recognized expert on the precious metals, it tells how to appraise old gold articles, identify platinum, silver, etc. It covers dentures; solutions; white, yellow and green gold; palladium, and so on. It describes several tests never before made available to the layman, and has an appendix of useful and interesting information. It is practical, entertaining, non-technical in language, and accurate.—$1.00 postpaid.

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NINETY-FIRST YEAR • ORSON D. MUNN, Editor

The SCIENTIFIC AMERICAN DIGEST

CONTENTS · JANUARY · 1935

COVER

IN a new refining plant which has been constructed in California to refine oil by the process described in the article starting on page 19, is the vacuum distillation unit shown on our cover. The vacuum fractionating column in the center background is designed to produce several grades of oil.

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ACROSS THE EDITOR'S DESK

Our 90th Anniversary!

LAST month we promised an important announcement in our January issue. Here it is: 1935 is SCIENTIFIC AMERICAN'S 90th Anniversary Year! To us this year is naturally a prideful one. It marks an important milestone in the successful publication of a journal of world-wide prestige—90 years of publication by the family of the original editor. To you, 1935 promises important monthly events.

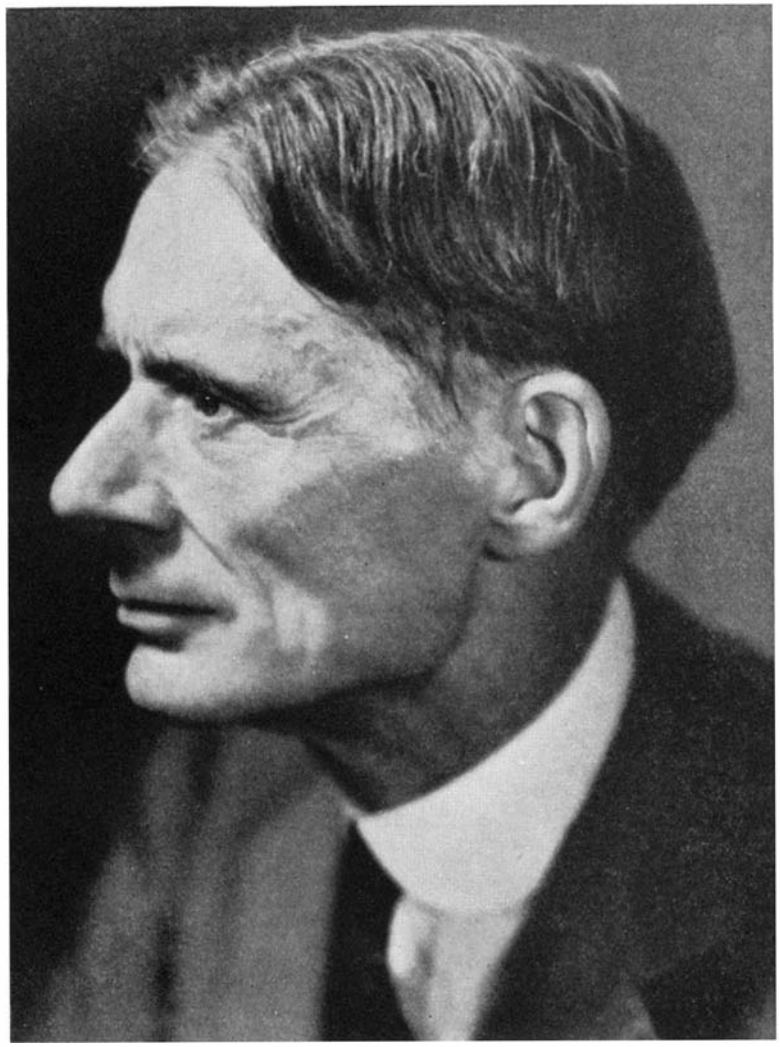
It is customary at anniversaries to look backward, to reminisce. By doing so we could uncover, in yellowed pages of bygone days, a wealth of interesting scientific fact and comment and of predictions, long since fulfilled in glorious measure, of practical industrial applications which we saw would follow various pieces of scientific research. We could carry our review of scientific achievement through four of the six major wars of the United States and through the difficulties of panics and depressions. We could tell of dark and uncertain days when progress seemed to stand still for want of courage and vision; and in turn, of high flying days when industrial expansion, if not sound progress, set the world in a fever. We could remind the world of many master strokes of genius which were also interpreted in pages now yellowed by time.

We prefer, however, to look to the future, sparingly toward the past. Present achievements come fast upon the heels of others and time is too short for reminiscence; progress today and tomorrow are too vital to admit of delay in interpretation and evaluation of new strokes of genius. The year 1935 is indeed our 90th Anniversary Year, but SCIENTIFIC AMERICAN is modern, is 90 years young. Thus devolves upon us, more than ever before, the job of mentor to thinking, science-minded people; the Age of Science is here, and science is taking its place as one of the strongest cultural influences of the day.

During this year 1935 momentous events will occur—in all fields of human endeavor. In science, and particularly in industrial applications of scientific findings, these events will have a very definite bearing on our future social and economic existence. This is borne out by the fact that even during the depression years, the much talked about "children of depression" have shown the progressiveness of the practical men of science. Therefore as new ideas, new products, and new processes are created in this swift march of science, SCIENTIFIC AMERICAN will carry on with outstanding articles in the true 1935 manner.

Editor and Publisher

Personalities in Industry



J. C. LINCOLN

AN ominous rat-a-tat-tat once spelled death and destruction on the battle fields of France. Peace put an end to both the clatter and the destruction of the machine gun. In peace time another sort of rat-a-tat-tat, still destructive to human nerves, has betokened progress. Research bids fair to supplant this staccato voice, in large measure, with a sibilant hiss of greater progress. But even in this process of supplanting, there has been war—a war of words, of claims and counter-claims, of citations of strength of materials tables, of industrial research, a war between far-sighted men and skeptics, engineers, manufacturers, steel men.

There is no doubt that J. C. Lincoln has been the outstanding general in this war of electric arc welding against the rivet hammer. Our own records, as war correspondent on this peace-time front predicting success for arc welding, show this clearly. Moreover, the recent award to Mr. Lincoln of the Samuel Wylie Miller Medal "in recognition of his great contribution to the advancement of the science of electric fusion welding" by the American Welding Society. completes the record.

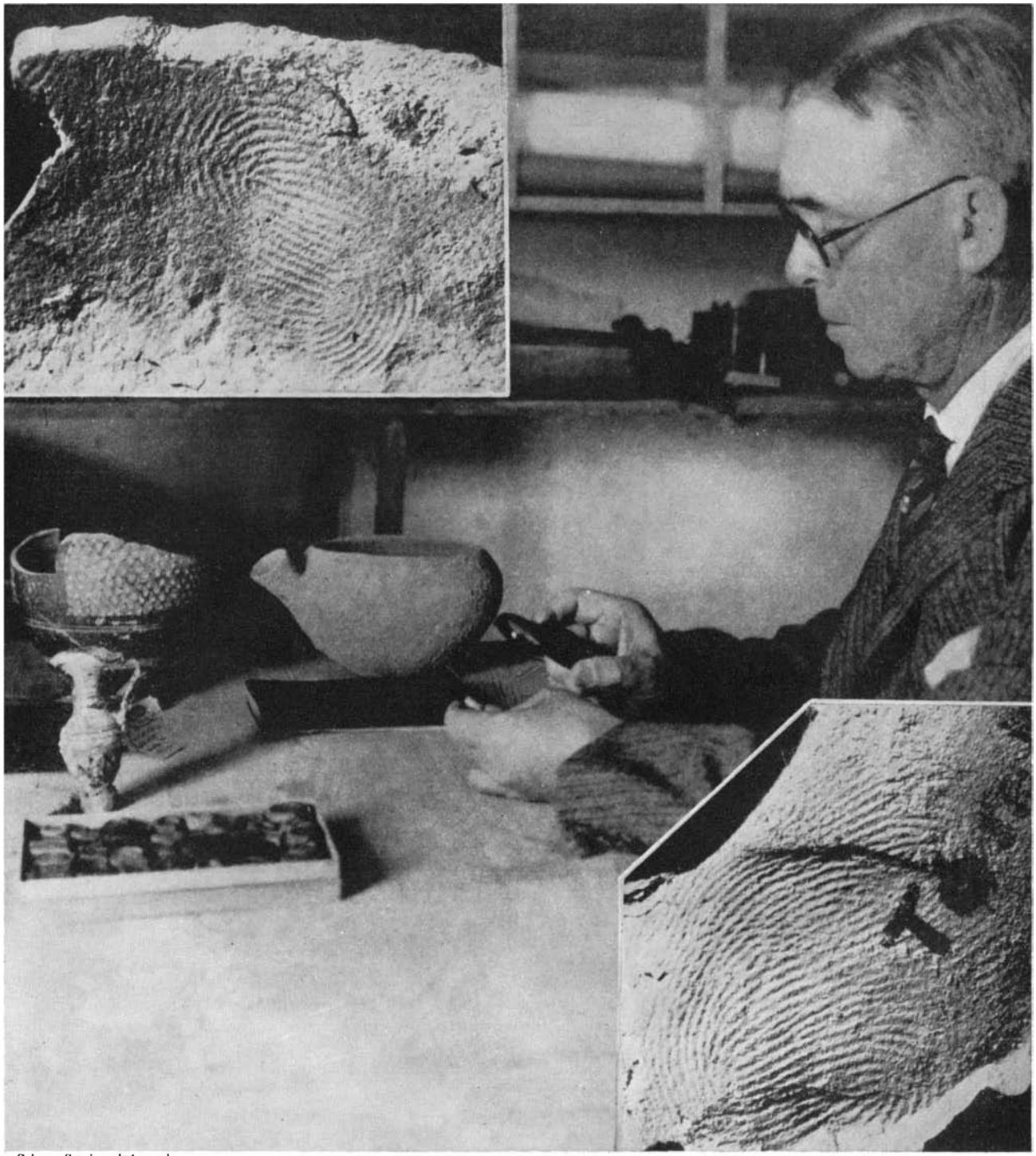
Mr. Lincoln knows the electric arc and its capabilities for, after receiving his degree from Ohio State University, he joined, in 1888, the staff of Charles F. Brush, inventor of the arc light. Later he became affiliated with the Elliot-Lincoln Company, one of the pioneer manufacturers of electric motors. In 1896, with this company as a nucleus, he formed the Lincoln Electric Company, of which he is now Chairman of the Board. Producing, in 1907, the first variable voltage welding machine, the company under his leadership rapidly improved the technique of arc welding. He was the first to carry the electric arc into the structural field.

Today arc welding is rapidly finding new applications. Mr. Lincoln explains thus:

"The application of arc welding has changed our concepts in many ways regarding methods of manufacture. From the point of view of repairs it has given us the much-desired putting-on tool which has made possible low cost repair in almost all cases instead of high cost replacement.

"The second application which appeals to the public strongly is its application in building construction. The elimination of the noise of the riveting hammer has appealed to many nerve-racked neighbors. The thing which has been largely overlooked, however, is the fact that arc welding makes it possible to make a joint as strong or stronger than the parent metal, which rivets cannot possibly do. Therefore, the amount of material needed for a structure is very considerably reduced. This is particularly important in marine construction where the smooth outline possible with welding will materially increase ship speeds. This construction also will very materially reduce all costs of construction because of the cheaper method of doing the job and less material required for the same result.

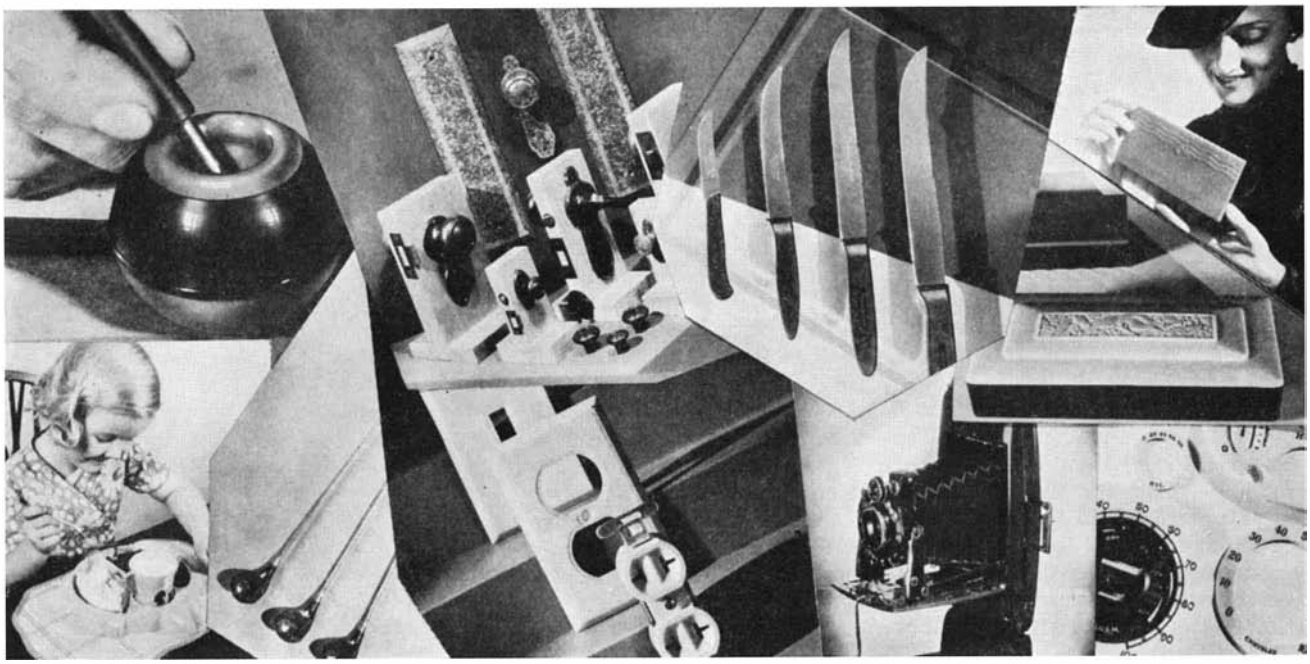
"In spite of the attractiveness of these two applications, the one which is by far most important, insofar as size of the application, is the replacement of steel and iron castings by welded structural steel. This is the application in which arc welding is used much more than in the two cases above. This application gives a lighter, stronger, unbreakable, cheaper part than is possible by the casting method. This will also result within a comparatively short time in the elimination of a large part of foundry work. It will at the same time increase the amount of steel used. At the present time probably about one and one half million tons of castings per year have been eliminated by this process. It is probable that it will eliminate a total of about 75 percent of castings as made prior to the time of the advent of welding. This process will also entirely eliminate the rivet as a method of joining structures. It will also largely increase the utility of worn and broken parts."



Science Service photograph

FINGERPRINTS OF 3000 YEARS AGO

THE long arm of archeological science has reached back 3000 years to obtain a record of ancient potters who left fingerprints in their clay wares. The prints were detected by Dr. William F. Bade, shown above examining dishes which he unearthed at the ruins of Mizpah, in Palestine. In wine jars, cups, and lamps he discovered prints that were so plain that the work of different potters could be sorted. The prints shown in the corners of the illustration are those of the same potter impressed on two different objects. In some cases pottery from different levels of the town's ruins were discovered to be the work of the same potter. Mizpah is the Biblical city where Saul was chosen king.



PLASTICS IN INDUSTRIAL USES

PLASTICS COME OF AGE

Age 66 . . . Structural and Insulating Qualities . . . Shoes and Dental Plates . . . Fireproof Wall Panels . . . Transparent or in Colors . . . Compete With Wood and Metals . . . An Even More Plastic World Seen

By PHILIP H. SMITH

FEW are the residents of these United States who do not make daily use of some plastic. Upon rising, the individual may drink from a plastic tumbler, manipulate a plastic handled toothbrush and shaving brush, and button plastic buttons. When he climbs into his car he grasps a plastic ball on the gear-shift lever, glances at a plastic instrument panel and glides away in a vehicle which functions with the aid of plastics. Once at his office he may lay his cigarette on a plastic ash tray and reach for a plastic telephone receiver. And so throughout the day—yet the plastics industry has little more than passed through infancy.

From this brief listing of items, plastics can be fairly well identified, but we are no nearer to knowing what they are. Examination of them reveals little or nothing. What makes a plastic and why?

Plastics is the name given to a more or less arbitrarily chosen group of substances which, when properly compounded and treated, become plastic and can be molded or cast to shape. The plastics group embraces nitro-cellulose, rubber, phenolic and urea resins, cellulose-acetate, shellac, casein, and styrol, glyptal, and vinyl resins.

So many and varied are the plastics on the market today the layman may well ask "why?" Do these products compete for identical markets? And the manufacturer contemplating their use may carry the question a step further and ask "which one?" Both questions can be answered by stating that many plastics are partially competitive, but each type has properties differing more or less from all others. Each type was developed with specific uses in view, or, having resulted from laboratory experiments, certain properties were recognized and new markets developed. The properties which recommend the various plastics are: dielectric strength, heat, chemical, and moisture resistance, color, ease of fabrication, tensile and bending strength, and impact resistance, or combinations of such properties.

Plastics came into existence just 66 years ago when John Wesley Hyatt, searching for a substitute for ivory for making billiard balls, invented Celluloid, a nitro-cellulose product. But it wasn't until 1907 when Dr. L. H. Baekland discovered how to control the union of phenol, or carbolic acid, and formaldehyde to make the synthetic resin known as Bakelite, that one could speak of plastics and a plastics industry. It was that discovery, precipitating development of synthetic resin plastics, which gave rise to a producing group and an allied group of fabricators—a host of specialists in molding. Statistics bear this out for during the past 20 years plastics production has risen steadily. Now, following a few years of very rapid growth the industry has an annual output conservatively valued at 50,000,000 dollars.

TO explain the phenomenal growth of recent years it is necessary to consider the chemistry of materials and processes, for commercial expansion is the natural outcome of technical progress linked with other factors which will be mentioned later.

Plastics can be divided into two groups — thermo-setting and thermoplastic. The first group undergoes a chemical change when heated to curing temperature in a mold. The resultant

product is permanently hard, infusible, insoluble and non-reversible. The thermo-plastic type, when molded, softens in heat without chemical change and hardens to form. This latter type can be remolded with heat. Aside from these two types are plastics molded cold with a binder. Chief among the thermo-setting type are phenolic, hard rubber, and urea. In the thermo-plastic group fall cellulose nitrate and acetate, shellac, Plioform—a new rubber base material — and vinyl, styrol and glyptal compounds.

Plastics are either molded or cast. In molding, the compounds are placed in a mold cavity in the form of powder, granules, or chips and the proper heat and pressure are applied. The product comes from the mold with a permanent gloss needing no surface treatment. This process is fast, and complex form can be given to the finished piece so that molding offers many economies in production. Cold molded plastics receive similar treatment except that the charge is pressed without heat and the formed piece cured outside the mold by baking in an oven. The advantage of this type lies in speed of molding and in certain savings in cost of molds, since rapid press work can be obtained with single cavity molds and the curing done in mass. In general, three types of binders are used for cold molded plastics—asphalt where lowest cost is sought; phenolic resin; and cement or silica-lime, these last two being used where high refractory properties are desired.

LAMINATED plastics can be classed with the molded group. They are made in sheets, rods, and tubes. Sheets of fabric or paper stock are impregnated with the plastic, then piled upon each other to any desired thickness and pressed, the resins fluxing in the process and taking a permanent set as in molding. Tubes are made by winding impregnated fabric onto mandrels and either rolling under heat and pressure or molding with heat in steel molds, while rods are produced by machining laminated sheets or by winding impregnated fabric on a wire, then removing the wire and molding.

The casting of plastics is performed by pouring a liquid plastic into a mold. Cast plastics are usually cast in sheets, rods or tubes ready for machining to form, much as metals are handled. Rods, for example, are widely used for buttons, which are machined to form.

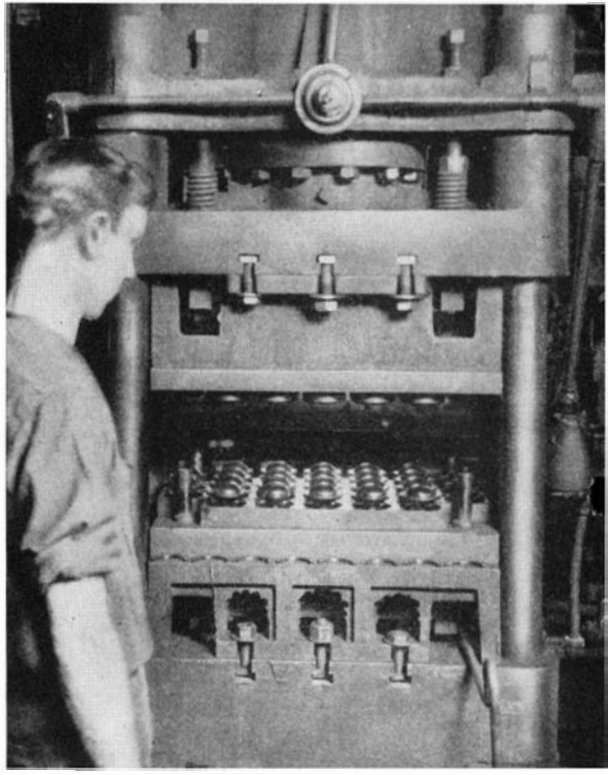
When Dr. Baekland introduced Bakelite, he made available a plastic which, unlike nitro-cellulose, was non-combustible. This original phenolic type with its high dielectric properties found prompt application, but it could not be made in light colors without heavy pigmentation and the resin tended to darken with age. So the next step in the phenolic field was to get permanently light colors, translucency and transparency, and this gave rise to the cast phenolic. Later came the urea products.

All this development work took years to accomplish but success was crowned with a utility value almost beyond imagination. Manufacturers discovered that they had at their disposal virtually a new material —something which combined mechanical and structural qualities to make it competitive with wood and metal or to be used in combination with both, something which lent itself to mass production use and so attractive as to aid in the creation of its own market. Indeed, the eye-appeal and pleasant surface feel of plastics have produced sales

results which largely explain the phenomenal growth of the past few years. Commercial records are replete with instances of success achieved with plastics.

Though the discovery of new plastics has brought about some replacement of the older types, that is of minor import in comparison with the boost it has given the industry. Each plastic has made a distinct contribution and this will be seen from discussion of some of the newer forms.

Consumption of the phenolics has increased by leaps and bounds and today they are the most widely used of modern synthetic resin plastics. No adequate statistics are available, but a hint of this growth is given in figures which show output of synthetic resins of coal-tar origin, mainly used in plastics, multiplying more than 20 times in the past dozen years. The molded type using such fillers as wood flour (sawdust), mica, asbestos, and fabric, has high bending and tensile strength, excellent heat resistance, and performs well in the presence of weak acids, alkalis, oil, and water. The public knows this material under many names, among them Bakelite, Durez, Resinox, and Textolite. The laminated type can be made stronger than cast iron and this property of strength coupled with fine insulating properties has given it wide industrial application for such items as gears, bushings, plates, washers, non-metallic shims, pump valves, electrical parts, and



Above: **Making phenolic objects in a multiple die under hydraulic pressure.** ***Left:*** **A pile of the raw material from which such objects are molded**

the like. This type will be recognized by such well known names as Bakelite, Micarta, Formica, and Celoron, among others.

The cast phenolic plastics are used where lightness and brilliancy of color are paramount or where transparency or translucency is desired. This type is perhaps best known under the names Catalin, Bakelite, and Marblette.

STILL newer types of plastics are those basing on urea. This is a thermo-setting plastic best known by such trade names as Beetle, Plaskon, and Unyte. Urea plastics have several properties which particularly recommend them. They are tasteless and odorless, which explains their use for dishes, and they can be made translucent or in light colors without heavy pigmentation. Solka, the new cellulose product of spruce forests, is most often used as a filler for it provides strength without impairing the translucency or brilliancy of the light colors, but paper products are also used. Urea plastics come in molded, cast, and laminated form. Molding around metal for articles where hard usage demands great strength, such as for automobile door handles, has just been announced. In this instance the plastic replaces metal plating.

Styrol and vinyl resin plastics are as yet used in much smaller quantities than the phenolics or ureas. The former compares with amber or quartz as a dielectric and by some is considered superior. The latter features transparency, translucency, and bright colors. It has machining and dielectric properties of a high order.

Rubber is still used on a very large scale as a plastic, but the phenolics have tended to replace the hard molded

forms. Among outstanding qualities are its capacity to withstand shock and resist abrasion. Quite recently a thermoplastic, rubber-base material was introduced by Goodyear under the name Plioform. Plioform is molded in much the same manner as the phenolic resins, but it has the quality of resisting moisture and possesses high dielectric properties.

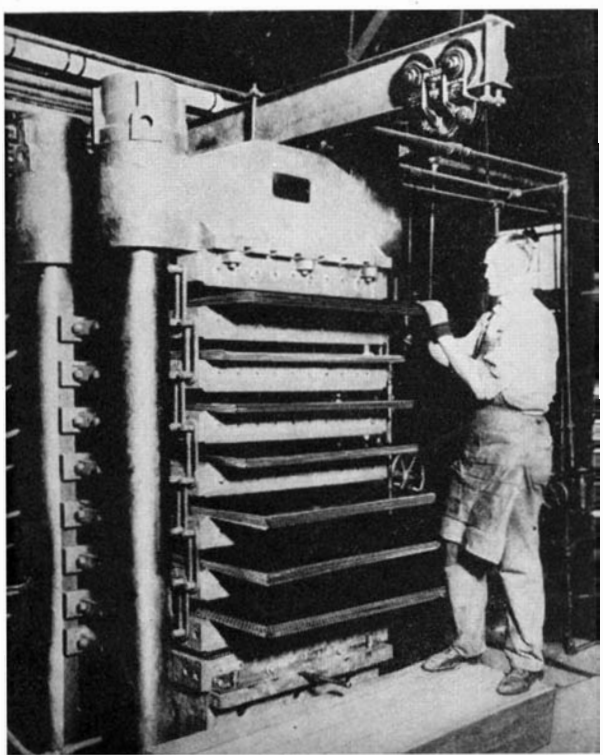
NO description of plastics would be complete without specific mention of the nitro-cellulose and cellulose-acetate types. The former, called pyroxylin, and best known to the public by such names as Celluloid and Pyralin, has wide use as a decorative material. In 1933 close to 12,000,000 pounds were produced. It is usually formed in sheets, rods, and tubes for machining, but it can be molded. Cellulose-acetate is much like pyroxylin, but it does not burn explosively and therefore, sometimes substitutes for it. Its high dielectric properties and low water absorption make it an excellent insulator. It is made in practically all colors and is perhaps best known commercially as Lumarith, Tenite, and Masuron.

Plastics' first big use was as a non-conductor in the electrical field and as an imitation product for such items as pipe bits, umbrella handles, and the like. Only with the advent of the cast type came the conception of a plastic as a material in its own right with endless commercial possibilities, and coincident with this came a cheapening of the basic materials and improvement in the making of molds, leading to lower fabricating cost. Then the race was on.

Viewing the present position of plastics one might think they had reached a stage of complete exploitation. Certainly there is hardly any commercial endeavor in which they fail to play a part, but widespread as is their use the limit is not yet reached. There is room for development—along chemical lines in discovering new types and refining existing ones; along commercial lines in finding new uses and extending present applications. We may hazard the opinion, held by many, that search will be made to uncover a cheaper resin which will cut costs and open the way for much larger consumption. Plastics are not cheap materials. Prices range all the way from about 15 cents to several dollars per pound, depending on the type and form.

Let us for the moment consider the future of plastics without reference to cost, since possible application precedes consideration of cost. What direction will expansion take? There is no certainty of direction; one must use one's imagination. It sounds absurd but consider the material. Plastics combine structural and insulating qualities, need no finishing, possess attractive color and pleasant surface feel, will not rust or tarnish, and have all the other properties already mentioned.

Below: **Layers of fabric or paper, impregnated with plastic varnish, are pressed to yield a laminated material.** *Right:* **Some uses for this product**



Draw upon these facts and possible applications come to mind. Maybe they have been thought of already; maybe they haven't. Someone, for example, recently thought to use plastics for photo-elastic stress studies. Now, forms to be studied are made up in a transparent plastic, polarized light is passed through them and the stress is measured by the refraction of the light. Certainly any material which can thus be used to promote science, which can be used for the box toes of shoes, for dentures, and serve as a chinaware, as a table top, as a substitute glass to transmit ultra-violet rays, and as the transparent binder in non-shatterable glass, simply puts it up to human ingenuity.

If we consider plastics as competitors of wood and metal we find undeveloped fields immediately. The principal ones are house furnishings and building construction. Plastics can be made into furniture by combining a resin with wood flour; they can be used as veneers for tables, cabinets, and the like, or in laminated form for the solid tops of tables and bars. Such plastic equipment is fire-resistant and will not mar from ordinary wear and tear or from cigarette butts and alcohol.

THE use of plastics in building has hardly begun, yet its possibilities are known. Panels are offered by many producers, among them Bakelite, Formica, and Micarta. These panels can be produced to simulate stone, wood, or tapestry for walls, store fronts, or elevator cars. Carbide and Carbon Chemicals Corporation, experimenting in co-operation with the Pierce Foundation, having the pre-fabricated house in mind, found vinyl resins practical in the manufacture of doors, wall panels, and floor tile.

It does not take great imagination to visualize houses of the future exhibiting plastics in a much wider number of applications. Floors, doors, and walls would be fire-resistant, unmarrable and in attractive color. Lighting fixtures will feature translucent plastics. Even windows would be made of plastics, translucent or transparent, depending upon the desirability of the view. And much the same application would take place in public buildings, stores, and the like. We can look forward with certainty to an increased use of plastics in transportation equipment where non-inflammability and light weight would be an asset in airplane, railroad train, and steamship construction.

If this comes to pass, and any great development hinges very much upon successful efforts to lower costs, then the production volume of this relatively new material will rise much more rapidly than it can by subsisting upon a vast array of small items, though they are produced in mass. And we shall live even more in a plastic world.

●

EDITOR'S NOTE: *Unless listed below, trade names mentioned in this article are identical with company names. No attempt has been made to list all producers of plastics.*

Beetle (American Cyanamid), Celoron (Continental-Diamond Fibre), Durez (General Plastics), Lumarith (Celluloid), Masuron (J. W. Masury & Son), Micarta (Westinghouse), Plaskon (Toledo Synthetic Products) Pyralin (DuPont), Tenite (Tennessee Eastman), Textolite (General Electric), Vinylite (Carbide & Carbon Chemicals).

Photographs courtesy makers of Bakelite, Plaskon, and Beetle.

INDOOR PHOTOGRAPHY

With Ordinary Cameras . . . Super-Sensitive Film . . . Inexpensive Flood-Lights . . . Flash-light Bulbs

By A. P. PECK

An indoor photograph taken with the arrangement of Photofloods and camera shown at the left. With two bulbs at A, three feet from the subject, and one at B, six feet from the subject, an exposure of 1/25th of a second was given at opening *f*/6.3

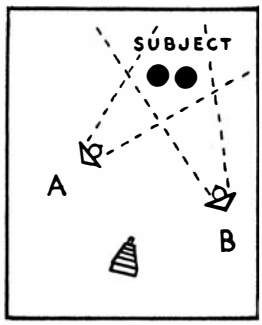
ALL you need to take indoor snapshots of the youngsters before you tuck them in at night, of fun at parties, and other home scenes, is a camera with *f*/6.3 or faster lens, a few inexpensive Photoflood lamps, and a roll of super-sensitive film. With cameras having slower lenses (even those of the box type that have "time" adjustment) you can make quick time exposures.

Preparations are few and simple. Depending on your lens, you can take indoor night pictures in one of three ways.

1. For *snapshots* (1/25) with an *f*/6.3 lens at full opening, use super-sensitive film and three flood lamps as shown at the right.
2. With slower lenses, use Photofloods in the same way but place camera on a table and make short time exposures.
3. An easy method for successful indoor pictures at night with single lens and box type cameras is simply to replace the bulb in any readily portable home light with a Photoflash lamp. Remove the shade and hold lamp about six feet from subject, a foot or so higher than the head. Set camera for "Time," place it on a table, open the shutter, flash light, close the shutter, and you've got your picture. Inexpensive reflector units are convenient and make the light more effective.

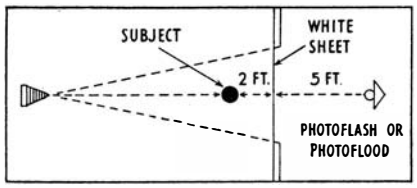
Striking silhouette photographs are easy for the amateur photographer to make, results such as the above being obtained with the set-up illustrated at the right. A white sheet is stretched tightly across a doorway between two rooms. With two Photoflood bulbs in a floor lamp with shade removed, an exposure of two seconds will suffice for single-lens cameras. Double-lens cameras at *f*/8 will require one second, and *f*/6.3 lenses about ½ second. With Photoflash bulbs, set shutter for time, open it, flash the bulb and close shutter. Use fast film. Silhouette photographs are most interesting showing profiles of the subjects

FOR pleasing pictures, especially close-ups, there should be a proper balance of light. It is usually best to place flood lamps on each side of the subject, arranged to give somewhat more illumination from one side than from the other, with at least one light a foot higher than the subject's head. Where but two Photofloods are used—one on each side—good modeling is secured by having one lamp about twice as far from the subject as the other. See sketch above.



Where lamps cannot be tipped for directing light on the subject, remove the shade. In such cases, some sort of reflector *back* of the lamps will throw more light forward. A white cardboard, a pillow case, or even a bright dishpan held directly behind the lights will help.

Be sure that lights, especially those unshaded, are far enough to the side



so that they do not reflect into the camera lens.

Complete all preliminaries with ordinary bulbs in lamps, then when ready, replace with Photofloods.

With focusing cameras, get the distance right. If, for example, you have focused for six feet be sure that the distance from the subject to the lens is exactly six feet. Better measure it.

When flood lamp bulbs are employed for general illumination for a picture of a room, it is best to use a medium sized lens opening such as *f*/16 or the second stop on single lens cameras to get objects at various distances sharp. An exposure from one to six seconds is needed when using super-sensitive panchromatic film—depending on distance included, number of lamps, character of reflectors, and color tone of the room. When using Photoflash, bright room lights very near the subject should not be on, as a secondary image might be recorded if the subject moves in the intervals just before and after the flash, while the shutter is open.

Reflectors, such as those mentioned above, may often be used to good advantage in many types of photography with artificial lighting. Large sheets of Bristol board, obtainable at art stores, serve as inexpensive reflectors, and often enable the photographer to direct a small amount of light to a dark part of the subject, thus "cutting" shadows or adding to the modeling effect. For permanent use, white cloth may be stretched on a frame, and a stand provided for holding the reflector in the desired position.

OUR POINT OF VIEW

Here America Lags. Time to Change

MOST persons who are familiar with science in general and radio in particular will recall the litigation which has been taking place for some years between Lee deForest and Edwin H. Armstrong, over the regenerative circuit in radio. The question was: Which of these two was its real inventor? During a decade or so previous to the latest court decision, which has been rendered by the United States Supreme Court, exactly 12 courts had handed down decisions in this famous case. Six of these decisions favored the deForest claims to priority of invention, while six others favored the Armstrong claims. Now the Supreme Court has declared that the inventor of the regenerative circuit was Lee deForest, and in denying a rehearing it has ended the case, since there is no higher tribunal than this one. The prize is, of course, the most valuable of all radio circuits, and the decision given awards a monopoly of its use and control. This, then, is how the law, through its mouthpiece the jurists, answers a vexed question.

The law is a very old, very well established and consolidated human institution. Today, however, there is a new estate in the world, science, a comparative upstart but widely acclaimed by all or nearly all, and recognized as the increasingly dominant influence of our age. Yet so youthful is science, relative to the other estates, that its prestige and position remain to be consolidated in a formal way, as a peer of the older traditions. Now the two have come to loggerheads in one instance. The radio decision that was acceptable to the law is unacceptable to science: Men of science whose work permits them to formulate an opinion are almost a unit in the belief that the discoverer of the regenerative circuit was not deForest but Armstrong. They feel that the Court was confused by the technicalities involved and, in short, did not fully comprehend them.

This brings to the front a question which has been in the back of many scientific heads for a long time. Is it fair to any court composed of members who have not had technical training to ask it to adjudicate questions on science which a lawyer's training does not necessarily fit him to understand? How can most men who have concentrated on law and jurisprudence as intensively as is implied by their reaching the Supreme bench also be expected to know all the ins and outs of science? Certainly no scientist does.

Now that science and industry have come to play so important a part in modern life, and will play an increasingly important part in the world as we march on into the real Age of Science which has just begun, the time has clearly come when the courts should have at their elbow some kind of outside technical aid when dealing with technical matters—the best aid science can offer, honest and disinterested. Abroad, this fact has been recognized, and court aides—technical men—form a legal adjunct to the courts in cases involving patents. Here America lags and should catch up.

Railroads Look Ahead

CONGRATULATIONS, *M-10001!* Congratulations, also, to those farsighted officials of the Union Pacific and to those scientists and designers of this streamlined, Diesel-powered train marvel and of her equipment, who made possible her record-breaking trip from Los Angeles to New York in October. Better than by any amount of short-run testing or sensational publicity of the usual type, you have, by breaking all sprint and distance speed records, revealed a vision of the future to our wondering eyes; and that future looks good. It shows an aroused spirit of railroad progress, a determination to step forward into the vanguard with other leaders of the modern age.

Fifty-seven hours from Los Angeles to New York—3500 miles—against a 1906 record of 71 hours; two refuelings of oil at four cents a gallon; 1.6 gallons of oil per mile consumed by the Winton 900-horsepower, V-type Diesel engine; 83 dollars total fuel cost for pulling the six-car, 211-ton train—this is indeed a significant achievement. Why it has been called a "bold and promising experiment" is rather unintelligible; there was no uncertainty as to the result as that statement infers. This train is a scientifically grouped set of known factors, the performance of which was predicted with great accuracy by noted scientists. The "experiment" lies only in the question as to whether this train, and others like it that are to come, will bring back to the railroads the passenger traffic that has been taken from them by buses, airplanes, and private cars. We think so. We venture to predict an early revitalization of railroads and their accession again to a strong position in the national scheme, conditioned or delayed only by the necessity for discovering what to do with present rolling stock which represents a huge investment.

M-10001 has, indeed, shown the way toward railroad prosperity. Without deprecating what she has done, our comment is: Why not long ago? SCIENTIFIC AMERICAN has urged for many years—almost since the airplane first taught the public something of aerodynamics—that the railroads be up and doing, that they adopt streamlining, increase speeds, cut the weight of their trains, and with it all build again a prosperous transportation system to serve the country that it helped, more than any other one agency, to build. Action comes late, but not too late. The railroads will no doubt now recapture, slowly but surely, much of their lost business and with it their moribund prestige.

Movies for "Death Drivers"

THE scene is a New York City court room. Behind the vacated judge's chair is a motion picture screen. The shades are drawn, the lights dimmed. Motor-car drivers, arraigned on various charges, compose the "audience" at this unusual movie show. By no stretch of imagination are they there to be entertained. Rather, they are being subjected to a novel psychological experiment.

From the "talkie" equipment comes the smooth, even tones of an experienced announcer. He is describing fluently, but none the less grippingly, the horrors of disaster on the highway—horrors brought about by just those things that brought this movie audience to this court room. On the screen cars careen into view, crash head-on; the terrifying sounds of crumpling steel, splintering wood, human voices in agony, lend stark realism. A careless driver swerves from the road, crashes over a cliff. A passing car gets too close, sideswipes another, a human life is sacrificed. And the voice of the announcer goes on to drive home forcefully the much needed lessons.

Here, briefly, is an educational use for movies, which at the same time can contribute mightily to highway safety. Many motor-car drivers cannot be taught by ordinary methods. The much needed lessons must be pounded home through eyes and ears; talking movies can do the job effectively.

QUINTUPLETS, QUADRUPLETS

The five famous Dionne infants, about five days after their birth in Canada

DURING the last few months considerable popular interest has been aroused concerning human multiple births, through the extensive publicity accorded the remarkable Dionne quintuplets. Having made a specialty of the subject of twins and twinning for nearly a quarter of a century, the writer was quite anxious to see these quintuplets, but for some strange reason was denied the privilege by the doctor in charge. We went so far as to visit the village of Callander, Ontario, calling at the doctor's residence, only to find him away on a case and unavailable.

There is only one very remarkable thing about the Dionne quintuplets, namely, that at the date of writing they are all living and show promise of surviving at least the period of infancy. Quintuplet births are not very rare, some 30 cases having been recorded in medical literature, at least 20 of them probably authentic. There has been no previous case, however, in which all were alive at birth or survived the first few hours or days. Dr. Dafoe and his nurses are therefore to be congratulated on their remarkable success in overcoming the hazards incident to premature births and in rearing these five little infants through the first four months. The babies have now as good a chance as any children to grow up, for they have the very best of care, and no expense is spared to give them everything necessary for their welfare during the first two years of their lives. The Ontario government, in collaboration with the Canadian Red Cross Society, are official wards of the quintuplets and spend about 150 dollars per week on their care. A backwoods hospital has been erected near Callander especially for the infants, which will be in charge of Dr. Dafoe. We shall all watch with interest this striking experiment in infant welfare.

ONE other possibly unique feature of the Dionne quintuplets is that they appear to be identical, derived from a single fertilized ovum (life cell). Dr. Dafoe asserts that they are identical on the basis of his own studies. The fact that they are all of the same sex—female—and that they are remarkably similar in appearance, favors his statement, but much more crucial tests are necessary. It is our hope that at some future time we may be of service in helping to determine by means of our methods whether Dr. Dafoe's judgment is correct. The study of their finger prints, palm prints, and sole prints should go far toward determining whether or not they are derived from one, two, three, four or five ova.

A good deal has been written within recent months about the occurrence of plural births of higher than five individuals. Extravagant statements occur in the older, non-critical, literature to the effect that much larger numbers have appeared at one birth. In view of all the facts, it seems safe to say that sextuplets represent the limit of human multiple births, and that even such numbers are extremely rare.

As we have said, quintuplets have been recorded about 30 times, with the probability that at least 20 cases are authentic. Quadruplets, triplets, and twins are all comparatively common, but their relative frequencies differ greatly. Twin births occur once in about 88 births, though their frequencies vary in different countries, being apparently highest in Denmark. Curiously enough, the frequency of triplets is about one in every 88^2, or one in approximately 7700 births. Quadruplet frequencies are said to be about one quadruplet in every 88^3, or approximately one in about 6,000,000 births. The actual figures fit but roughly the neat progressive series of one in 88 for twins, one in 88^2 for triplets, and one in 88^3 for quadruplets. No one has any good theory as to why the frequencies should even approximate this progressive series. Some critics consider the progression 88, 88^2, and 88^3 as largely forced and not well supported by the actual data. Nevertheless this mysterious progression of decreasing frequencies with increasing numbers at a birth is rather generally recognized as valid and is known as Hellin's Law, after the discoverer of the alleged series. If Hellin's Law should be stretched to apply to quintuplets we might expect a set of quintuplets to be born once in about 500,000,000 births, which would not be much more than once in a human generation. The actual frequency appears to be somewhat greater than this, but even at that, quintuplets are sufficiently rare to be true curiosities. If the writer, a specialist in this field, should be denied a future opportunity to see the Dionne quintuplets while all are living, it would be a shame, for no other set is likely to be born in his lifetime in a region accessible to him.

Comparatively little scientific work has been done on quadruplets and triplets, although work on triplets has been quite active in recent years. We know at least that identical quadruplets and identical triplets occur, though the fraternal sets are far more frequent. Twins, on the other hand, have been the subject of very numerous investigations and have been highly valuable as materials for attacking numerous bio-

TRIPLETS, TWINS

By H. H. NEWMAN, Sc. D., Ph. D.
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logical problems of some significance.

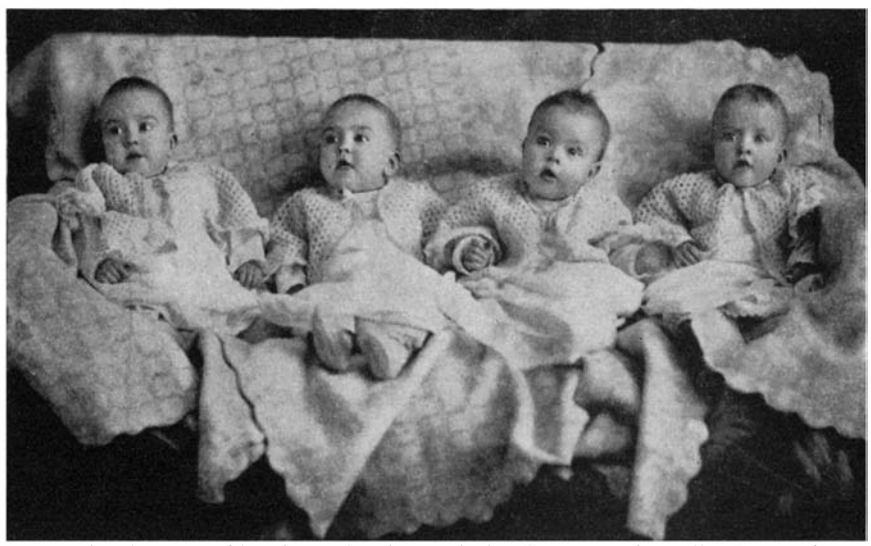
Twins are of two main sorts, identical and fraternal. Identical twins are the product of the division of an early embryo into two tissue masses, each of which is capable of developing into a whole new individual. Sometimes the division of the original embryo is incomplete, and the result is a pair of twins united by some more or less extensive fleshy and bony bridge. Thus Siamese twins, of which a number are at present surviving and earning a good living on the stage, represent one type of incompletely separated identical twins. Other types have two heads on one trunk, which is externally single, but double in many internal parts. Double monsters are not infrequently born, but, fortunately, few survive. True Siamese twins are less handicapped than others, but at best their lives must be very much hampered by their close union. Recently the newspapers have been enlivened by stories of the engagement of one of the Hilton Siamese twin sisters and her unsuccessful application for a license to marry, her twin sister not being a party to the contract. License bureau officials, sensing the anomalies of the situation, have refused to issue such a license both in New York and in Chicago. We suspect that the whole business may at least afford good professional publicity for the twins.

FRATERNAL twins are not strictly twins at all, but merely coincident births. They are the result of two ova freed and fertilized at the same time. The human species typically frees but one ovum in connection with each monthly period, and the occasional liberation of two ova is merely evidence of the inexactness of an otherwise nearly constant mechanism. Because fraternal twins start independently and have an origin no different from that prevailing among brothers and sisters, they may be both of the same sex or of opposite sexes. And the members of a pair are no more similar than are brothers and sisters, except that they are of the same age while brothers and sisters are usually a year or more apart.

The situation with regard to identical twins is quite different. The two members of a pair are always of the same sex and much more similar than are ordinary brothers and sisters. The reason for this is clear. Identical twins are derived from a single zygote (fertilized egg) and it is known that sex and many other characters are determined at the time of union of the ovum (female gamete) and the spermatozoon (male gamete). Any given zygote has at the time of its origin a unique and fixed hereditary potentiality, hence two or more individuals derived by division from a single zygote will have the same hereditary potentialities. This is why identical twins are always of the same sex in a pair, and have such a high degree of resemblance. Identical twins are, however, never completely identical, for several reasons. There may be slight or marked differences in the prenatal and postnatal environment that cause the same potentialities to express themselves somewhat differently in the two individuals. Again, since one twin is derived from the right half of a single embryo and the other from the left half, we might expect pairs of twins to differ as much as do right halves and left halves of single individuals. Thus it is quite common among identical twins for one to be right-handed, the other left-handed, and not unusual for one twin to have the crown whorl of the hair twisted clockwise and for the other twin to have a counterclockwise whorl. This type of mirror imaging involves many other parts of the body including palm and finger prints, tooth irregularities, and in extreme cases such as Siamese twins, even the heart, stomach and main blood vessels. So we may expect some identical twins to be as unlike as are sometimes the two halves of a single body. The most extreme differences between the components of a twin pair are, surprisingly enough, found in Siamese twins. In a few cases the two members have been so different in appearance as to resemble each other hardly at all.

THE chief scientific value of twins comes out of the fact that in identical twins we have two individuals with the same hereditary make-up. This gives us a chance to determine what effects may be produced in the development of individuals by differences in the environment. Thus we have determined for 50 pairs of identical twins reared together, how much they are alike and how much they differ on the average, with respect to all sorts of characters. We have determined their differences in intelligence (in their intelligence quotient, I.Q.), their differences in temperament and emotional reaction, their differences in height, weight, head size, dentition, and a score of other characters. All differences found are, on the average, relatively slight. The average differences in I.Q., for example, are hardly greater than those made by a single person on two attempts at the same test. Average differences in body height are not much greater than the differences found in a single person at different times of the day. Differences in body weight average only five pounds, a difference no greater than that found in single persons weighed at two periods a few days apart. In brief, the differences between identical twins reared together in the same environment are actually, on the average, hardly greater than those found in single persons at slightly different periods.

Now a group of identical twins reared together would make an ideal control



Quadruplets, possibly identical. This and the two succeeding illustrations by courtesy of the *Journal of Heredity*, organ of the American Genetic Assn.

Identical triplets. Triplets average a single set for each 7700 births

for a scientific experiment in which identical twins were separated in infancy and reared apart under various degrees of environmental difference, but how can the investigator manage to separate twins and rear them apart? Scientists could hardly expect parents to give up their twin babies for scientific experimentation and society would probably frown upon any such cold-blooded procedure. Fortunately, however, at least for our work, a good many pairs of identical twins are left orphaned in infancy and the twins are offered for adoption. Commonly the two are adopted by different families and are brought up sometimes far apart and under very different environmental conditions. There may be great differences in education, in social status, in physical surroundings, and in many other ways. In some cases one twin is reared as an only child, the other as a member of a considerable family of children. Our task has been to locate these separated twins, bring them to our laboratories and examine them in detail. In five years we have had the good fortune to secure 21 pairs (including two pairs examined by two other investigators). The amount of effort required to locate so many pairs of separated twins and to persuade them to come to Chicago for examination has been even greater than you might imagine, but the last ten cases were made much easier to get through the Century of Progress Fair. Many previously refractory cases long on our list were unable to resist the inducement of an all-expenses-paid visit to the Fair. So we have the Fair to thank for aid in attaining our goal of 21 cases.

NOW I think that anyone will admit that when we find significantly greater differences in twins reared apart than in those reared together the increased differences are the result of differences in the environment. Also when we find that in some characters, such as height and head size and shape, that those reared in different environments show no greater differences than those reared together in the same environment, we have a right to conclude that such characters are not appreciably influenced by existing differences in environment.

The detailed analyses of the effects of environmental differences upon the development of individual characters are as yet incomplete, but one may be permitted to say with but slight reservation that such characters as I.Q. and body weight are definitely influenced respectively by education and physical-health environmental differences, whereas such characters as stature, head shape, fingerprints, and so on, are little if at all influenced by post-natal environmental differences. One of the strange and unexpected findings derived from this study is that there appears to be no correlation between differences in social environment and the temperament-emotional differences found in separated identical twins. As to what the meaning of this strange result may be we have as yet no satisfactory theory.

MANY of our cases of identical twins reared apart have afforded facts of great human interest. There is even quite an element of romance in several of the cases. Consider the dramatic possibilities of such a case as this: A young man employed by a telephone company is startled one day by having a stranger slap him on the back and say "Hello Fred! How's tricks?" Since he was not Fred and did not know the one who accosted him, he made these facts known, but the stranger was hard to convince for, as he asserted, the Fred he knew was the exact image of our young man. It turned out subsequently that Fred was his twin brother who had been lost to him for over 25 years and about whom he knew nothing.

Another case was equally dramatic. A young lady taking a bus trip across Michigan happened to be seated by a Catholic sister who greeted her like an old friend. When our subject denied any previous acquaintance, the sister said that a girl exactly like our young lady had lived for years in her convent, and the way was opened up for bringing together these twin sisters who had never suspected the existence of each other. Their first meeting was a high point in their lives and they have been inseparable ever since, both working in the same building, one as a doctor's and the other as a dentist's assistant, and both consider that they have found their right niche in life. Several other cases are equally full of human interest, but space will not permit us to relate their stories.

Some of the environmental differences found in cases of separated twins have been very marked. In one case one twin had stopped her education at the end of the third grade while the other had completed her college education and was a high school teacher. In another case one twin married a poor man and had a hard and wearing life, while the other married a prosperous merchant and had lived in comparative luxury. In still another case one twin had led a thoroughly steady and respectable life while the other had spent a good deal of time in legal confinement. Such cases as these afford extremely valuable material for the study of the relative values of nature and nurture in determining human personalities. More cases of this sort are badly needed.

IN conclusion, it may be said that both heredity and environment are shown to be strongly effective in determining human characters. In some types of character heredity has much the greater influence in producing differences, in other types of character environmental differences have a profound effect. No general statement to the effect that heredity is more important than environment, or that environment is more important than heredity, has the slightest meaning. Both factors are essential for the development of any character. Some characters are not affected by existing differences in environment, others are profoundly affected by such differences. This is as much as can be said by way of generalization. More specific statements can be made only for particular characters and under special conditions.

The old problem of nature versus nurture turns out to be immensely complicated, and will not be fully solved for a long time to come. Identical twins reared apart, however, give us the best clue to an ultimate solution of an age-old problem.

Identical twins. Twins arrive once in 88 births. This is an average

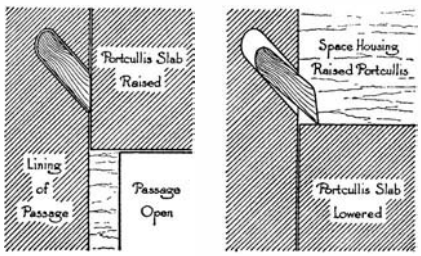
GUARDING EGYPT'S TOMBS

Protective Portcullises Broken Open . . . Trick Sliding Doors Failed . . . Granite Slabs Circumnavigated

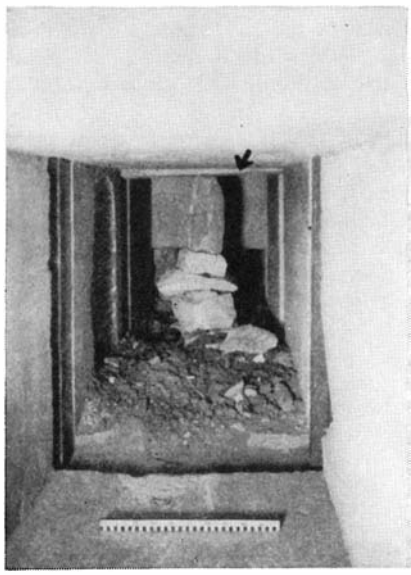
IN ancient Egypt there was little to steal except in palaces and tombs. Even at that there were racketeers, public enemies, burglars, and small-fry chiselers to be considered. The precautions which the ancient architects employed were practical, as far as they went, but their brains were pitted against the skill of the members of Egypt's best underworld.

It is due to the last two years' work of the Metropolitan Museum of Art's Egyptian Expedition that it is possible to show how these ancient gangsters were combated by the temple and tomb builders.

In the case of one tomb at the small pyramid at Lisht where Se'n-Wosret-'Ankh was *once* buried, there was a sloping passage down which the remains were lowered and a chimney which was probably an escape shaft to be used by the workers after the sloping passage was sealed. There were four portcullis recesses (see drawing below) to receive stone slabs which raised and fell vertically. When once closed, pins dropped into place as shown in the other drawing, thus preventing would-be robbers from raising the slab. Eventually, however, plunderers attacked the tomb from another angle and dug another passageway to the burial chamber, as is also shown in the drawing below.

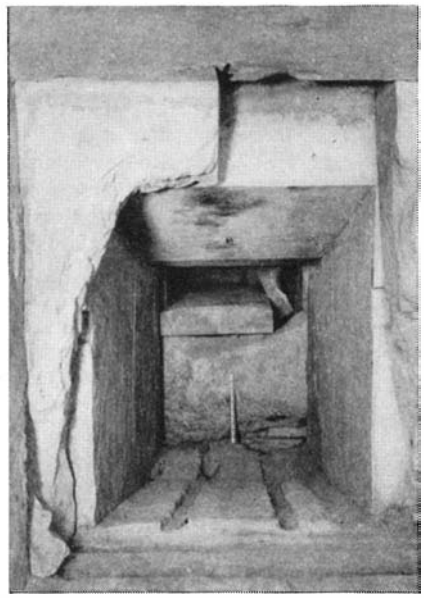


An ingenious method of using pins to retain lowered portcullis slabs



Arrow points to sliding stone slab propped up by the tomb plunderers

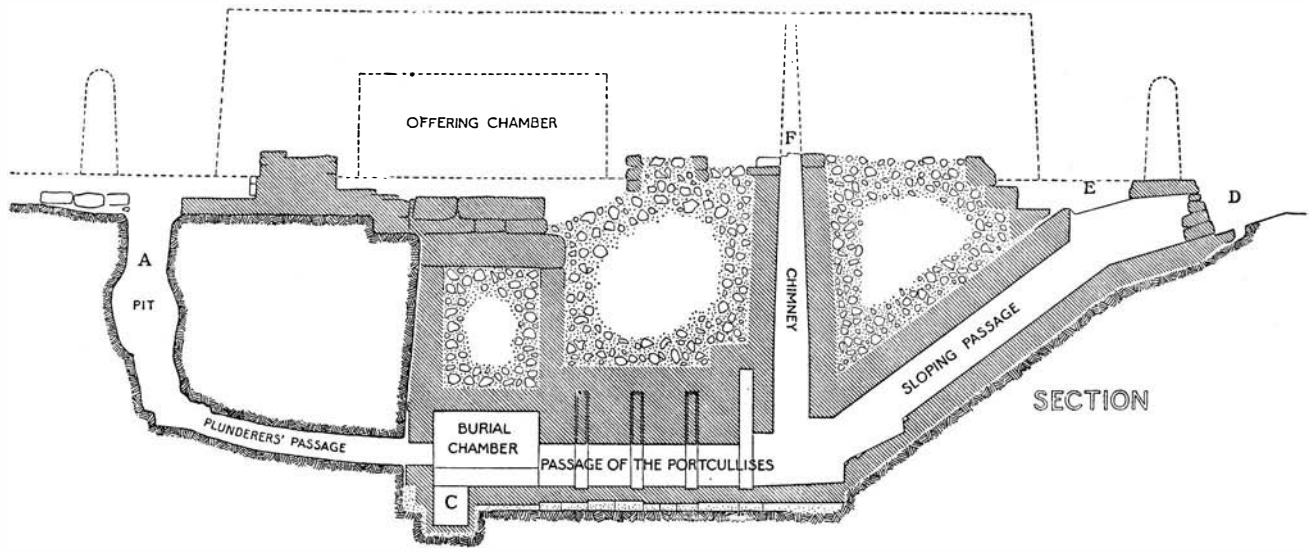
Near the north side of the pyramid were found the remains of a chapel.



Sliding door of stone (arrow) rested on perishable wooden rollers

The inclined entrance to the tomb had been plugged with granite, but to no avail, as plunderers had dug around the stone and sacked the tomb.

In the neighborhood was discovered another tomb that had been robbed. Examination disclosed a pair of limestone sliding doors which rested on wooden skids. It may be presumed that the designer of the tomb expected the wood to rot and thus leave the doors in an immovable position. Clever plunderers, however, smashed one of the doors, and when the Expedition found the spot they had to press into service a five-ton jack to move the other.



A well protected tomb where plunderers found that the easiest method of ingress was not that of the builder

How Big is the

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
Retiring President of the American Association for the Advancement of Science

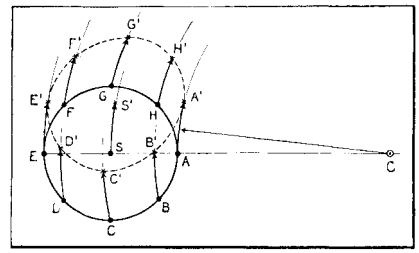
EVER since Herschel's memorable star counts more than a hundred years ago it has been recognized that the galaxy, which appears to our eyes as a band of diffuse light encircling the heavens, is really a vast flattened assemblage of stars shaped roughly like a thin watch or a convex lens. For a long time it was supposed that the sun was not far from the middle, since the numbers of stars visible to the naked eye or even with a small telescope are about the same for equal areas of sky in all parts of the circle. But within the present century it has been discovered that we are actually far out of center.

Shapley's studies of the globular star clusters, which gave the first fair idea of the real expanse of our stellar system, showed clearly that the center of their distribution is far away, in the direction of the constellation Sagittarius. About the same time Barnard's recognition of the dark nebulae, visible only because they hide the stars behind them, led to the recognition that the great dark band which splits the Milky Way in two from Cygnus to the Southern Cross arises from obscuration by an enormous succession of dark clouds. Could these be swept away the bright region in the southern summer skies would be far bigger and brighter, and no one could doubt from a mere glance at the sky which way to find the center of our great starry system.

BUT why should the galaxy be flat? The natural form of any body at rest is spherical, and this deduction from theory is confirmed by observation of bodies all the way from raindrops to globular clusters. There is only one known force which can flatten out a mass isolated in space and keep it so, and this is the centrifugal force of rotation. The planets, for which the centrifugal force is but a small fraction of the gravitational attraction, are but moderately spheroidal. The galaxy is greatly flattened, hence the centrifugal force due to its rotation must nearly equal its attraction.

The dynamics of a great rotating swarm of particles have been worked out by Lindblad and by Oort. In the case which concerns us there is a great, moderately flattened central swarm surrounded by a thin and almost discoidal sheet of particles moving in nearly circular orbits — something very like a spiral nebula, except that the outer parts may be spread out into a disk rather than concentrated into arms. In this outer region the particles, which in the present case are stars, are moving in nearly circular orbits about the central condensation. There are, of course, small differences in the speed and direction of motion of individual stars.

When we study the motions of the nearest stars, hoping to find from them the "sun's motions in space," we are



Motion of stars about the center of the galaxy (all in plane of paper)

dealing almost exclusively with bodies moving in these nearly circular orbits. The average of these stars, to which standard the "solar motion" is referred, represents motions in a circle about the galactic center. They may all be moving together very rapidly—and, indeed, they are.

There are several evidences of this. In the first place the stars which move slowly (relative to the above standard) seem to move nearly at random, but the fast-moving stars, of which dozens are known, have motions which, though far from parallel, are practically all directed toward one half of the celestial sphere.

These stars, according to Oort, are members of a "field" of bodies which, though moving about the galactic center, have orbits of high eccentricity and inclination. As a whole these form a thin, scattered cloud extending far on both sides of the denser disk. Those in our general vicinity are moving slower on the average than those which have circular orbits. So they are left behind and appear to drop toward the rear.

Still more definite evidence comes from observations of the radial motions of distant objects which lie on the outskirts of our galactic system, like the globular clusters, or quite outside it like the globular nebulae. Strömberg finds that, compared with the clusters, our "local" system of reference is moving toward a point in the constellation Cygnus at a velocity of 272 kilometers a second. The nebulae are more troublesome to handle, on account of their own very rapid motions, but Hubble, allowing for these, finds a speed of 280 kilometers a second in the same direction.

THESE data alone are enough to convince us that the galaxy is actually in rotation; but further tests may be applied. With motion governed mainly by the attraction of the central mass, the stars nearer the center, which have smaller orbits, will move faster in them, as the planets do; those further out will have smaller velocities. This will have curious results, as is illustrated in the diagram. Suppose that a star S is surrounded by eight others A, B, C, D, E, F, G, H, all moving in circles about the center C. In due time S will move to S', A to A', and so on. The eight will still form a ring about the one, but this will be no longer circular but oval. The stars H and D will be in nearly the same direction from S as before, but farther away; while B and F will be nearer. C and G will change their distance very little, but will shift in direction in the same sense as the real rotation, while A and E, also with unchanged distance, will swing around S in the opposite sense but more slowly.

Stars originally lying on a circle were chosen in order to make a simpler diagram, but the same effects will appear for any others. Those in the direction of the center and opposite to it, as seen from S, will drift backward, and those at right angles to the center forward; while stars near the middle of the respective quadrants will approach S or recede from it. The linear motion in all cases turns out to be proportional to the distance from S (to the first approximation). The angular rates of drifts are therefore independent of this distance. All this holds for stars moving in strictly circular orbits. Actually a smaller random motion is superposed, so that the effects here illustrated may be obscured for individual stars but come out in the mean for large numbers. The sun,

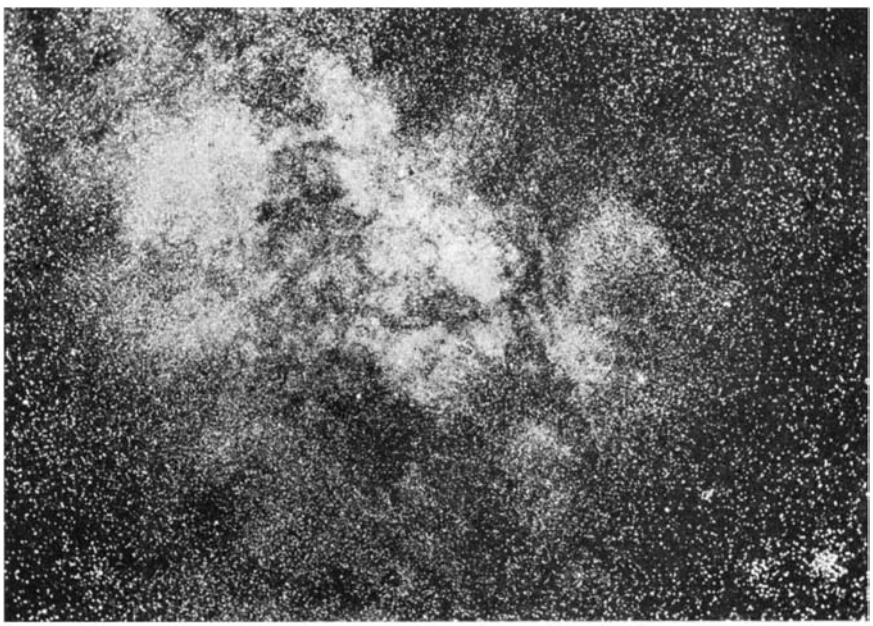
MILKY WAY?

too, is not moving just at the standard rate like our imaginary *S*, and this causes another set of star drifts affecting the average motions. These, however, can easily be separated from the effects of galactic rotation, for the former have only one maximum and minimum value for stars around the whole circle, while the latter, as is obvious from our diagram, have two.

Many investigators during the last ten years have sought for these phenomena and they have found them in almost every group of stars that they have investigated. Either proper motions or radial velocities may be used, but the latter have some advantages. The directional changes due to galactic rotation are very slow, and are likely to be concealed by the random motion of individual stars except for the average of very large numbers. The effects on radial velocity increase with distance, and for remote groups of stars they may become relatively large and even quite conspicuous.

A comprehensive discussion has recently been made by Dr. J. S. Plaskett, the veteran director of the Dominion Observatory at Victoria, and Dr. J. A. Pearce, based on stars of spectral classes *O* and *B*, "the most luminous stars in the sky and hence the most distant that can be adequately spectroscopically observed." A ten-year program of observation at Victoria, supplemented by observations in the southern hemisphere, by the Lick Observatory station, gave the radial velocities of some 850 stars—enough to get good average values for many sub-groups. The rotational effect is very clearly shown. It is greater for the fainter stars than the brighter ones—as it ought to be, since the former look faint largely because they are farther away—and for the same reason greater for the hottest stars, which are the brightest and hence can be seen at the greatest distances. The direction of the center comes out in 324 degrees galactic longitude; that is, toward Sagittarius, and only three degrees different from that found by Shapley from the globular clusters.

The proper motions of the stars also showed the predicted effects. After allowing for the solar motion it was found that the forward drift of the stars at the points *C* and *G* was eight times as great as the backward motion at *A* or *E*. For stars moving in empty space about a distant cluster the motion at *A* would be half that at *C*. But the discrepancy is not in the least alarming, for the space in which the stars actually move is by no means empty but is occupied by the great flattened swarm. For stars with larger and larger orbits the attraction of an ever-increasing portion of this is added to that of the central mass. In consequence, the orbital velocity falls off much more slowly with increasing central distance than is illustrated in the figure. The observed conditions indicate that in the sun's vicinity three quarters of the whole attraction is due to the central condensation, and the rest to the outlying portions.



Star clouds and obscuring matter in Sagittarius. Shapley places the center of the galaxy behind impenetrable cosmic clouds of meteoric dust where the constellations Scorpio, Ophiuchus, and Sagittarius corner together. This is in the part of the Milky Way which has the appearance of dividing into two branches, a mere appearance which is due to a long obscuring cloud of dark matter of this kind. Some of these clouds show in the photograph, especially toward the right, and it is near here that the galactic center is believed to lie. Were it not for this "unhappy caprice" in the arrangement of the material of our world we should see the galactic center on summer evenings, doubtless as a heavy concentration of Milky Way stuff (stars). The obscuring clouds are much nearer to us than the galactic center, but the clouds or swarms of stars which show in the photograph are at practically the same distance as the obscured galactic center. From the "Photographic Atlas of Selected Regions of the Milky Way," by Edward Emerson Barnard. Taken at Mount Wilson, with 10-inch lens, *f*/5, exposure four hours. "These star clouds," says Barnard in the same atlas, "are the most magnificent of the galactic clouds visible from this latitude." In the reproduction they show to poorer advantage than on the original photograph, because the dark obscuring clouds around them, mainly on the right, do not have the blackness of the original. Note cluster in lower right hand corner of cut

IT appears also that the period of rotation about the center in an orbit passing near the sun is 224 million years. With the velocity of 275 kilometers per second this makes the distance to the center 10,000 parsecs, or 32,000 light-years. It is probable that the sun is about two thirds of the way from the center to the edge, which makes the diameter of the galaxy 30,000 parsecs, or roughly 100,000 light-years. This is much bigger than the average spiral nebula, but hardly more extensive than the outer fringes of the Andromeda nebula which have recently been detected. The mass of the system follows from its attractions at a known distance, and comes out 160 billion times that of the sun (1.6×10^{11}). The known stars will account for only a fraction of this. But the obscuring matter scattered through the galaxy, though very tenuous, must have a very great aggregate amount. It may be roughly assumed that it occupies a layer 1000 parsecs thick and 30,000 in diameter. Its density can be little more than guessed at. Eddington suggests 10^{-23} grams per cubic centimeter, which amounts to one ounce in 700 million cubic miles. Even with this incredibly small density the supposed layer would have a mass 100 billion times the sun's and would account for the discrepancy.

A New Deal For Mice

Why Mice are Used in Research on Human Diseases

By C. C. LITTLE, Sc.D.
Head of the Roscoe B. Jackson Memorial Laboratory for Cancer Research

DO you like mice? Of course you don't. "Useless vermin," "disgusting little beasts," or something worse is what you are likely to think as you physically or mentally climb a convenient chair. That is the inherent right of all women and some men. Granted, however, that you are all figuratively placed safely above "floor level" where the terrified little brown creature that rushed for shelter as you approached will not disturb you, I want to appear as attorney for the defense and try to show you a little of what the domesticated relatives of that same mouse are doing for humanity. It is at least an even bet that you will descend from your place of refuge with deep and lasting interest in the little rodents which, when tame, are not nearly as "cowerin" and "timrous" as the immortal Burns has painted them.

The particular service to humanity about which I am going to tell you is research in the nature and cause of cancer. There are many other phases of medical research which might have been chosen, such as pneumonia and yellow fever, in which mice are the troops which literally by tens of thousands occupy posts on the firing line of investigation. Their reactions to the microorganisms that cause infectious disease are used as indications of its type and virulence. I have picked cancer, however, because mice are afflicted with it very much as are we ourselves. It occurs in them naturally as it does in humans. If untreated, it kills them as it does us.

IF we had to depend on wild mice for our studies it would not be very convenient. Such, however, is far from being the actual situation. Mice have been domesticated and kept as pets since long before the beginning of the Christian era. There are more color varieties of mice than there are of all breeds of domesticated dogs. There are white mice, piebald mice, as spotted as any pinto pony, yellow mice of various shades, from pale cream to deep orange red; there are mice that exactly resemble a maltese cat, and in addition many shades of fawn, tan, brown, and gray. In Great Britain, mouse fanciers may be numbered by the hundreds. Exhibitions are held and prizes are awarded according to standards such as those that govern thoroughbred poultry, horses, or other livestock.

The idea that mice may be thoroughbreds has a certain amusing side. Yet even to those of us who painstakingly and with some pride and expense have traced—or believe that we have—our ancestry some 40 generations back to William the Conqueror, the mouse need not bow his furry head. In the laboratory

Operation on a mouse under ether

are thousands of mice whose exact pedigree is known and recorded for more than twice that number of generations.

You may naturally ask "why bother?" "What earthly good does it do to have pedigreed mice?" The answer is full of surprises. In it there will be elements of modern scientific advances as yet unappreciated by the non-scientific reader —but of great interest to him none the less.

In the first place cancer in mice occurs in certain lines of descent, or strains, and not in others. This fact was first noted at the end of the first decade of this century. Since that time additional studies have shown that not only is the amount of cancer formed characteristic of the strain, but also the type and location of cancer tends to be the same within members of an inbred strain of mice.

Cancer may, under certain conditions, be successfully transplanted from mouse to mouse but not from mouse to rat or *vice versa*, or between mice and men. The study of the reaction of various inbred strains of mice to implants of the same mouse cancer, or of the reaction of a single strain of mice to implants of several different types of mouse cancer, is both interesting and important. Not all mice successfully grow transplants of all kinds of mouse cancer. This gives us material with which to gain information concerning the nature of the differences that exist.

THE age of the individual mouse is an important factor in determining the way in which it is going to react to bits of mouse cancer placed beneath its skin. In a certain strain all mice which are young adults may eliminate such implants of cancer tissue promptly and effectively within a week. There is not even temporary growth of the introduced cancer tissue. Animals of the same strain, when implanted with cancer when they were from two to twenty days old, show more tolerance towards the implants. There is a certain amount of growth of the cancer followed, however, as the mice grow older, by its regression and disappearance. If we describe the typical reaction of young adults of the strain as "negative" we must conclude that the very young animals of the strain have not yet acquired their racial characteristics in full degree. When very old mice of the same strain are inoculated, they too allow temporary or even permanent persistence of some of the bits of implanted cancer. These old animals have begun to lose the "negative" response which characterizes animals of this strain in their prime.

The bearing of these facts on our ideas of biological individuality is obvious. As humans we lay great stress on that term. We prize individuality and bitterly resent any intimation that we are in danger of losing it. Yet it is clear that, from a physical point of view, we acquire individuality gradually and after keeping it for a time, begin to lose it through a process of disintegration. It is perhaps much more than a striking coincidence that the commonest ages of cancer incidence are

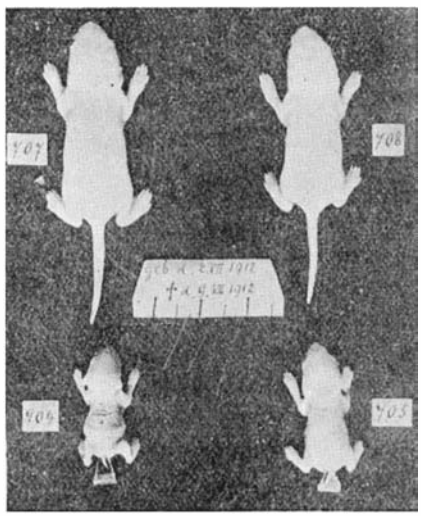
those when either generally or in some particular organ the process of disintegration has begun. This fact opens one of the fascinating lines of advance on the cancer problem which biology has given us. It may in the not too distant future lead to important results and conclusions.

Our present social customs serve to confuse and complicate the collection of pedigrees in humans. Outbreeding rather than inbreeding is the established procedure. This makes it especially difficult to determine in human material the course of any inherited character. We are fairly well "scrambled" biologically and the sorting out process necessary to trace inheritance is in many cases scarcely worth the effort. This however is not the case in mice.

SOME years ago the principle was discovered that close inbreeding makes for great uniformity. In order to obtain this uniformity, however, the process has to involve the mating of brother and sister or of parent and offspring. Inbreeding, as such, creates nothing new. It merely brings out consistently and with increasing uniformity the various characteristics which are being inherited. After 12 or more generations of this procedure the animals within a single inbred line resemble one another extremely closely. The characters which are inherited in the strain are fixed and, to a high degree, predictable.

As a result of this process, strains of mice have been built up in which cancer of the breast appears in from 80 to 100 percent of the female animals. Other strains have been obtained where no cancer of the breast has occurred in more than 30,000 animals comprising over 40 successive inbred generations. In mice, therefore, it is clear that the tendency to form cancer of the breast depends largely on constitutional factors which are inherited. A high cancer stock can be used day in and day out as a natural source of cancer material for study and research. Because it is known in advance what the stock is going to do the research worker can be on the look-out for characteristics of the earliest stages of cancer. This is an advantage which is not possessed by any group of human material. It is another great contribution which mice, after over 20 years of controlled breeding, have given us in our fight against cancer.

Uniformity of type produced by long-continued inbreeding gives material which, for the first time, allows the biologist to approach experimental work with something resembling accuracy. This means a great deal to the research worker. The chemist, for example, could get nowhere in his attempts to analyze unknown substances if he could not turn to his laboratory shelves for the already analyzed materials which—as known reagents—are available to him. In a somewhat analogous way, it is useless to expect the biologist to be able to analyze unknown living material without having, at his disposal, strains of relatively homogeneous animals which he can use as "known" values in that work. The building of such strains is never particularly spectacular or exciting. It is, however, an essential foundation to further progress of any sort. Now that biologists and research workers in experimental medicine have such material where they can obtain and



Two normal and two short-tailed young mice about ten days of age. The short-tailed variety of mouse was first discovered in Germany

utilize it we may expect more accurate results capable of repetition at will.

An interesting example of how effective known strains of mice may be in analysis is the following: For decades, British investigators have inoculated mice of unknown ancestry with bits of a certain mouse cancer. In some of the animals the implants grew, while in others they did not. A long series of groups of perhaps 50 mice each were used. The variation which occurred in the successive groups gave an appearance of fluctuation in the virulence of the cancer. This explanation was adopted by those who did the experimental work. Recently this experiment has been repeated in this country, using, however, mice of known strains. It was found that *all* the mice of some strains grew the inoculated cancer while *none* of other strains did so. By mixing the animals of the two sorts of strains in various proportions it was possible to repeat exactly the earlier results obtained by the British investigators and to predict in advance what those results would be. This was done with less than three tenths of one percent inaccuracy. Thus it was found that the nature of the strain of mice used, and *not* fluctuation of virulence in the cancer itself, was the important factor which, because of lack of controlled material, caused the British workers to misinterpret their results. Experimental science is full of friendly international competition of this sort. It is a game quite as exciting to those who participate in it as are the Walker Cup matches to golfers or the Davis Cup contests to tennis enthusiasts.

Another advantage which mice provide to research is the rate at which they grow old. To understand this point we must realize that, in humans, the vast majority of cancers occurs in middle-aged or older individuals. It is obviously impossible for a research worker to observe many generations of human beings because he grows old too quickly. Mice of a year old are roughly comparable to humans of 40. They thus reach, at an obligingly rapid rate, the ages at which cancer is most prevalent. This is an immense help in research. It makes possible the observation, by a single investigator, of scores of successive generations of cancerous individuals.

AGAIN, humans have a disappointingly small number of children. Not so with mice. There is, to be sure, a record of one woman who competed favorably in this respect with a mouse in that, by abundant production of twins, triplets and quadruplets, she gave birth to more than 40 children. This total is common among mice. Even in the days of polygamy a man might well feel proud if his children totaled a hundred. To a gentleman mouse a grand total of 400 sons and daughters is not in any sense an impossibility.

Nature has made, in mice, its most remarkable reproductive machine among mammals. The first litter of young usually appears when the female is from 50 to 80 days of age. The female mates again at once and is thus carrying her second litter while nursing the first. Young mice develop for a period of from 18 to 21 days in the body of the mother and can safely be weaned at approximately the same period after birth. Many stocks of mice average from six to eight young per litter. Exceptional litters may reach 14 young.

At birth the young are pink and naked. They weigh about one gram each. Yet in this tiny bit of living material is represented each of the organs and tissues which we ourselves possess. Successful surgical operations under anesthetics can be performed on mice as young as one day old. Their skin at that age, however, is so tender that even the finest surgical silk, unravelled and used as separate strands, tears out. For this reason incisions are closed by a hair-like strand of collodion drawn across the wound by a very fine camel's-hair brush. On its return from the operating table the young one is apt to be un-

welcome to the mother mouse. She may desert or even kill it—recognizing undoubtedly the foreign odors. To prevent this, it sometimes suffices to block the mother's nostrils with Vaseline. The removal of this so occupies her attention that by the time it is accomplished the young mouse has resumed the smell of the nest and is again received into the bosom of the family. Ordinary handling of young mice is, at once, followed by their careful washing on the part of their parent. It would seem that the odor which we impart is quite as unpleasant to the mouse as theirs is to us. This instance of "turn about is fair play" serves to satisfy—partially at least—our senses of humor and of justice.

THE cancers formed by mice differ in some minor points but not in their chief characteristics from those of humans. They begin as local areas of insurgent and uncontrolled growth. It is this extreme naturalness of cancer and its very apparent independence from micro-organisms that make its early detection a matter of the greatest difficulty. Since it has clearly been shown that, in humans, the chances of successful treatment increase directly with the recognition of cancer in its earlier stages, it follows that the opportunity of studying its early occurrence in thousands of mice is an important one.

The term "local insurgent growth" is worthy of further attention. We are all familiar with the results of normal growth. Everyone of us has experienced them. Each of us started as a microscopic bit of living material called a fertilized egg-cell. In the nine months of our life before birth we progressed almost miraculously to an organized typical human baby ready for birth. We had grown from the fertilized egg-cell to many thousands of times our original size. During our first year of life after birth we still grew rapidly. At best, however, we probably did not grow to more than five times our weight at birth. The next and each subsequent year we increased in actual size by growth—but did so at a steadily decreasing rate. This process went on until we reached adult size. We then stopped growing.

In us, however, there remained a potentiality for further growth. Ordinarily we used that ability simply to repair and to replace worn out tissues. At times, however, locally we may have formed a wart, mole or wen which is a center of growth—more rapid than that shown by surrounding tissues. These growths are, in a way, distant cousins of cancer, in that they represent local areas in which central control of bodily growth has been lost. Whereas, however, growths of the type listed do not invade surrounding or adjoining tissues and organs, and therefore cause little or no trouble, cancer is not so innocent.

Starting with no more visible signs of its presence than do the other growths, cancer grows rapidly, invades the surrounding—or even remote—tissues and causes an upset in the general orderly behavior of the body. Cancer often demands and receives preference in blood and food supply as compared with the normal tissues. At times, it shows an amazing rate of growth, resembling that of very young tissue. It

A view of the under surface of a male mouse with a cancer of the breast. This mouse was operated on when it was five weeks old. Both male sex glands were removed and a female sex gland from a sister animal was placed under the skin. About 16 months later the mouse was observed to have a cancer of the breast. Normal males do not do this once in a thousand times

may even outgrow its food supply and cause trouble by the formation of areas of death and degeneration of its own substance.

It should be clear to all that an enemy of that type is a foeman worthy of our best and most skilful opposition. No fortuitous or fly-by-night campaign will win the fight against cancer. Slow, patient, well-organized experimentation will be needed. Even then, no one in his right mind has any illusions concerning the probable magnitude and importance of his potential contributions to the cancer problem. He is prepared for disappointment and, by being so, need never admit lasting defeat.

A question, frequently asked, is by what right we believe that work on mice is transferable to human beings. The answer is an interesting one. There are many points of close resemblance in the two types. Both types, for example, form two types of male sex-cells which are the most important single influence in determining whether an individual young mouse or a baby shall become a male or a female. In a single nationality of mankind the ratio of the sexes at birth is approximately 103 males to every 100 females. Practically the same ratio is found in mice. If, in humans, the sex of children of parents of different nationalities is computed the ratio is found to be about 120 males to 100 females. If two unrelated inbred strains of mice are crossed a similar increase in males is observed.

Cancer of the breast in humans is confined to the female sex in practically 99 out of a 100 cases. Exactly the same fact holds true in mice.

MICE frequently die of inflammation of the lungs or of the kidneys, just as humans do. The parallel between mice and men is so striking that there is every reason to believe that mice will serve their useful purpose in contributing to our knowledge of human ailments just as rats have helped our knowledge of the vitamins, rabbits have aided in combating syphilis, and guinea pigs have increased our information concerning many human ailments.

Mice have already proved to be of great practical value in the Ascheim-Zondek test to determine human pregnancy.

With these and other facts in mind, and with the mental picture of the hundreds of thousands of these little animals which year after year have done their part in increasing our chances of survival, it seems not too much to ask that a new place in human appreciation be given them.

A visit some day to one of the mouse laboratory "cities," with its cleanliness, orderly arrangement, and activity, will do much to convince those in whom doubt remains. The lives of these mice are scarcely more confined than our own. They live in warmth and plenty. When need for surgical aid occurs, their treatment is asceptic and humane. No marauding cat disturbs their slumbers, no erratic taxi drivers imperil their existence. We humans cannot claim as much. Tame, bright-eyed and trustful, they seem to have become an integral part of man's helpers, instead of wasteful and undesirable vermin.

Under those circumstances, perhaps mankind will accept and develop his relationships with mice in a different spirit. They have earned their right to respect, and perhaps some day by being partners in our fight against disease, will obtain our everlasting gratitude.

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Before submerging various areas in the Tennessee Valley with dams, the TVA has thoughtfully carried out a scientific archeological survey of them. An account of these excavations will be published soon.—The Editor.

REVOLUTION Among the LUBRICANTS

Low Grade Crudes Give High Grade Motor Oils... Propane Used in Refining . . . Process Removes All Wax

By ANDREW R. BOONE

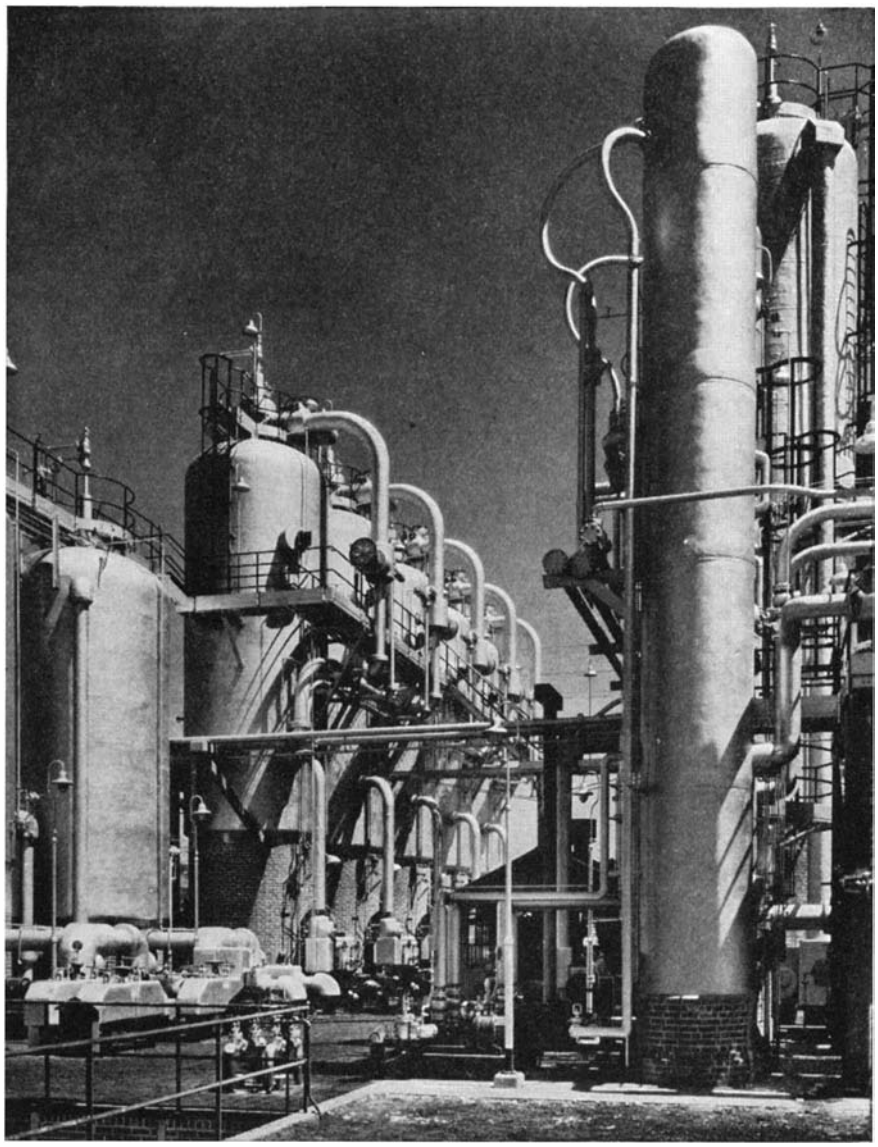
REVOLUTION born of the test tube stalks among the petroleum refineries. Domination of Pennsylvania oils is threatened. Too-great national popularity has raised a contender to their superiority. California crude occupies the challenger's corner. Low-grade crudes now supply values of lubrication thought impossible of production a year or so ago. By developing a solvent refining process using propane, western manufacturers promise rich development of California fields producing wax-bearing crudes.

The development is of great importance economically, of much interest scientifically. For years Pennsylvania oils have been the "sterling" among lubricants. But something has been happening in the design of motor-car engines during the last nine years. There has been a steady increase in the average horsepower of passenger-car engines, resulting in increased loads on bearings, and increased piston speeds, demanding oils of great stability, low susceptibility to oxidation, and a flat temperature-viscosity curve, capable of withstanding excessive pressures.

Pennsylvania oils came closer to meeting these needs than western oils. The public in the west apparently recognized this superiority, for, in California, Oregon, and Washington, where 2,800,000 automobiles, farm power units, industrial and ocean-going engines consume 80,000,000 gallons of motor oil annually, sales of higher-priced Pennsylvania oils climbed last year while westerns dropped in volume. Thirteen years ago, 85 percent of the oil sold on the Pacific Coast was manufactured from western crudes; last year—55 percent.

Western producers and marketers faced a problem close to their pocketbooks. The challenge could not be ignored. Several companies set about to develop a refining process that would isolate the desirable paraffin-base constituents and reject unwanted materials.

With this as the goal, a close study of California crudes was begun by the Union Oil Company, of California, and it was found that the wax-bearing crudes being produced in such fields as Santa Fé Springs, Kettleman Hills, and Elwood, contained a higher percentage of the paraffin-base constituents than the wax-free San Joaquin Valley crudes, from which all Western motor-oil manufacturers had previously refined their oils. The ratio was about three to one. Experimentation proved further that if a paraffin-base oil were to be refined from California crudes it would be necessary to use the wax-bearing crudes in order to secure a yield economically feasible. This brought up the problem of de-waxing. Eastern manufacturers had found this an expensive operation



A central view of the propane de-waxing plant. Near the center are the five chillers in which the wax is frozen out of solution. These chillers have remote controlled operating and pressure valves and also remote liquid level indicators

Dr. Ulric B. Bray, left, and C. E. Swift, demonstrating the precipitation with liquid propane of asphalt from lubricating stock

and one that was a constant source of trouble. In order to simplify this operation, if possible, experiments were conducted in various phases of de-waxing. From these and other experiments have come many patents, pooled by Union, Standard Oil Company (Indiana), and Standard of New Jersey.

C. E. Swift and Dr. Ulric B. Bray, a young Georgian who joined the Union Oil research department in 1928 and who formerly was a research fellow at the California Institute of Technology, undertook the solution of the de-waxing problem in the company's Los Angeles laboratory.

IT was the discovery that propane could be used as a de-waxing agent that made possible the production of this new type of oil from California crudes. During his experiments with propane, Dr. Bray came upon the discovery that under pressure most petroleum fractions, except asphalt, were soluble in propane, and that when lubricating-oil-bearing crudes were treated with propane the asphalt settled out in semi-solid form. Since by releasing the pressure of the container holding the solution of oil and propane, a sub-zero temperature is created, the wax previously held in solution is literally frozen out of the oil and can be entirely removed by passing the solution through a pressure filter.

Thus, in what amounts to a comparatively simple refining operation, it is possible to remove two troublesome materials and prepare the way for the final treatment of the asphalt- and wax-free oil. The unstable materials and low-grade oils, many of which have not previously been removed even from our most expensive lubricants, were soluble in various solvents, whereas the high-grade oils, or those of the paraffin-base constituents, were not soluble, the latter being drawn off in the form of a raffinate consisting only of desirable oil, and the other as an extract containing all of the undesirable materials.

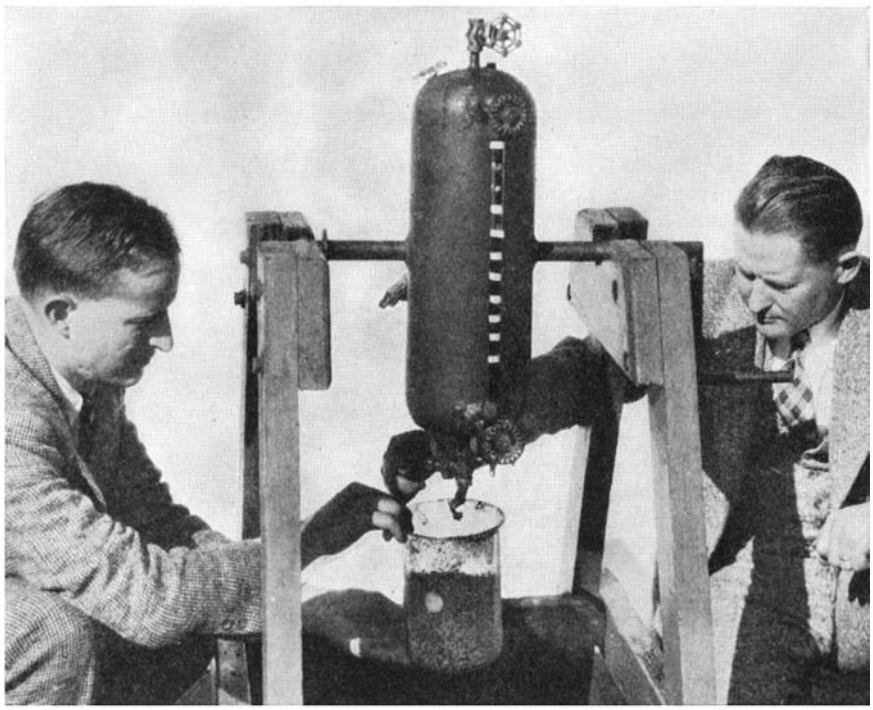
Petroleum chemists have known for some time that western, as well as eastern, crudes contained a percentage of paraffin-base oils. However, where they are present in the greatest quantity, they are accompanied by the troublesome wax. The removal of this wax by old refining methods is costly. The result has been that, until the development of the propane solvent process, western refiners have been restricting their production of motor-oils to so-called asphalt crudes containing virtually no wax and but a very small percentage of the paraffin-base constituents, which tests show form the most stable of motor oils.

By the development of the propane solvent process, it is possible for the refiners to revamp their entire motor-oil production program and turn to several of the large California fields producing wax-bearing crudes, which were formerly almost ignored in the production of motor oils. From these can be obtained a sufficient yield of the paraffin-base materials to make the production of motor oil from them commercially possible. This development, members of the petroleum industry contend, will revolutionize the entire motor-oil picture and remove the dominance that certain eastern crudes have had in this particular market.

As Dr. Bray continued his experiments, he soon was manufacturing the new oil in a miniature solvent treating plant. He commenced by introducing the crude oil and propane into a pressure bomb. Propane went in first, under pressure of 180 pounds to the square inch to prevent return to a gaseous state. Then the oil stock was introduced and the bomb revolved, end over end, to mix the contents thoroughly.

AFTER 20 or 30 whirls the bomb was returned to an upright position, the asphalt settling out of the propane solution and being drawn off as a semi-solid. The next step in the refining of the motor oil in the miniature plant consisted of the removal of wax. To accomplish this, Dr. Bray proceeded to transfer the asphalt-free solution of propane and oil to what he termed the "chiller."

In the "chiller" the gage registered 180 pounds, and as the pressure was gradually released, permitting the propane to evaporate, the pressure dropped to normal and the temperature to 40 degrees below zero. The solution at this temperature was then forced through a pressure filter. The wax, by that time having been reduced to a semi-solid form, was completely removed from the solution by the filter, while the wax-free solution was drawn off into beakers, and then transferred to



Withdrawing propane precipitated asphalt under pressure of 180 pounds to the square inch from a miniature refining plant bomb. See description in the text

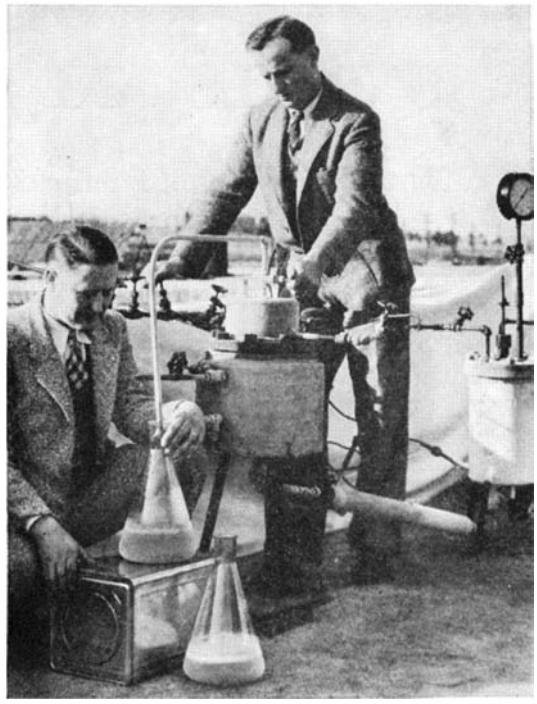
agitators where it was subjected to a solvent treatment using liquid sulfur dioxide to remove the unstable materials and the low grade and low gravity oils.

Thus, for the first time, asphalt, wax and other undesirables are removed and refined oil obtained in a single continuous process.

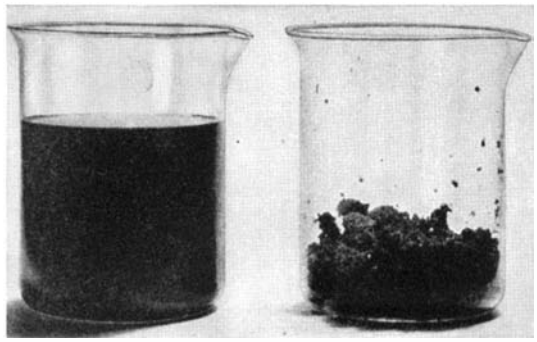
The next step lay in applying the method in large-scale production. By following five general steps—vacuum distillation, propane de-asphalting, propane de-waxing, double selective solvent refining, and final finishing for uniformity of color and grade—at its Oleum plant, Union now finds it possible to choose only those fractions desired, discarding the others.

Importance of the new method to the petroleum industry can hardly be overemphasized. As Mr. Earle W. Gard of the Union Oil Company, points out:

"Many of our greatest and most useful inventions are the direct result of years of research. The development of the process and equipment for the manufacture of Triton is no exception to the rule in this respect. Advancement in the manufacture of lubricating oils has been slow and no previous invention in this field can even closely compare with the general effect that the development of methods of solvent manufacture of lubricating oils will have on the petroleum and allied industries."



Right: **Experimental equipment used to demonstrate the removal of wax from lubricating oil stock. The solution of propane and stock, chilled to 40 degrees below zero, is being drawn through a filter into flasks. Note frost on the equipment.** *Below:* **Beaker at left shows de-waxed oil and one at the right the wax obtained in the process.** *Lower left:* **Wax which has been frozen out of solution and collected on filter in the propane treating drum shown at right**



This new refining method marks a definite step in a virtual revolution now taking place in the manufacture of lubricating oils. Until recently most lubricants were "acid refined." That is, the crude was first broken into fractions of different weights by distillation. These distillates were treated by mixing with strong sulfuric acid, which formed a black sludge by charring the undesirable portions. The black sludge was drawn off, and the oil neutralized with caustic soda and washed with water. In order to remove more of the colored materials, some oils were mixed with a porous clay and filtered. If the crude contained a high percentage of wax, the wax was removed by mixing the oil with some diluent, such as gasoline, and chilling the mixture. The wax separated out.

SEVERAL years ago Dr. Edeleanu, a Roumanian petroleum technologist, discovered that liquid sulfur dioxide —the kind used in household refrigerators—has the power of dissolving undesirable constituents from a kerosene distillate, leaving the more desirable portions untouched. This system was later extended to lubricating oils. In actual operation, the oil stock is mixed with the sulfur dioxide which dissolves the undesirables and drops with them to the bottom of the vessel, while the desirable oil, soon ready to reach your crank-case, rises to the top with a very small amount of sulfur dioxide in it. Distillation removes the sulfur dioxide from both the settled extract and the raffinate which rises to the top. In this method a remarkable separation has taken place, since neither portion has been altered or destroyed as in acid treatment. Tests show that both the raffinate and the extract may be called lubricating oil, though the raffinate is far superior.

IN the development of Triton oil, production was carried on in semi-commercial plants for nearly two years before a commercial plant was completed at Oleum, California.

An interesting sidelight on some of the difficulties often encountered in the commercial production of a new product concerns the specifications of the propane unit at Oleum. It was found that no steel was available for the construction of the chiller units, which had to withstand operating pressures up to 200 pounds per square inch at 100 degrees, Fahrenheit, and then function at atmospheric pressure and a temperature of 40 degrees below zero. Ordinary steels after being chilled to this low temperature were found to be brittle, fracturing easily. Steel manufacturers, presented with the problem, worked for several months in co-operation with the oil company's representatives to develop a nickle-alloy steel which proved satisfactory for vessels of the size required in the new refining process.

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While the foregoing article was being prepared for publication, announcement was made by Socony-Vacuum Oil Company, Inc., of the Clearosol solvent process of refining motor oils, which makes use of propane and chrysalic acid for eliminating from crude oil those constituents which are undesirable.—*The Editor.*

SUNDIALS AND THEIR CONSTRUCTION

Part VIII—Lines of Declination for Dials in Planes Parallel to the Earth's Axis

By R. NEWTON MAYALL
Landscape Architect
and MARGARET WALTON MAYALL, M.A.
Research Assistant, Harvard College Observatory

FOR a long time after the introduction of the clock, the erection of sundials continued, especially in Europe and the British Isles. Many pillar dials may still be found in the rural districts, some of them occupying prominent positions in the town squares.

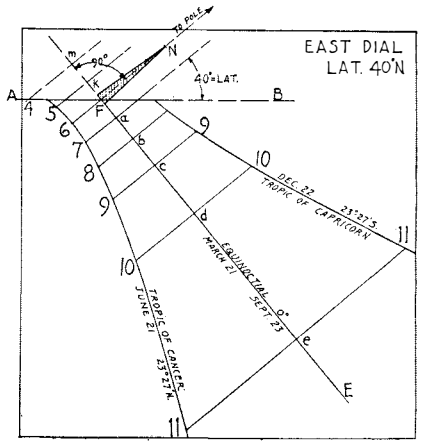


Figure 1

The pillar dial usually contains four vertical dials, each facing a cardinal point of the compass. The north and south dials have previously been described, and the construction of the lines of declination for them has been shown.

From the preceding articles, the reader has doubtless noticed that a single dial does not show the time of sunrise and sunset, throughout the year. This deficiency may be overcome by employing a combination of dials, such as that on the pillar dial, where the time of sunrise is shown by the east face, and sunset by the west face. Therefore the reason for the prominent position occupied by the early pillar dials is evident and, although analogous to the town clock of today, they were more useful.

THE planes of the direct east and west vertical dials and the polar dial lie parallel to the axis of the earth. If the lines of declination are to be inscribed on these dials the most satisfactory gnomon will be one shaped like a pin, because the point or apex will be both style and nodus.

Figure 1 shows an east dial computed for 40° north latitude, with lines of declination properly drawn upon it. The gnomon has also been drawn in the diagram, for clarity. The style and nodus are coincident at the point N; the height of the style is equal to the height of the perpendicular style, FN; the foot of the perpendicular style intersects the 6 o'clock line at F.

The equinoctial line FE is drawn through the foot of the perpendicular style and at right angles to the 6 o'clock line.

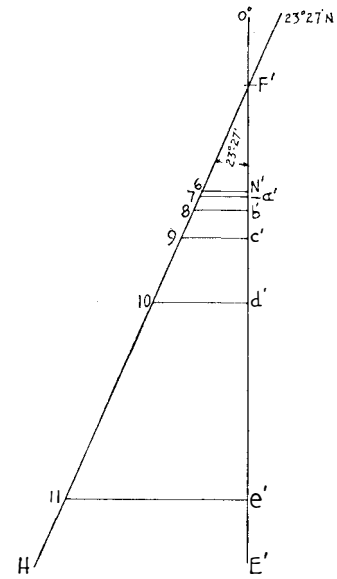


Figure 2

On vertical dials, the horizontal line is drawn through the point where the equinoctial line crosses the 6 o'clock line, or through the foot of the perpendicular style. On the east and west dials, these two points are coincident at F; therefore, the line AB, drawn through F, making an angle with the hour lines equal to the latitude of the place (in this case 40°) will be the required horizontal line, for this dial.

THE construction of the lines of declination for the east dial follows:

Draw the line $F'E'$, Figure 2, representing the equinoctial line; and through F', draw $F'H$ making an angle with $F'E'$ equal to the sun's greatest northern declination (23° 27′).

Lay off from F' the distance $F'N'$ equal to the height of the style.

Take the distances from N (Figure 1) to a, b, c, d, and so on (the points where the equinoctial line cuts the various hour lines), and lay these distances off from F' (Figure 2) to a', b', c', d', and so on.

Through the points N', a', b', and so on (Figure 2) draw lines perpendicular to $F'E'$, cutting the line $F'H$ at 6, 7, 8, 9, 10, 11 (the figures represent the corresponding hour lines in Figure 1).

Now lay off the distances $N'6$, $a'7$, $b'8$, and so on (Figure 2) on Figure 1, so that $F6=N'6$, $a7=a'7$, $b8=b'8$, and so on. Then, a line drawn through the points 6, 7, 8, 9, 10, 11 (Figure 1) will show the path of the shadow of the nodus when the sun reaches its greatest northern declination.

To find the points on the hours before 6 through which the line of declination is to be drawn, make $k5$ and $m4$ (Figure 1) equal to $a'7$ and $b'8$ (Figure 2), respectively.

In the same manner all other lines of declination can be plotted on the dial plate.

The horizontal line is a useful addition to an east or west dial, for by it the time of sunrise and sunset throughout the year may be estimated.

In Figure 1 the line of declination for December 22 cuts the horizontal line between 7 and 8 A.M., and a little before 7:30 A.M., apparent time. Therefore, on December 22 the sun will rise shortly before 7:30 A.M.

According to an almanac computed for 40° N. latitude, the sun will rise, on

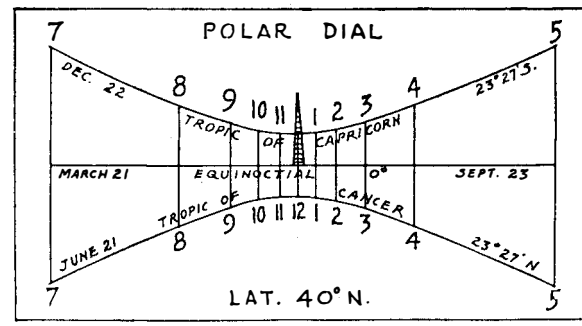


Figure 3

December 22, at 7:20 A.M. apparent time. The time may be more accurately measured on a large, carefully constructed dial.

If Figure 1 is looked at from the back, a west dial for the same latitude, with its lines of declination properly drawn and designated, will be seen. The morning hours will become the afternoon hours, and the horizontal line will show the time of sunset.

A POLAR dial, with its lines of declination, is shown in Figure 3. The construction of the lines is the same as for the east dial. The horizontal line is not shown on this dial, because it would be of use for only about one month during the year. It is, however, constructed in the same manner as that for the equatorial dial, described in the September number.

The polar dial is seldom constructed, although it may be adapted to many situations. The symmetry of its lines adds to its attractiveness.

There is another easy method of drawing the lines of declination, which employs tables showing the altitude of the sun, and will no doubt appeal to those readers who have access to such tables.

The United States Hydrographic Office publishes many books useful to the navigator. Two of these books, designated as No. 201 and No. 203, show the altitude and azimuth of celestial bodies for stated values of declination and latitude, which are useful to the diallist. Publication No. 201 is now out of print and consequently difficult to obtain, but No. 203 is the current publication and it contains the same tables.

The method of constructing the lines of declination, by means of these tables, will be briefly outlined. Its application to the various types of dials is the same as that shown in the following example, where the path of the shadow of the nodus is plotted on an horizontal dial in latitude 40°N., when the sun has a declination of 20°N.

From the tables mentioned above, take out the values for the altitude (angular distance above the horizon) of the sun, for each hour of the day, in latitude 40°N when it has a declination of 20°N. (The values, as shown below, have been taken from the United States Hydrographic Office Publication No. 201.)

HOUR			Altitude of Sun
12 noon			70°
1 P.M.	and	11 A.M.	66°14′
2 "	"	10 "	57°29′
3 "	"	9 "	46°48′
4 "	"	8 "	35°26′
5 "	"	7 "	23°58′
6 "	"	6 "	12°42′

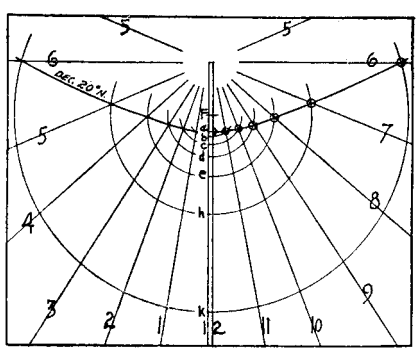


Figure 4

In Figure 5, the line $F'k'$ represents the substyle line on the dial. The foot of the perpendicular style is noted at F' and the nodus at N.

Now draw lines from N to the line $F'k'$, making angles with $F'k'$ equal to the altitudes shown in the above table. Thus, angle $F'a'N = 70°$; angle $F'b'N = 66°14'$; and so on.

Then, in Figure 4, lay off from F (the foot of the perpendicular style) the distances Fa, Fb, Fc, and so on, equal to $F'a'$, $F'b'$, $F'c'$, and so on (Figure 5) respectively.

With center at F (Figure 4) and radii Fb, Fc, Fd, and so on, describe arcs cutting the corresponding hour lines (radius Fb cuts the 1 and 11 hour lines; Fc cuts the 2 and 10 hour lines; and so on). Through the points thus found

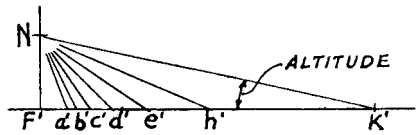


Figure 5

on the hour lines, draw a curved line, which will be the desired line of declination.

All other lines of declination may be plotted in the same manner.

BY the end of the 17th Century almost every conceivable type of dial had been constructed; and gnomonics had become a finely developed art, to which "well informed gentlemen gave careful consideration." Since that time few new dials have been devised, and most of these have been modifications of earlier types.

There seemed to be no limit to the amount of "furniture" that the early diallists were wont to place upon a single dial. Figure 6 is an admirable example of such a dial, which has more lines than most people would want to compute. Aside from the time of day the facts depicted on this dial are varied and interesting, and a short description of them will not be amiss. Upon this dial are inscribed:

1—Lines of declination, which show the path of the shadow of the nodus when the sun is on the equator and in the two tropics. On the meridian or substyle line is marked the position of the shadow of the nodus for each degree of declination.

2—Azimuth lines, which show the position of the sun throughout the day, with respect to the points of the compass; or its angular distance east and west of the meridian.

3—Lines showing the length of the day; the time of sunrise and sunset.

4—The dial is constructed for London, but the time of sunrise and sunset in Constantinople is also shown.

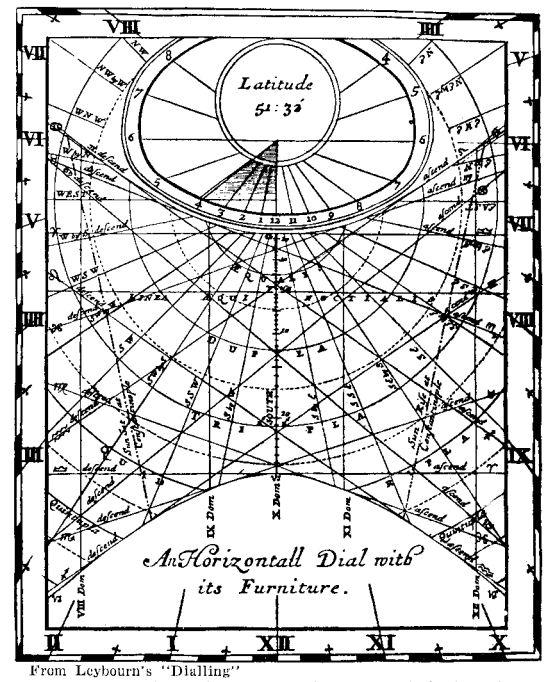
5—Lines showing the rising and setting of the signs of the zodiac (ascending and descending signs); and the position of the sun with respect to the signs. These lines were used by astrologers to tell the position of the sun in relation to its cuspis, and they did not have any astronomical application.

6—Lines showing the altitude of the sun.

7—Declination of the sun at its entrance into the various signs.

It is evident that the computation of such a dial would require a good knowledge of celestial mechanics; also, in the 17th Century, the services of an expert engraver.

There are many collections of sundials and early astronomical instruments in this country—most of them private. Among the most noteworthy collections, open to the public, are those in the Adler Planetarium, Chicago; Industrial Museum, New York; Metropolitan Museum of Art, New York; and the Boston Museum of Fine Arts.



From Leybourn's "Dialling"

Figure 6: **A 17th Century horizontal dial with its complicated furniture, a typical example of what is possible—if one likes complexity**

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The concluding article of this series will describe the armillary sphere.

Norris Dam

Storage and Flood Control . . . Link in Tennessee Valley Program . . . Will Produce Power . . . Unique Engineering Problems . . . Economic Significance

By BARTON M. JONES
Construction Engineer

NORRIS DAM, on the Clinch River 25 miles northwest of Knoxville, Tennessee, has a three-fold duty. It will develop power during certain months of the year; it will aid navigation and flood control materially; and it will have the effect of increasing greatly the "firm," or dependable, power at run-of-the-river hydro-electric plants downstream on the Tennessee River, such as Wilson Dam at Muscle Shoals, and Wheeler Dam, under construction near the Shoals.

All three functions are vitally necessary if the Act of Congress creating the Tennessee Valley Authority is to be fulfilled to the letter and in spirit.

Norris Dam itself is essentially for storage purposes. Designed for the foothills in eastern Tennessee, it will back up an immense lake, 83 square miles in area, containing 3,600,000 acre-feet of water, and having a shore line of 800 miles. Such storage is not possible in low, flat sections of the Tennessee as at Muscle Shoals. Generally speaking, a plant like Wilson Dam on the Tennessee, must "take the water as it comes." When the river is high, as it is during approximately nine months of the year, a generous amount of power may be generated. But when the river is low, little power in comparison is possible. Estimates have indicated the output of power possible at Wilson Dam may run from 65,000 KW to as much as 200,000 KW. In other words, the firm, or dependable, power output is low.

AN entirely different picture is presented with the completion of such a dam as that of Norris, which is on a tributary of the Tennessee. Here water may be stored during the months of the year when it is not needed downstream. But when the "mother river" drops, the stored water at Norris may be released. There it will generate 132,000 horsepower of current, and the same water, passing down the Clinch into the Tennessee, will increase the flow of the latter during the dry months and increase the output of dependable power four or five times at the run-of-the-river plants. Linked together into an integrated, unified system, the dams will harness the power of an entire watershed.

Of equal importance to its power-producing duties, is the relation of the reservoir to navigation and flood control. Reservoir dams hold back water not needed in wet months and release it when most needed. Thus the possibility

A rigger at Norris Dam on the cable across the river

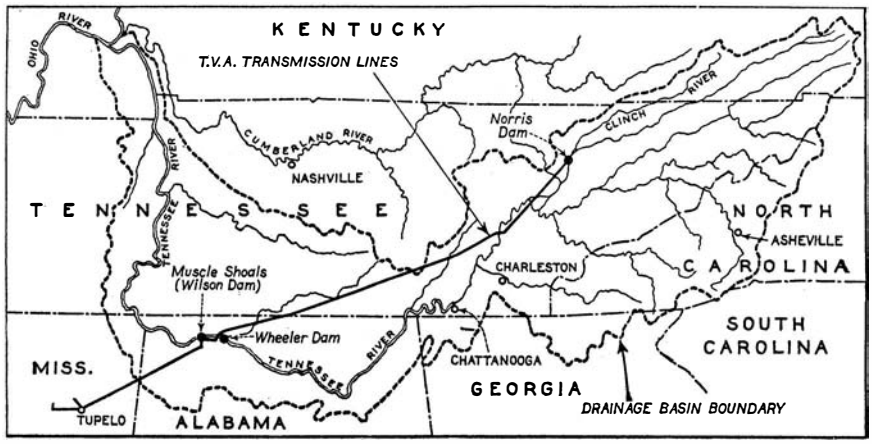
of such a river as the Tennessee going on a rampage after the completion of the series of dams in the Valley will reach the vanishing point. And thus, too, will the navigability of the river be heightened due to the leveling of the stream flow.

That is the first picture that strikes the eye when considering a storage plant such as Norris Dam. However, its significance is deeper still when the more fundamental purposes of the Authority are understood. The Authority is charged by Congress with the development of an entire watershed embracing more than 40,000 square miles. Development of a yardstick by which to measure the cost of generation and distribution of electricity, and to find ways to widen its use in homes and on farms, is but one of the Authority's duties. The development of new and better forms of fertilizers, or plant foods, is another vital one; the tremendous problem of stopping the erosion of the soil is another; the maintenance of a proper balance between agriculture and industry to avoid stagnation of either in the future is a fourth; the reforestation of wide areas which are submarginal is another. And there are many more. All, however, have a common aim: the utilization of the resources of an entire watershed so that the burdens of life are reduced to a minimum.

ALL are inexorably bound together if the common aim is to be achieved; and all must be retained in one's mental background when considering the real

importance of such a project as that of Norris Dam.

Norris Dam will be a concrete structure, 1850 feet long, 253 feet high. The wall of water it will hold back requires a dam of mighty strength. The concrete wall will be 210 feet thick at the base and 213 feet high to the crest of the spillway. Forty feet higher still will be a 22-foot roadway for vehicular traffic. The cost is estimated at 35,000,000 dollars for the dam, power house, and reservoir. The preliminary work has been completed and the work on the dam proper is approximately one fifth finished as this is being written.



The Tennessee Valley watershed, showing dams and tie-in transmission line

THE preliminary work consisted of a number of subsidiary but important undertakings. Test borings, some as deep as 400 feet, were taken to ascertain the stratification, type of rock, and feasibility of building a dam at the site.

A heavy-duty temporary bridge had to be thrown across the Clinch River for transporting materials. A heavy-duty highway was constructed for hauling materials from Coal Creek, a distance of four miles. Roadways had to be developed at the dam site. Warehouses, office buildings, first aid facilities, and repair shops were erected at the site.

Complete housing, commissary, and recreation facilities have been built for the workers at the edge of the new town, Norris, four miles away. Meanwhile, aerial surveys were made of the reservoir area to be inundated and 1000 men are clearing timber and brush along the 800-mile shore line.

Norris Dam on the Clinch River shortly after pouring of concrete had been started in east coffer dam

The first stage of the work on the dam itself called for the diversion of the Clinch in order that a foundation might be prepared. This was done by means of timber-crib, clay-and-rock-filled coffer dams. Since the Clinch is only about 300 feet wide, only three of these were required.

The first-stage coffer dam, extending part way across the Clinch from the east bank and about 475 feet up and down stream, was completed and unwatered January 28, 1934.

Excavation operations on the east hillside were extended into the bed of the river, and five 12-yard dump trucks with two electric and two gas-electric power shovels were put on this work. One of these shovels dug the foundation for the power plant, while another cleared a foundation for part of the apron of the spillway. The other two stripped the overburden and excavated rock from the hillside over the area to be covered by the base of the dam.

Excavation necessary for the foundation for the entire dam will require the removal of 127,500 cubic yards of earth and 158,000 cubic yards of solid rock.

The rock in the vicinity is hard dolomite, a limestone formation with part of the calcium replaced by magnesium. Sixteen wagon drills and 30 jackhammer drills are busy night and day reducing this rock to movable size. Three air compressors, each with a capacity of 2300 cubic feet per minute, and one with a capacity of 1100, all at 100 pounds pressure, are used in this work. Six 12-yard and two 8-yard dump trucks, owned by the Authority, and a fleet of smaller, rented trucks are in circulation 22 hours a day in four 5½-hour shifts, carrying away the earth and rock.

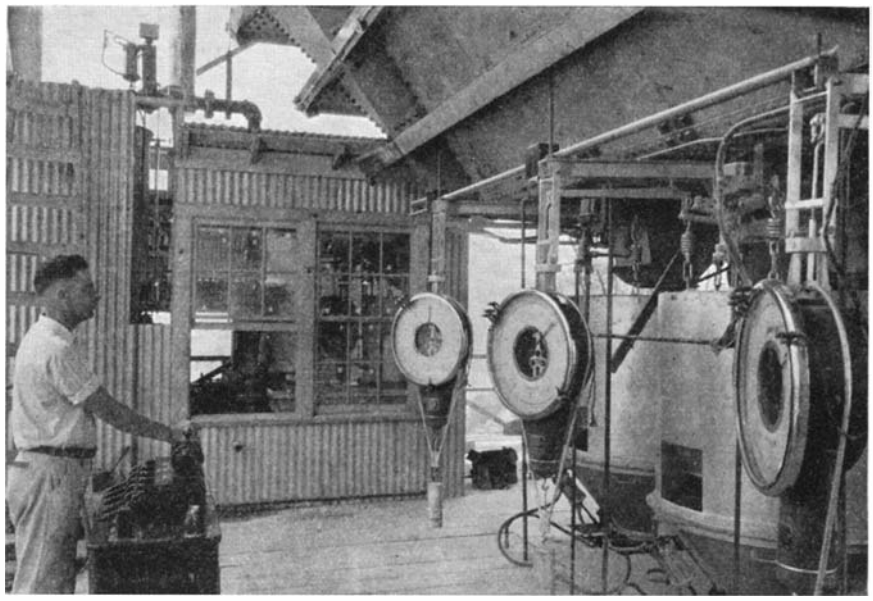
The placing of concrete began some time ago in the east part of the river bed. Gaps will be left in the dam to take care of the flow of the river, after the third-stage coffer dam will have been thrown up to uncover the middle part of the river bottom. Excavating operations will then be carried into this remaining portion of the stream bed.

While excavation of the foundation was being done, a complete plant for production of stone and sand aggregates and for mixing concrete was installed on the west side of the river.

ON the west side of the Clinch, a small draw leads down to the river between the dam site and the mouth of Cove Creek. It was found that beneath its few feet of dirt, the north hillside of this miniature valley is entirely of dolomite rock, of a quality satisfactory for the 2,000,000 tons of crushed rock needed for the job. This fact eliminated the necessity of building a railroad from the town of Offert for shipping in such unusual quantities of materials, a saving for the Authority of several hundred thousand dollars. The overburden of dirt and clay on the face of this potential quarry was washed or sluiced away by hydraulic pressure to uncover the stone to be quarried.

This was accomplished by running three centrifugal pumps in series, one at the river bank and the others at the quarry floor level, and delivering water to the 2½-inch nozzles at 100 pounds pressure. The water was pumped over a total distance of about 1200 feet and to a height of 600 feet. All of the quarry operations are carried on at levels more than 240 feet above the river.

At the lower edge of the quarry, the trucks dump the rock into the top of a 42-inch gyratory crusher that stands 19 feet high and 15 feet in diameter. This primary crusher is able to reduce a 42-inch boulder to rocks six inches in size and smaller. All crushed rock is trans-



One stage of the concrete mixing plant. Here different sizes of rock, sand, and cement drop from storage bins to tanks where the proper batches are weighed

ported by means of a 36-inch rubber belt conveyor, for a distance of 335 feet across the draw to the secondary crusher on the south hillside.

Along this hillside is a straight-line series of operations leading to the preparation of concrete. The six-inch rock is reduced by the secondary crusher and run through a screening plant to produce four different sizes of crushed stone aggregate. A part of this crushed stone is passed through the hammer mills and reduced to sand which will be screened into two sizes. This stock is stored in a row of six separate piles over a concrete recovery tunnel in the top of which are several ports and gates under each pile of stock. A conveyor belt running lengthwise of the tunnel carries any particular size of stock to storage bins above the concrete mixing plant.

The batching equipment under these bins on the mixing plant weighs exactly the right amount of each size needed to feed the mixer. A cement silo of 6000-barrel capacity, with pumping equipment for filling, stands nearby. The mixing unit is a cluster of three 3-yard mixers, capable of producing 4000 cubic yards of concrete a day.

One million barrels of cement, 425,000 yards of sand, and 825,000 yards of crushed stone will be fed into these mixers. Tilting hoppers on transfer cars hauled by gasoline-electric locomotives deliver the concrete to 6-yard bottom-dump buckets on the cableways. The buckets remain attached to the cableway.

High above the bed of the river on each side of the Clinch stand the four cableway towers on their two two-rail runways. The two head-towers on the west side stand 75 feet high on a bench cut into the hillside 340 feet above the river; the tail-towers, 1950 feet distant across the river, stand 110 feet tall on an earth fill 100 feet lower.

The cable spanning the river is three inches in diameter, contains 165 strands of special steel wire, and has a total tensile strength of 550 tons. The cableway is rated to carry a load of 18 tons when in use. To resist this loading, and the weight of the cable, which itself weighs 28 tons, the base of each tower is unusually massive in structure. Also, there is horizontal anchorage in the form of a horizontal thrust rail.

THESE cableways will see considerable service as the work progresses. One million yards of concrete, 2325 tons of reinforcement steel, timber, turbines, and machinery—all will be swung out into space and dropped carefully into position as a part of the routine of construction.

Though primarily a storage and flood control project, Norris Dam will include a power plant containing two 50,000 KW generating units. It should not, therefore, be regarded as an undertaking separate from all other Authority projects. It is, rather, an important link in the power program, the ultimate purpose of which is to utilize completely all the vast water power resources of the Tennessee watershed now flowing practically unretarded to the sea.

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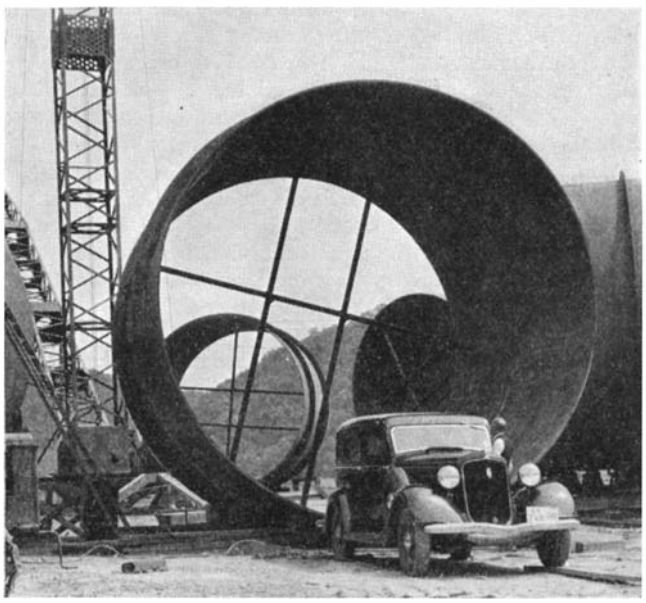
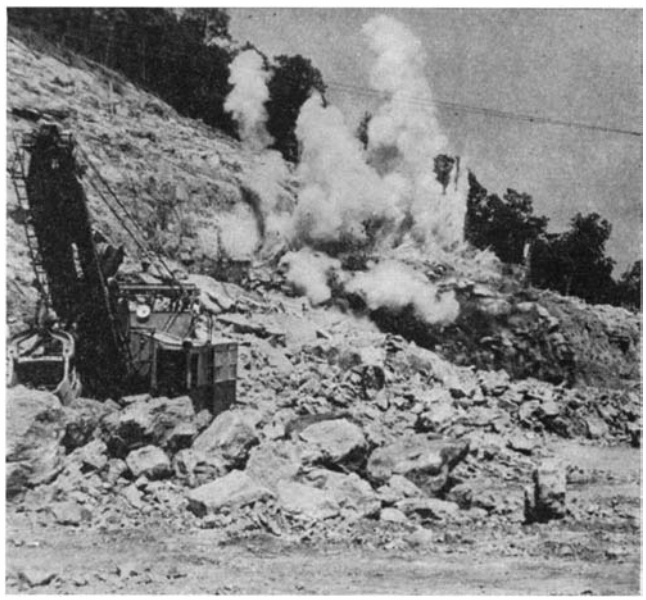
Realism in advertising illustrations is rapidly gaining ground by reason of advances in photographic technique. An article to be published soon tells of this work, and the amateur photographer, reading between the lines, will find many hints that will help him in his hobby.—The Editor.

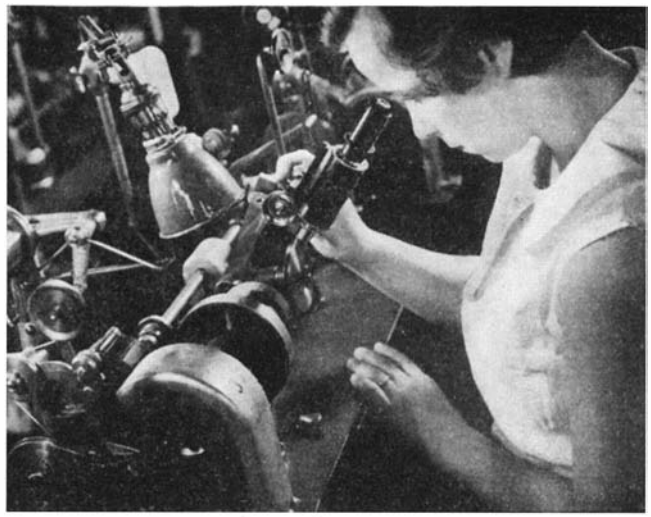


Sections of penstock tubing for Norris Dam; 20 feet in diameter, these sections are electrically welded at dam site

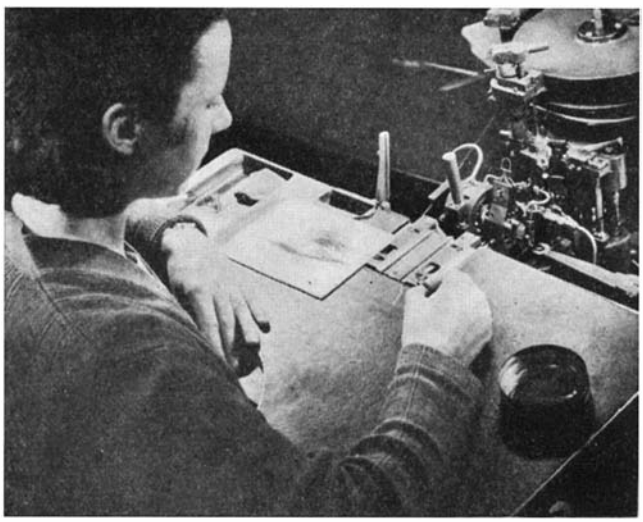


Quarry on the hillside above the dam site just as a blast was set off to produce broken stone for primary crusher

Delicate torsion balances check the diameter of filament wire before it is coiled. Eight-inch lengths are weighed



Automatic winding machines form the fine wire into coils, the operator checking the work through a microscope



The straight filament coils are loaded into a machine where they are bent and drawn into hooks on the supports

Photographs Courtesy Hygrade Sylvania Corporation

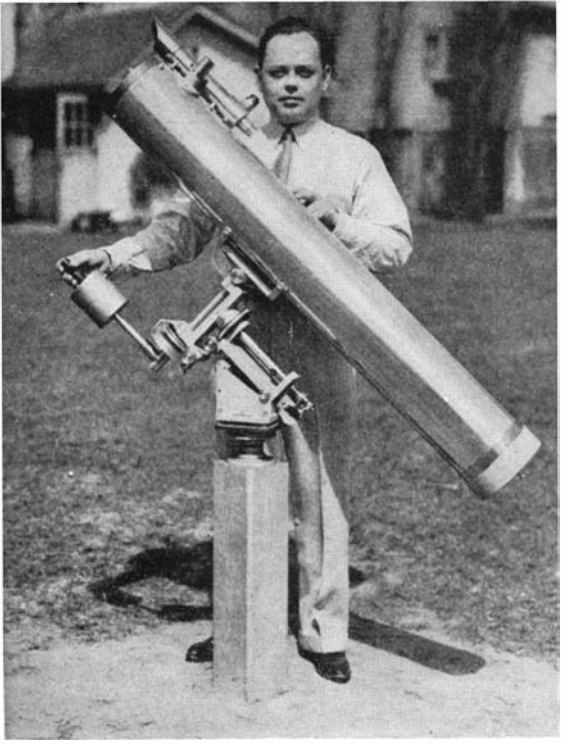
Base twisting test to determine if base is properly cemented. Scale indicates strain in pounds applied by the tester

LIGHT IN GLASS PACKAGES

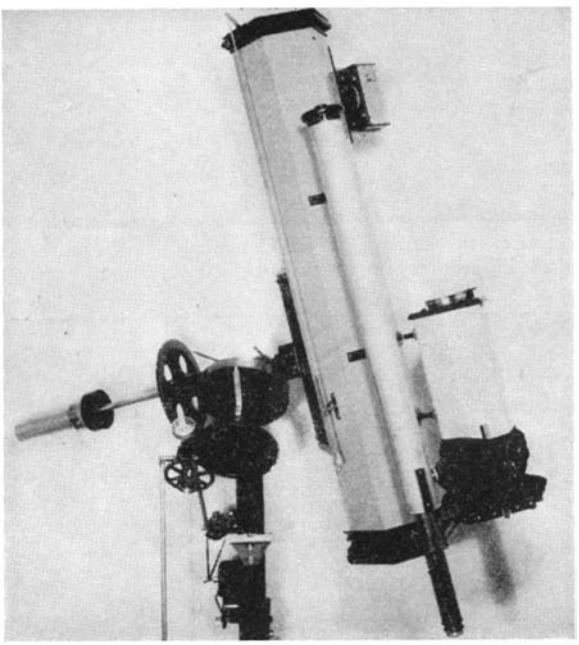
EVEN a king's ransom could not buy a single modern electric lamp bulb, if only a single one had ever been made. The vast background of research and engineering, the quest for rare materials in far-flung corners of the globe, the laboratory precision and skill required in fashioning the glass and metal parts, and lastly the numerous tests and inspections necessary to insure a truly satisfactory product, would prove appalling in magnitude and extent. Only because lamp bulbs are manufactured by the hundreds of millions, with the aid of automatic machinery, can they be made available to rich and poor alike. Lamp production begins with the filament. In the usual 50-watt lamp, the filament wire is so fine that its diameter cannot be determined by a wire gage; it is accurately measured within 0.00001 of an inch by weighing. Upon accurately maintained diameter depends current consumption, luminous output, and service life of finished bulb. This fine wire is wound into coils or helices so small that, to the naked eye, they appear as straight lengths. In some coils there are 1000 turns to the inch. The tungsten wire is wound about a steel wire core or mandrel which later is dissolved in an acid bath. The filament is picked up by tiny metal hands, bent into a loop and thrown over and drawn up into the support wire hooks. Lead wires are automatically clamped on to the ends of the filament. In the revolving sealex machine, glass bulbs with elongated necks are sealed to the filament supporting mount during the first trip around. Then the air is exhausted during the second trip and the glass tube connecting with the exhaust port is tipped off, making a complete glass seal. If the bulbs are to be gas-filled (modern lamps of 40 watts and larger are filled with argon gas) the process is the same except that gas is introduced in the bulb after exhausting. The lamps are then provided with the brass screw base connected to the wire leads. This is accomplished on a basing machine which attaches the base shell to the bulb by melting and baking the cement lining, and automatically solders the leads. Meticulous care in making lamps is only half of the story of a quality product. The other half is of even greater importance, for rigid and relentless inspections and tests provide means of checking quality and insuring that only the proper grade lamps reach the ultimate consumer. Even after lamps have been placed in warehouses they are not beyond the long arm of the inspection department, which takes cases at random and conducts rigid tests as a periodical checkup on the entire stock.

AMATEUR TELE

EXHIBIT ORIGINA



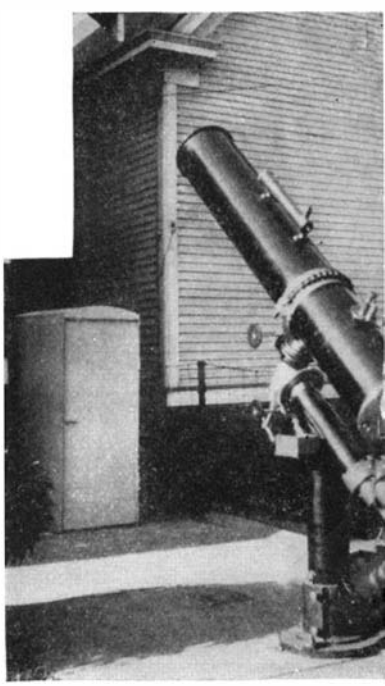
A clean piece of design and workmanship is the 6-inch telescope with finder, made by L. F. Berry, 406 Consumers' Power Building, Jackson, Michigan. It was modified from blueprints by John M. Pierce. Duraluminum tube. The finder magnifies 12 diameters and has a 6-degree field. Mirror aluminized. This telescope is driven by a 6-watt G. E. Telechron motor unit from an oil furnace

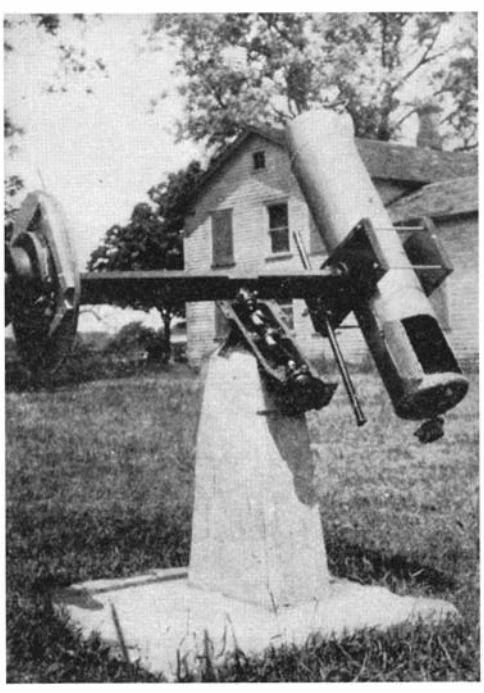


Right: What looks like an anti-aircraft gun is but a refracting telescope. It is uniquely mounted by means of a pair of steering worms from old cars, their housings welded together. One is for motion in altitude, the other in azimuth (the same equipment could be rigged equatorially). One steering wheel spider shows in front, the other faintly behind the finder. A tube hanging from the eye end is a temporary counterweight. Devised and made by J. Janes, 1332 Twelfth Avenue, Saskatoon, Saskatchewan, who states that the gears work smoothly

Below, right: Lew Wallace of Gowanda, New York, was resourceful in seeing possibilities in many things when accumulating his telescope mounting. Chemical or some other kind of analysis reveals the following constituents: One old hot water tank, for tube, eked out with a roll of sheet iron. One inverted Chevrolet motor block for polar axis. One solid iron cross bar an inch and a half thick, from an old mill, to which the declination axis is attached. One 30-inch wooden declination circle, one small grindstone and one motor car hub, these three together forming the counterweight. The net tonnage above the pedestal is given as two tenths, yet its maker says it moves at the touch of a finger. It gets there, though it does perhaps lack sex appeal

A lot of neat equipment is embodied in a 6½-inch, *f*/6 reflector made by Raymond C. Gagnon, 70 East St., Holyoke, Massachusetts. Hexagon tube of sheet metal, a three-inch photographic camera attached. Three-inch finder. In box near top is a roll of motion picture film. Clock drive on pedestal. Setting circles. By substituting a plate for the mirror, removing prism, and attaching 6-inch lens at top of tube, this telescope is convertible into a camera. The entire assembly looks trim, neat, practical, and sound





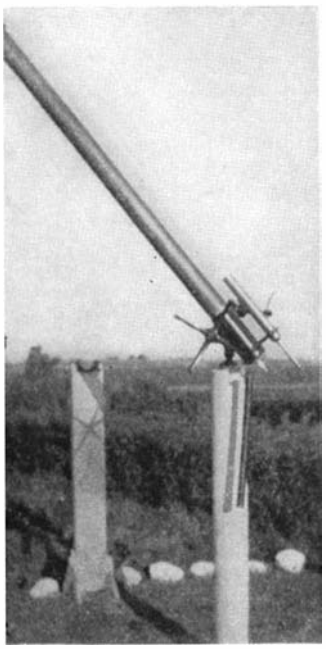
Below: The feature of a 12-inch reflector made by Tracy D. Edmonds, 815 Foster Avenue, Coeur d'Alene, Idaho, is its really adequate truck (it is a locally portable type). Note that this is not a set of bedroom casters but a whole front-axle assembly, with handles of the wheelbarrow type for pushing it about. The two uprights between wheels have large bottoms and are dropped and set for stability

TELESCOPE

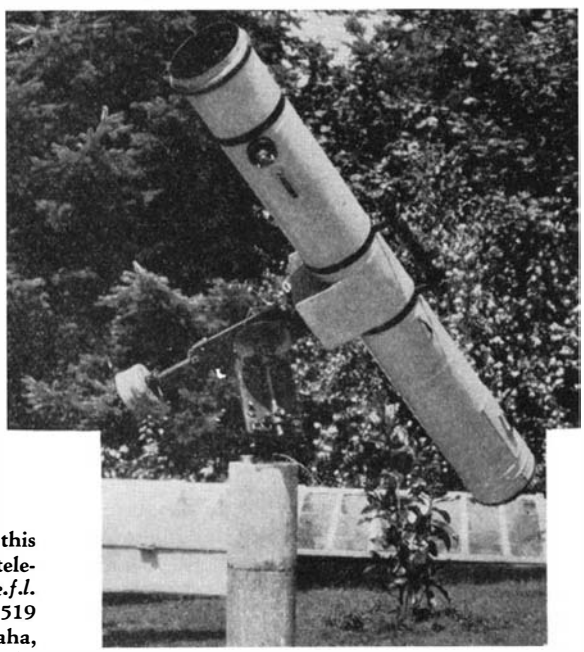
SCIENTIFIC AME

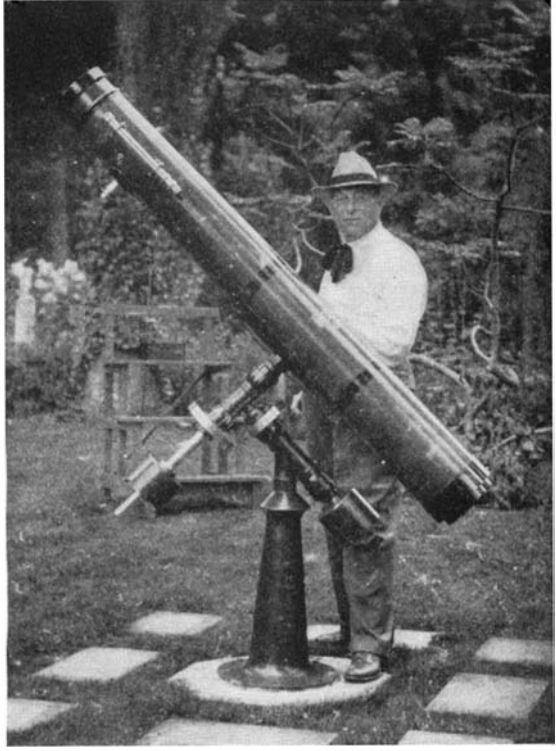
ESCOPE MAKERS

TY AND INGENUITY



Below: "The results on Jupiter with 415 diameters magnifications have been superb," according to the maker of this 9¾-inch reflector, Frederick Ellis, 1863 S. W. Montgomery Drive, Portland, Oregon. The flat, which was made by John E. Mellish, is mounted on an adjustable three-legged spider and works perfectly, Mr. Ellis says. The mirror was polished on an *H.C.F.* lap and he adds that he swears by *H.C.F.*

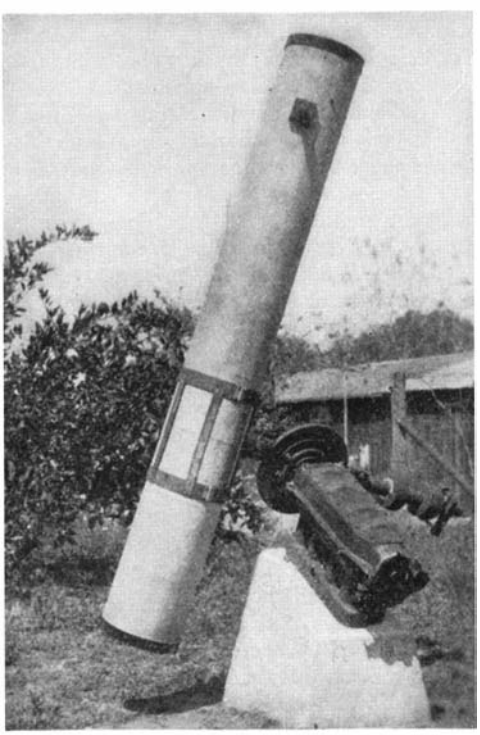




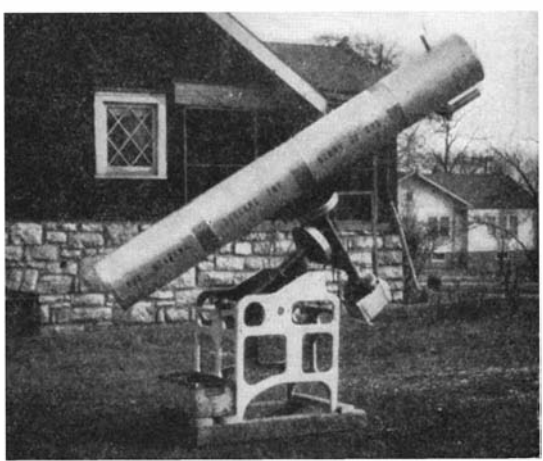
Looking like a field gun and glistening in the sunlight is the very sophisticated looking telescope, a 6-inch, made by Edward R. Perry, M. D., president of the Amateur Telescope Makers and Astronomers of Tacoma, Washington, the mirror having been made by Alan R. Kirkham of the same organization. The tube is a ten-stave wooden porch column and Dr. Perry believes he is the first to use such a tube for a telescope. He writes enthusiastically of the advantages of wooden tubes, of which he cites a half dozen. One is better temperature effects

Left: When making this 10-inch Gregorian telescope of 150-inch *e.f.l.* James E. Myers, 1519 Olin Avenue, Omaha, Nebraska, switched the counterbalance around to the south end of the polar axis. It is a sitting-down telescope with controls handy at all times. Declination axis is hollow, with taper fits for yoke, permitting any sized yoke carrying any sized telescope to be attached. The bar which carries the counterweight is coarse-threaded—two threads per inch—which facilitates quick adjustment for different tubes, of which the maker owns four. Box in background is a cover for mounting. "It took time and a lot of patience," Mr. Myers writes, but at last came success

Below, left: A discarded Ford motor block makes a neat, solid, accurate, and generally excellent polar axis, so Fred D. Ayres, 2236 Sherman Ave., Evanston, Illinois, found when he discovered the original idea of using one while a student at Northwestern University. But he credits the design to his father. He states that the telescope can be clamped in declination by means of two brake shoes tightened against the shaft on opposite sides, with wing nuts



Below: A large reflecting telescope made by Edward F. Bowman of the Telescope Makers of Kansas City, Missouri (1406 Ewing Avenue). The chair-like pedestal is not a chair, but the frame of an electric stove. What object on earth has not been adapted to excellent use in some amateur's telescope! It is alleged to be morally justifiable to covet and confiscate any object around home for use in a telescope, all in the interests of "Sacred Science"



MADE BY
ICAN READERS

RESEARCH FOR INDUSTRY

Institute's Creative Research . . . For Self . . . For Industrial Sponsors at Cost . . . End-Product Belongs to Sponsor . . . Avoids Abstractions and Curiosity

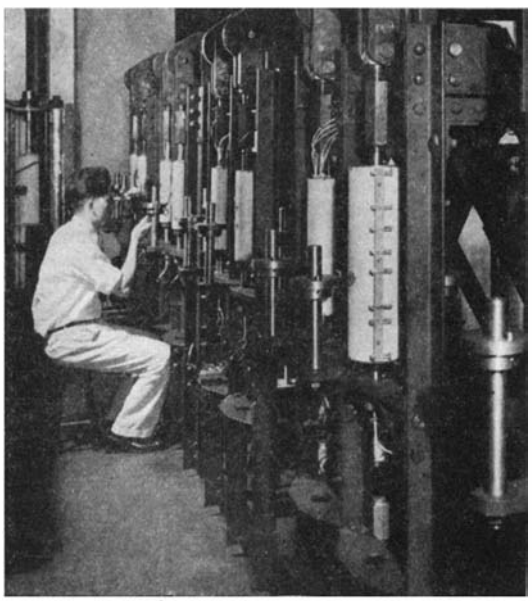
By CLYDE MITCHELL

IN Columbus, Ohio, there is a scientific organization which will take a manufacturer's research problem into its laboratory, study it, find a solution if possible, and charge him only nominal costs. The problem might be one of lengthening the life of gears, determining the quality of an alloy to be used in aircraft, or finding a new use for coal; whatever it is, if it relates to metals or fuels, a highly specialized scientific organization is available to him.

This unique service is being given by the Battelle Memorial Institute, a foundation endowed to make this sort of contribution to industry, to carry on creative research for the advancement of science, and to function as an educational institution. It is only five years old but its growth, its output, and its scientific achievements have been such that an appraisal of its operating methods from the practical angle can now be made.

The outstanding feature of operations, the feature which makes the Institute distinct from other research foundations in the industrial field, is its sponsored research plan whereby industry may utilize the scientific ability and technical equipment of this group. Its operation is extremely simple and can be illustrated by following through a typical case:

LAST year a manufacturer of automotive bearings wished to improve his product so that it would stand up under more severe service. He brought his problem to the Institute and a preliminary survey was made to determine just what the possibilities were. The project was found suitable, a program was laid out, and the manufacturer was invited to co-operate in picking out a research engineer to oversee the work. When this man had been chosen, he was given a laboratory of his own and all necessary facilities were placed at his disposal. The manufacturer was given an estimate of costs before the work began and he was kept informed of progress at regular intervals. To all intents and purposes the sponsor was having research done in his own plant since the work was carried on in complete secrecy by his request. The results—the development of a new bearing metal using cadmium instead of the ordinary alloy base—was his to patent if patentable.



Determining elongation in a number of creep tests of steel. Telescope micrometer is used

The procedure is the same in all cases whether the sponsor be a small manufacturer or a large corporation. The only requirements are that the problem be related to metals or fuels. The Institute, however, does remain judge of the suitability of the problem. Before acceptance, Clyde E. Williams, director; Dr. H. W. Gillett, chief technical adviser; and the staff must satisfy themselves that there is a good chance of obtaining favorable results and that conditions of operation are such as to aid rather than retard reaching the objective. It is a simple provision yet of benefit to both sponsor and Institute, since it has been found to insure productivity of effort.

The fact that research is done not for profit naturally has a very strong appeal, particularly to the industrialist whose problems are so intermittent or specialized that he is not justified in establishing a research organization of his own. At the same time large concerns, having their own laboratories, have used Battelle because of the specialized service and for the less obvious reason that creative research is carried on there. It is perhaps one of the most significant things about the operating plan.

Highly accurate equipment used in metallographic inspection of metals

The contribution this organization is able to make to industry through its sponsored research plan is aided by the creative research because it fortifies the scientific detachment necessary for impartial achievement. Scientific organizations, true to their cause, must be able to see facts and state them regardless of their implications, and this is possible in this case because of the ample endowment which assures freedom from the pressure of commercialism. The Institute has no need to get sponsored projects. It could continue to operate indefinitely without a single outside research job and for that reason it can give sponsored projects the same truly scientific handling as its endowed work.

There is one difference between endowment fund researches and sponsored work. The approach is the same, the equipment and scientific training are identical, but the character of problems is different. Sponsored problems very naturally have to do with specific problems in industry which may have as an objective the creation of a new use for

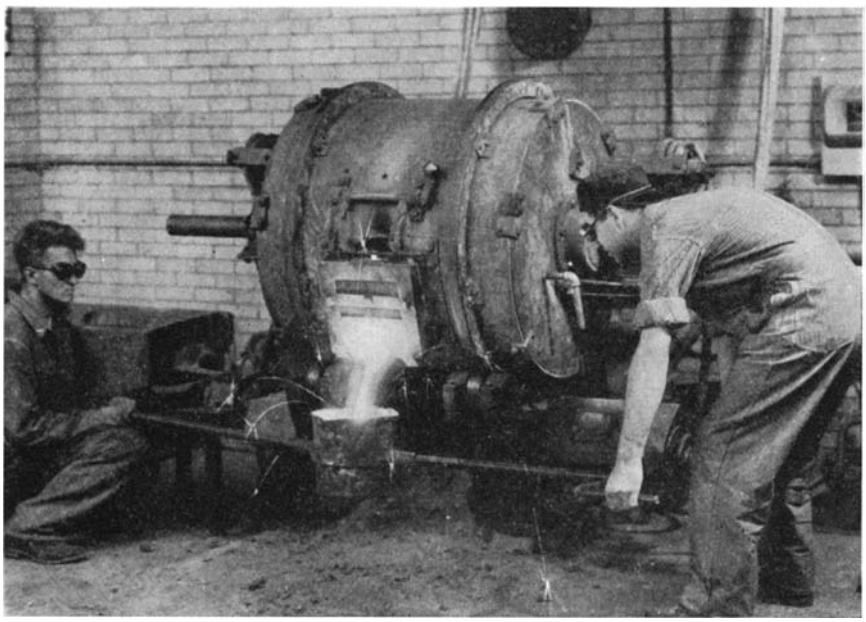
a product or the bettering of the product in old uses. For example, a group of copper producers and fabricators sponsored research to discover new uses for the red metal, while a producer of metal foil wished to have studied the possibilities of surrounding air spaces with this shiny foil for heat insulation. In the former case several new uses were found; in the latter, after study, it was suggested that the metal foil be used for house insulation which is now being done commercially.

When the Institute undertakes its own endowment fund projects, it tackles problems of a more general nature. Its aim can be said to be the working out of problems which industry would not undertake, either because a solution is not vital to its self-preservation or because there would be no immediate value to justify an outlay. Researches of this nature are rarely glamorous. Painstaking effort over a long period of time simply lays down a platform from which more dramatic work can spring.

Resembling a large industrial plant, this laboratory with full-sized equipment investigates pulverized coal and other fuel and exceptional power plant problems

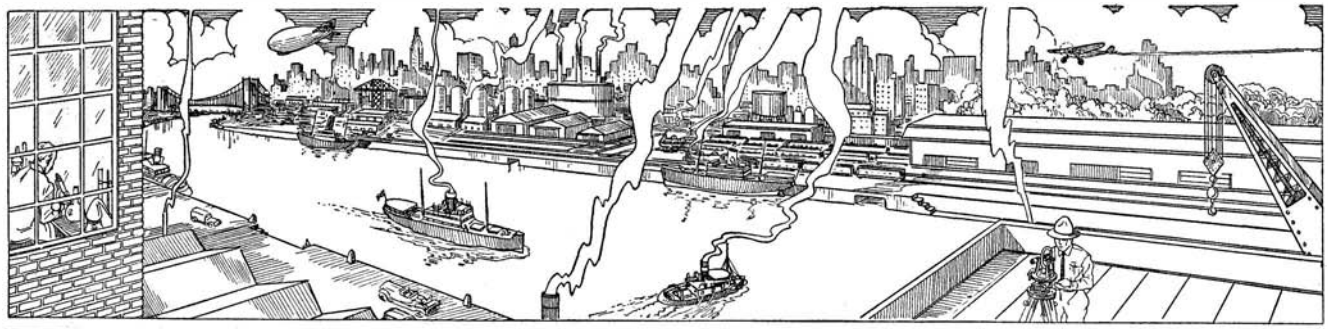
RECENTLY these laboratories perfected a new type of refractory of very light weight. A revolutionary method was developed for making a ceramic having a uniform cellular structure which can be used on a commercial scale with varied applications wherever heat and sound insulation is sought. This is more dramatic than the bulk of endowed projects. When studies were made of low temperature carbonization of coal and the combustion of powdered coal, the latter to reveal the virtue of luminous versus non-luminous flame, the proper fineness for grinding, and the correct size of fire box for best results, the work was not in a field which has much general appeal but the studies were of great value to combustion engineers. Some of the equipment used in this work is shown in the photograph immediately above.

The fact that the Institute in five years of life has expanded its staff from a mere handful to more than 85 to handle its many researches is certainly indicative of the vitality of research throughout the depression and it would also seem to indicate that Battelle's operating plan is sound even though it was conceived more than 12 years ago when industrial research was less urgent than it is now.



Pouring experimental heat of cast iron from a 250-pound capacity electric furnace. Large-scale laboratory experiments require great amounts of molten metal

This plan is the vision of one man, Gordon Battelle, a business man descended from a long line of Ohio industrialists. When he died in 1923, his will revealed that he had worked out a plan with certain definite objectives in view. Battelle wished to further the cause of science but he wanted research to yield tangible benefits in addition to the advancement of learning. He recognized that scientists set apart by themselves might come to devote their energies to the pursuit of abstractions or spend their time in satisfying idle curiosity, yet he fully realized the need for scientific detachment. To maintain this detachment and serve industry practically he strove to effect a balance which might be phrased as: Fundamental science pushing the adoption of scientific methods against the old rule-of-thumb; industry guiding scientific study into productive channels and checking preoccupation with abstractions. This was a valid balance 12 years ago, is today, and will be in the future.



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

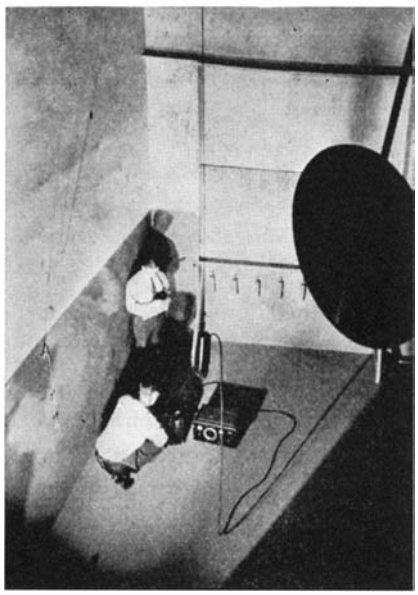
Contributing Editors

ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

A. E. BUCHANAN, Jr.
Lehigh University

The Noisiest Room in the World

WHAT kind of a noise annoys an oyster? That's nonsense, of course, but noises—and noise insulation—are important, so a unique chamber has been built to study them. Here between four walls at the Johns-Manville Research Laboratories is enough distortion and magnifying of noise



Looking into the noisiest room in the world; loudspeaker at upper right

to drive a person insane in half a day. All the worst features making for noise have been combined into an architect's nightmare. The walls are hard, reflecting surfaces, set at angles to one another. The floor throws back any sound. The roof is set at a tilt. In the center of the room is a loud speaker mounted on a pendulum which swings back and forth distributing the noise evenly into all parts of the room.

In the ordinary room, as we all know, a sound dies away almost immediately. Here each sound lasts for 12 seconds; hundreds of sound waves may be set whizzing from wall to wall in those 12 seconds. It is possible for one man with a wide voice range to sing all four parts of a song at once—a one-man quartet. A musician recently played "Home Sweet Home" in all four parts on a trombone in this chamber.

On the wall behind is hung a sample of Johns-Manville sound-absorbing rock wool material, being tested for its efficiency in lowering noise. This is the most effective method of lessening noise, after accoustics have been adjusted. In the silent chamber at Johns-Manville, a direct contrast to this room, one has the impression of being suspended in air. A blind man was led into this silent chamber and, his ear trained to sense the presence of walls, he drew back in fear, thinking he was walking off into space.

"But I Only Had One Drink"

AN analysis of 119 automobile accidents, involving the death of 216 persons, made in Milwaukee by Herman A. Heise, M.D., and published in the *Journal of the American Medical Association* (Chicago) shows that it is not primarily the obvious "drunk" who constitutes a major road menace, but the "drinking driver"—the man who thinks he can drive as well (or "even better") after a little nip.

Dr. Heise found that the alcohol accidents, mostly after little nips, were responsible for injury or death to more than two people per accident, while the non-alcohol accidents involved only slightly more than one person per accident. There is a direct relationship between the severity of the accident and the amount of alcohol; from which the only-one-little-nipper may draw the conclusion that he is relatively unlikely to kill anyone, but may merely maim someone for life. This knowledge should be a relief.

"Considering a person sober as long as he can still walk and talk is responsible for the small value of present day statistics regarding the relationship of alcohol to automobile accidents," Dr. Heise states.

Rubber Wrapping

CELLOPHANE has a new rival. This is Pliofilm, a new rubber product made by Goodyear. It is produced synthetically from rubber by an entirely new process.

Pliofilm has the advantage of being moisture-proof after considerable wrinkling or creasing. In this it is unique among wrapping materials. It is also claimed to have greater tear-resistance but, strangely enough, it does not have the elasticity one associates with ordinary rubber. It does have a toughness with some "give."

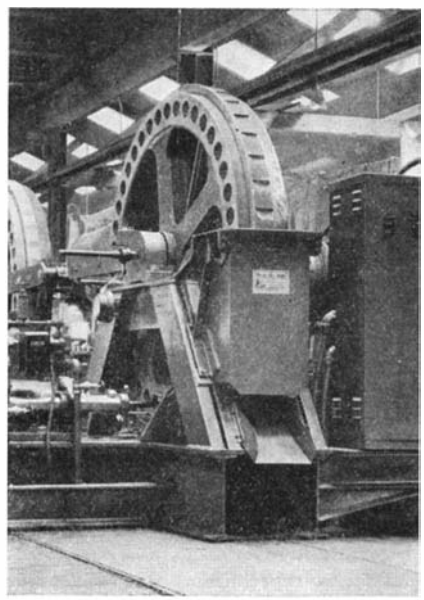
Another very important advantage of Pliofilm is its heat-sealing quality. A moderate amount of heat with pressure makes possible a strong permanent seal of the edges.

Wood Briquettes

EVER since man has been conscious of waste and inefficiency, the saw mill industry has been perplexed by the problem of what to do with the sawdust and mill waste.

This problem was solved temporarily for some by the building of sawmills in or near towns large enough to enable them to sell this mill waste to industrial plants or buildings for use as fuel. This method was only successful for a few mills as the centers of population are not, in most cases, near enough to make this feasible and as the forests are being cleared off farther and farther back, it became increasingly difficult. Sawdust piles grew larger and larger and lay as monuments to an age of waste and devastation.

This problem beset Mr. Robert Bowling, Chief Engineer for Potlatch Forests, Inc.,



An end view of the machine in which wood briquettes are made from waste

and was solved, as are most problems, by combining a few old ideas with a new application.

The larger sizes of dry mill waste first go through a "hog," a machine for breaking down the scraps into small fibers, and from there it is taken to the briquetting department to be made into a solid fuel. In the briquetting department the fine wood fibers and sawdust are compressed under enormous pressure without the use of any binder, into a cylindrical unit of fuel about four inches in diameter and 12½ inches long. The briquettes are so compact that they will not even float in water. They may be started with a match and because of their density, burn in a manner comparable to coal and leave almost no ash.

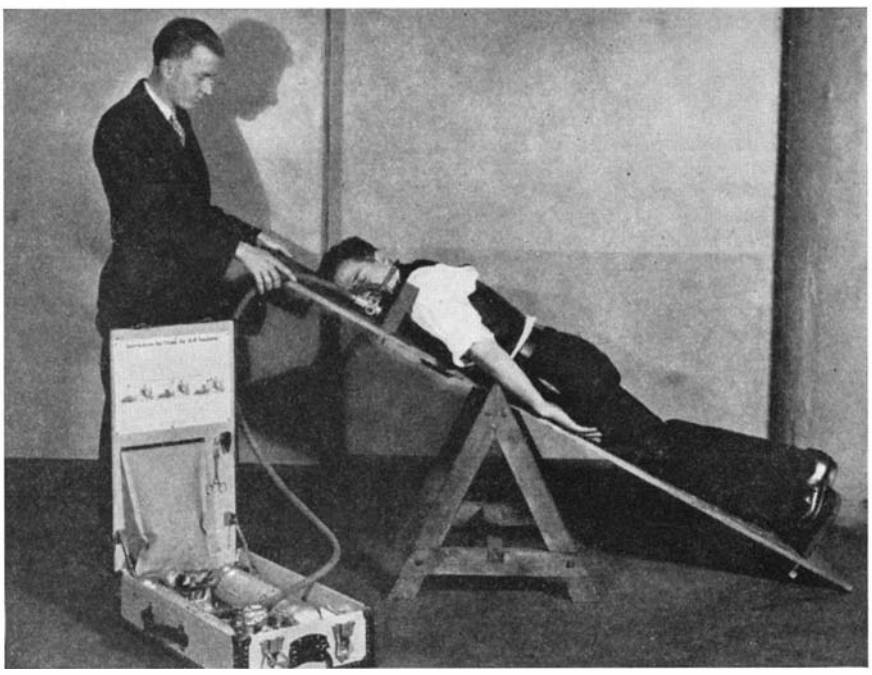
New 1000-Watt 16-mm. Movie Projector

THE new Filmo 16-millimeter 1000-watt projector threw 15- by 20-foot pictures of absolutely theater brilliance in a recent showing in a big Chicago theater auditorium. The theater, which has no balconies, seats 1400 people, and the finest details of the pictures were perfectly clear from the rear seats. The throw was 110 feet, and a two-inch lens (regular equipment with the projector) was used. The brilliant quality of screen result was unanimously conceded by all observers, it is stated.

The manager of the theater, who was present, stated that he could see little if any difference between the 16 millimeter projection and that which he ordinarily secures from a 35 millimeter arc projector run from the same booth where the 1000-watt projector was temporarily ensconced.

Tilting for Resuscitation

PROFESSOR Yandell Henderson of Yale, a physiologist and noted authority on the biochemistry of respiration, in a recent report to the American Medical Association, described a new development for resuscitation called the tilting board. "This device," he states, "is in principle a seesaw on which the victim is laid and rocked slowly through an angle of 30 degrees or more from the horizontal each way. Adjustable pegs are placed in holes in the board at the shoulders and feet to keep the body from sliding. When the head is lowered and the feet are raised, the weight of the abdominal viscera acts on the diaphragm to induce expiration. When the head is raised, the movement of the viscera and diaphragm feetward induces inspiration. If the body is completely flaccid, the victim should be laid on his face, so that the tongue will fall forward; otherwise on his back. The device is quite easily constructed by any carpenter and would probably prove useful at bathing places and in the accident rooms of hospitals. It is particularly adapted to use by laymen."



Artificial respiration applied with a tilting table

PROGRESS In This Age Of Science

As Told to SCIENTIFIC AMERICAN

By DAVID SARNOFF

President, Radio Corporation of America

THE business applications of radio facsimile transmission, which have been established by several years of successful operation of the transoceanic facsimile services, promise to be greatly extended by a high-speed radio facsimile service operating in the micro-wave band between cities in the United States. Our experimental accomplishments in this field justify the hope that we probably will have such a circuit operating between New York and Philadelphia within a year.

The higher speed we expect to obtain by transmission on ultra short waves should make it possible to send exact reproductions of written pages instantaneously between cities. This may revolutionize our ideas of telegraphy, based on dots and dashes of the Morse code. The business man may, within a few years, be flashing letters by radio over his signature.

This would seem to be a logical development of the transoceanic radio facsimile service, operating on longer waves. That service has made readers in the United States familiar with the appearance of photographs in their newspapers depicting events in Europe a few hours after they occur. It has already enabled business houses to transmit by radio across the Atlantic reproductions of engineering designs, legal documents, fashion drawings, and similar material.

Photo Cells Time Races Accurately

GREYHOUNDS winning races are now automatically timed by photoelectric cells which eliminate the possibility of errors. The time which it has taken the winner to cover the racing distance is instantly recorded in fifths of a second on a five-foot illuminated motor driven clock located conspicuously before the grandstand. The time which is recorded on the clock cannot be contested since it is entirely automatic, starting itself with the release of the greyhounds and stopping only when the winning greyhound crosses the finish line.

The light sources are mounted on a galvanized iron pipe firmly fixed in concrete and located at one end of the finish line directly opposite the judges' stand. The photo-cells are similarly mounted and located on the other end of the finish line immediately in front of the judges' stand. Two beams of light are used, one above the other, coinciding with the finish line of the race track. The use of two beams of light insures the positive operation of the control, for if a winner should happen to be leaping at the finish line, he is certain to intercept either the upper or lower beam. The control functions equally as well in daylight as it does under artificial light at night. In order to allow the mechanical rabbit to clear the timing device, the lower light beam is adjusted to throw its beam just above the rabbit and parallel to the track surface.

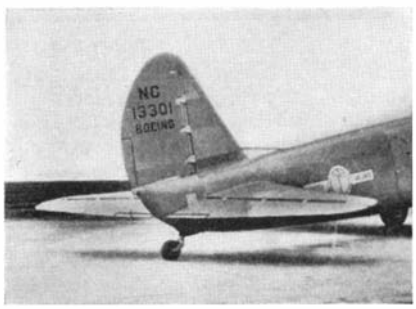
AERONAUTICS IN 1934

By PROF. ALEXANDER KLEMIN

[*Some of the items mentioned in this review have been published in past issues of* SCIENTIFIC AMERICAN. *Brief notice must be given to them, however, in order to present a complete picture of the aviation industry during the last year.*—The Editor.]

AS befits an industry which has passed through adolescence, aviation now advances with refinement and evolution as the watchwords, rather than startling innovation. Aeronautical achievements in 1934 have therefore been not quite so spectacular as in previous years, but they have been valuable, they have embraced every phase of the art, and they have shown an undiminished drive towards progress.

AERODYNAMIC RESEARCH. It is a mistaken idea that aerodynamic research is conducted solely in the laboratories. Such research is also carried on in the most practical fashion by the leading aircraft constructors, and there is constant co-operation between the design engineers and the laboratory men. Thus "trimmers" which have recently undergone investigation in the laboratories were initially a drawing office product. A "trimmer" is a small auxiliary or servo surface placed at the rear end of a principal control surface—rudder,



"Trimmer" or servo surfaces placed in large airplane control surfaces

elevator, or aileron. Trimmers, placed on the rudders of twin engined ships, allow a turning couple to be introduced, without heavy muscular effort by the pilot, which will keep the plane on its path when one engine is out of commission. Trimmers are now being used with equal success on the elevator; by displacing the trimmer a few degrees and in turn displacing the freely mounted elevator, it is possible to "trim" or "balance" passenger airplanes without the use of the adjustable stabilizer. Dispensing with the adjustable stabilizer means decrease in structural complication and an increase in aerodynamic efficiency. Trimmers used on the ailerons have been found useful in correcting wing heaviness.

Experimentation in the use of filleting has been proceeding steadily; by the use of such fillets between the fuselage and the wing it is now possible to avoid all the loss of lift and efficiency which were previously present owing to the mutual interference of wing and body.

Boundary layer experiments by the N.A.C.A. have been partially disclosed; there seems to be little doubt that by suitable ejection of air under pressure through slots in the wing the profile drag can be reduced and the maximum lift increased—with negligible power expended in the blower system. Foreseeing the time when airplanes may fly at nearly the speed of sound, the N.A.C.A. is constructing a high-speed wind tunnel in which airfoils will be tested at between 400 to 500 miles per hour. The first problem will be to develop sharp-edged airfoils to replace the round-edged airfoils of to-day, which are perfectly efficient at

Sharp edged airfoils become efficient when used at high air speeds

moderate speeds, but lose lift and efficiency at very high air speeds. At such high speeds the air becomes "compressible" with a wave formation similar to that of sound waves. While no radically new lift increase devices have appeared, the allied problem of lateral control when a lift increasing flap extends along the whole span is now approaching solution.

A very interesting aspect of aerodynamics is its growing influence on other branches of engineering, as in streamline trains, streamline automobiles and the design of the America's Cup challenger.

TRANSPORT PLANES. The transport airplane has again increased its top speed and cruising speed—there is apparently no end to progress in this direction. In safety, speed, and passenger comfort there is not the slightest doubt that American airliners now surpass the best designs of every other country. Proof of this assertion lies in the fact that German interests have purchased Douglas transports, and that the skilful designer and hard-headed business man Anthony H. G. Fokker has acquired a license to build these ships in Holland. The Douglas transport now in regular service on the T.W.A. lines has achieved a world-wide reputation from its very first public flights. Without prejudice to the merits of other fine ships, the Douglas DC-2 may be recorded as a supreme American achievement in transport plane design.

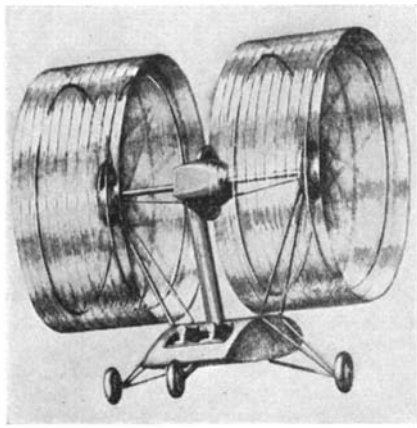
Before construction was started on the Douglas DC-1, hundreds of wind tunnel and structural tests were made in addition to an intensive mock-up investigation. Studies were made of special items such as fuel systems, control mechanisms, heating, lighting, and ventilating systems, and sound control. The finished airplane was flight tested for over 200 hours, and 15,000 gallons of fuel were used in these flight tests. The development cost of the first airplane was approximately 325,000 dollars.

The supremacy of the American airliner in performance, structure, and passenger accommodation is thus seen to be based on intense research and effort rather than on brilliant and unsystematic design.

Another worthwhile achievement in the transport airliner lies in the realization of airplane sleepers. Credit for the first use of sleepers goes to the Curtiss-Wright Condor, which now gives regular sleeper service on American Airways between Dallas and Los Angeles, and on Eastern Air between New York City and Miami. Day and night accommodations are equal if not superior to those of a Pullman car.

AIR RACES. The annual National Air Races held at Cleveland during the Labor Day week end were concentrated into four days instead of the usual ten. This concentration of events, perfect efficiency and timing in the various races, and such innovations as the "horse-race" start resulted in enhanced public interest and attendance, with a record crowd of approximately ninety thousand spectators on the last day. But if the Air Races were a popular success, they were not productive of much technical novelty. The builders of racing craft had contented themselves merely with crowding more and more power into their planes. This "super-power" together with the short laps and the consequent sharp turns 'round pylons in the famous Thompson Trophy race led to a dangerous increase in the centrifugal forces acting on the wings of the racers, and the death of "Doug" Davis. No former speed records were broken. While future races may be just as interesting as ever to the public, some modification of racing rules may be necessary if the races are again to foster engineering progress in aviation.

ROTARY AIRCRAFT. During 1934 great excitement was aroused by the announcement by several workers, American and European, of the "paddle wheel" type of aircraft. In this type of aircraft, airfoils placed at the ends of long arms rotate about a horizontal axis which is at right angles to the line of flight. While the "paddle wheel" aircraft gives promise of powerful vertical lift, some doubt has been aroused by wind tunnel tests as regards its efficiency in forward flight. In Belgium the Florine helicopter, equipped with two lifting airscrews so disposed as to eliminate turning couples (although rotating in the same direction), has made a number of successful though limited flights. The Autogiro has now been successfully flown with the fixed wing eliminated, two blades instead of the former four or three,



A drawing of one type of "paddle wheel" aircraft which holds promise

with control by suitable displacement of the vertical shaft about which the lifting blades rotate. As a result of these innovations the Autogiro has improved considerably both in efficiency and control. While production of the Autogiro on anything but an experimental scale has ceased, its advocates are working as energetically and hopefully as ever on experimental types. It is interesting to note that during the year both the Auto-

giro system and the Wilford Gyro-plane have been tried out for the propulsion of boats without application of engine power —that is, to replace the usual sail.

PLANES FOR PRIVATE FLYING. Eugene L. Vidal, Director of Aeronautics, in the Department of Commerce, startled the aviation fraternity by announcing a plan for a 700-dollar "flivver" airplane of wonderful characteristics. Mr. Vidal's first announcement was received with justifiable criticisms but was followed later on in the year by a much more practical step. The Department called for bids on 25 small inexpensive two-seater airplanes for use by its inspectors, with requirements specially directed to the needs of the private flier. The most important of these requirements were a landing speed of 35 miles per hour and a top speed of at least 110; an engine under 100 horsepower; side-by-side-seating and perfect vision; exceptionally short take-off and landing run; and ability to land safely without levelling out. The last feature would be of course a great boon to the "dub" pilot. Bids were opened in August with a great variety of designs and a wide range in price. While no decision has as yet been announced as to the winner of this competition, study of such designs as have been made public indicate the following advances in the low plane field:

1. The speed range of 110 to 35 miles per hour can be met by non-freakish, sound designs, equipped with suitable lift increase devices.

2. The gap between the "ideal" flying machine and the realizable airplane has been greatly narrowed.

3. All metal construction, including monocoque fuselage, is possible in the moderately priced plane.

4. An airplane is possible which will be easily controlled under almost any condition of flight.

5. Planes that can be used in small fields are within our reach.

6. Something around 3000 dollars is a much more likely price for the "ideal" private plane than 700.

Of course these characteristics of the competing ships exist only on paper. But the regular designs of the year in low and moderately priced cabin planes have been most encouraging. All metal construction; absence of vibration; vision front, down, rear, and up; flaps to act as air brakes; high speeds and low fuel consumption, make private flying this year much more enjoyable and safe than ever before in the history of aviation.

Strange to say, the greatest novelty in the moderate power field was not featured in the Department of Commerce competition. We are referring to the Crouch-Bolas Dragonfly. In this comparatively small machine two air-cooled engines of moderate power are placed rather far out on the lower wing of the biplane. The engines swing oversize propellers whose slipstream embraces a large proportion of both the upper and lower wing. By skilful utilization of the slipstream on wings provided with slots and flaps, excellent results are achieved in quick landing and take-off and climb at a steep angle.

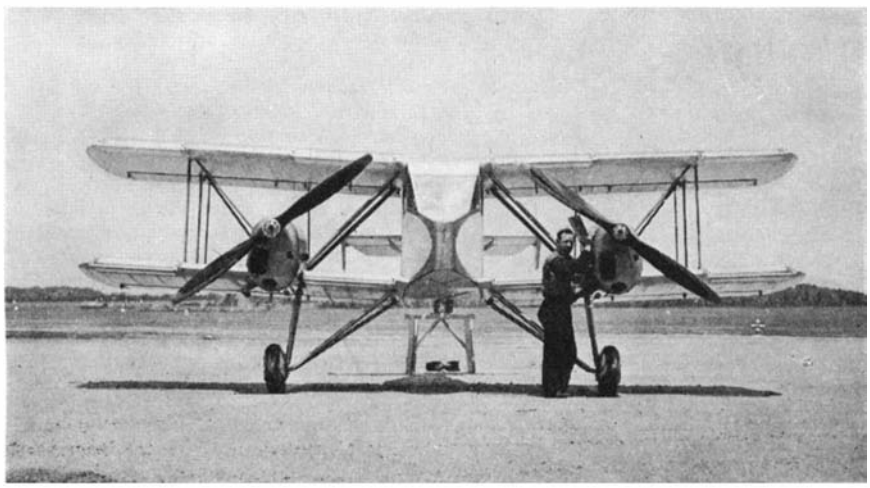
GIANT SEAPLANES. Lindbergh's valuable report on transatlantic service submitted to Pan American Airways, and the wonderful success of the Sikorsky *Brazilian Clipper* have brought the day of seaplane services to Europe appreciably closer. The construction of a larger seaplane terminal in the Bermudas will also be helpful. The Sikorsky S-42 is a four-engined, all metal, high-wing monoplane flying boat. With a gross weight of 19 tons, and a cruising speed of well over 150 miles per hour, the new clipper is the largest flying boat built for regular transport service. With 32 passengers, a crew of five, and 1000 pounds of mail and express, its range exceeds 1200 miles.

Full confidence may be felt that the *Brazilian Clipper* (which has already been fully described in our columns) is only the forerunner of larger, faster seaplanes which will eventually evolve into a commercially practical aircraft for non-stop service to Europe.

POWER PLANTS. In aircraft power plants there has been steady advance but no extraordinary changes—no aircraft Diesels, no gas turbines, no new cycles of operation have appeared on the horizon.

The air-cooled engine remains just as popular as ever, and since reduction of its drag remains a vital problem, two improvements in cowling are very welcome.

One improvement is in the Watter Tunnel Cowl. There are also the Townend ring and the N.A.C.A. cowl. Of these three types of cowling, the Townend consists of a wide metal ring placed around the engine just outside the cylinder heads. It is the simplest but also the least effective of the three types.



Two engines power the comparatively small Crouch-Bolas Dragonfly

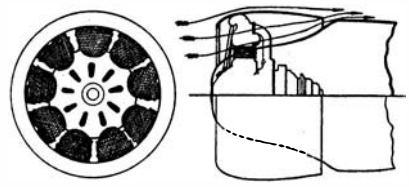


FIGURE 1. N.A.C.A. COWL

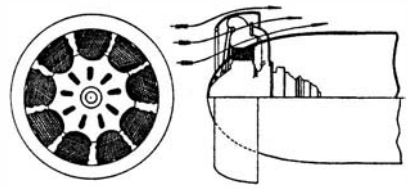


FIGURE 2. TOWNEND RING

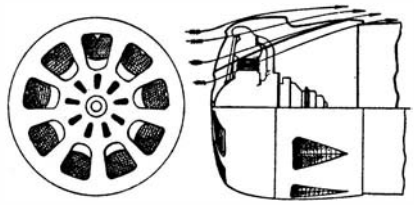


FIGURE 3. WATTER TUNNEL COWL

Courtesy *Aero Digest*

The three types of engine cowlings discussed in the text on this page

The N.A.C.A. cowl provides somewhat better guidance of airflow than the Townend, and diminishes the turbulence somewhat more. But it still leaves inter-cylinder interferences, does not prevent turbulence in back of the cylinders, and gives the air only two dimensional guidance.

In the case of the Watter Tunnel Cowl, the engine is completely enclosed within a streamline form and only a definite quantity of air is admitted through the main front openings to each of the cylinders. Once the air enters the opening it is guided around the cylinders by means of individual tunnels, the restriction being complete in three directions. The distance between the walls of the tunnel widens to its maximum at the cylinder and then converges to terminate in a point, the walls and side being cut out to form a triangular opening for exhausting the cooling air. Tests in Mexico on a Vought Corsair have shown not only excellent aerodynamic qualities, but also the best possible cooling for the engine. Tunnel air guidance has thus been shown of distinct value.

While the engine itself has apparently undergone no radical changes, higher speeds of revolution, higher compression ratios, better fuels, are resulting in a continuous increase in engine power *without* a corresponding increase in weight. Supercharging, both ground boost and altitude power maintenance, are making constant progress. With transport airplanes reaching an apparent limit in aerodynamic refinement, it is remarkable what increases in performance have been achieved during the year by improvement in the power plant and the propeller. For example, the Boeing 247 began the year with a cruising speed of 165 miles per hour. Without other changes the employment of a controllable pitch propeller raised the cruising speed to 171 miles. With the use of slightly more supercharged and geared down Wasp engines of 550 horsepower, there was an additional pick up of 14 miles in the cruising speed.

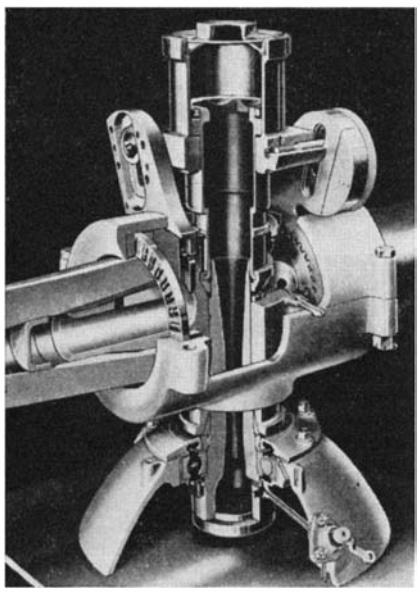
Aeronautics in 1934

(*Continued*)

One of the outstanding engine accomplishments of the year lies, however, not in increased performance but in the introduction of completely automatic lubrication of the valves and valve actuating mechanisms of the new Wasp engine by the standard engine oil supply system. Formerly this was a manual operation; now manual labor, grease guns, etc., are eliminated and maintenance costs are reduced accordingly.

NEW DEVICES. One of the extraordinary things about aviation lies in the way in which it fosters ingenious auxiliary devices, drawing on almost every other industry. The list of new devices achieved in the last year is too long for mention of them all. We will review but a few of the most promising ones.

Controllable pitch propellers have come into greater and greater favor, and almost every important commercial or military plane is now so equipped. The controllable pitch propellers which have already passed into current service are: The Hamilton Standard, which has but two settings and is



Above: **Cut-away view of the mechanism of a two-setting variable pitch propeller.** ***Right:*** **The same type of propeller installed in a plane**

operated hydraulically; the Curtiss which has an unlimited pitch range and is actuated by an electric motor with powerful speed reduction; and the Smith, mechanically operated and also with unlimited pitch setting. These types are all actuated at will by the pilot.

The past year has seen active and successful work on two types of automatic propellers—designed to relieve the busy pilot of at least one burden. Thus the Squires propeller (which has a pitch range of 8 to 10 degrees) is automatically actuated by centrifugal force on counterweights connected with the blades and properly balanced against adjustable spring pressures. The Eclipse automatic propeller has limited adjustment and is actuated by proper balancing of the propeller thrust and centrifugal torque forces against adjustable spring pressures placed at the front of the hub sleeve. At take-off, with high thrust and slow speed, the pitch is lowered automatically. At high speed and lower thrust the spring action induces higher pitch.

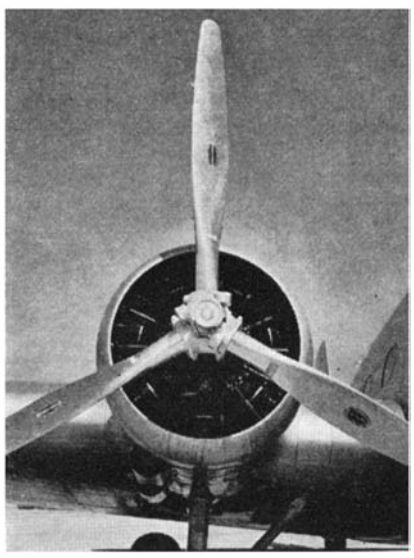
As to the improvement in performance possible with the manually operated variable pitch propeller, the following figures have now been definitely established: rate of climb 15 to 20 percent better; service ceiling raised 15 to 20 percent; take-off run reduced 20 to 35 percent. Flight on one engine in a twin-engine plane has also been established beyond all question, and largely by the use of controllable pitch.

An invention which aroused the keenest interest was the "fog dispeller" developed by the Massachusetts Institute of Technology. When nozzles fitted into a pipe 300 feet long began pouring a secret chemical into a rolling fog, buildings 2000 feet away and previously invisible stood clearly revealed against a background of white vapor. The chemical appears to have the ability to collect and condense water vapor in the air, and to precipitate it to the ground in a raindrop form.

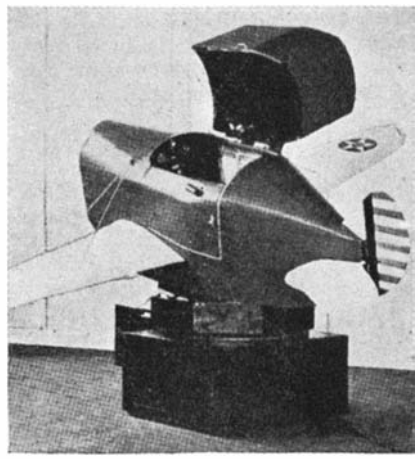
Another important development has been in the application of the Link trainer to blind flying. A cockpit with rudimentary wing and tail surfaces is mounted universally on a pivot. A hidden pneumatic mechanism simulates the movements of the airplane in the air by the operation of a normal stick and rudder bar. Covering in of the cockpit and mounting of special instruments enables this type of "hangar flying" to train men quickly and efficiently for blind flying.

There have been numberless improvements in such accessories as the automatic pilot, electric tachometers, navigational computers, radio shielding, camera guns, and so on.

FLYING IN THE STRATOSPHERE. One of the most significant trends of the time is the growing interest in stratosphere flying. Wiley Post, of 'round the world flight fame, made an earnest attempt in his Lockheed Vega *Winnie Mae*, powered with



a Pratt and Whitney Wasp, to beat the world's airplane altitude record of 47,352 feet. Mr. Post, for reasons which have not been made public, abandoned his efforts for the time being—in spite of some successful preliminary trials. Great interest attaches nevertheless to the special equipment which was developed at his instigation. His Wasp



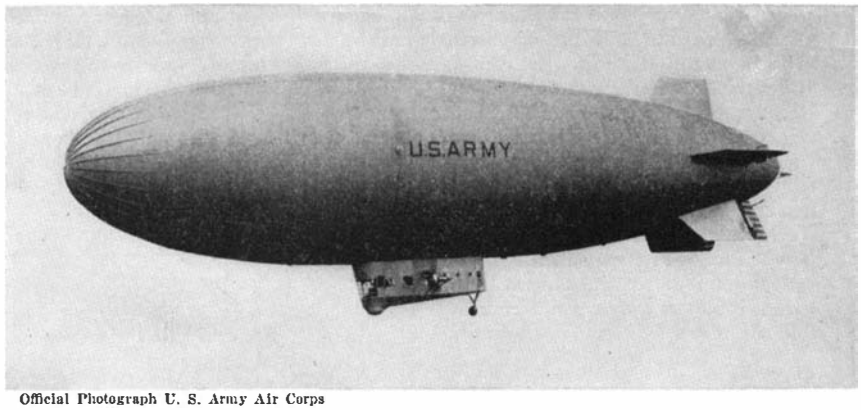
The Link trainer for blind flying, described in the column at the left

engine had a sea level rating of 450 horsepower and this was to be maintained absolutely up to an altitude of 30,000 feet, bringing up the speed of the *Winnie Mae* to 275 miles per hour. The use of two superchargers in series, with an intermediate cooler attracted wide attention. Not only the engine but the pilot himself was to be "supercharged." Mr. Post actually tried out an air-tight metal helmet and a rubberized silk suit. Air was drawn from the first supercharger into the helmet and exhausted through the boots. A mixing valve and air heated by the exhaust, allowed efficient temperature control.

Wiley Post's attempt has a special importance because it is most certainly the forerunner of the transportation of passengers in the stratosphere, with superchargers in series, airplanes with sealed cabins, air-tight ignition and carbureter systems and other obvious devices.

AIR TRANSPORT. In spite of the injuries which governmental policies have caused American air transport, this industry has made progress in a number of ways. The Air Express Division of the Railway Express Agency has arranged an air-express service to Central and South America, linking up the vast airline network in the United States with the Pan American Airways. The Railway Express air system has now reached a mileage of 15,500 serving 110 cities throughout the country. Tonnage has increased by about 150 percent over the previous year, individual shipments are growing in size, and the commodities handled are of an ever greater variety—with motion picture films, advertising materials, art work, flowers, jewelry, spare machine parts, reports, legal papers, and so on, leading the list.

The cancellation of airmail contracts early in the spring of 1934 was disconcerting. But during the month of July the last of the contracts under the revised set-up was awarded, and the system is again in full operation over all the airways. According to the latest figures of the Post Office Department the national system now covers 28,548 miles with daily scheduled flights totaling 78,198 miles. The system mileage has thus increased by some 3000 miles over the pre-cancellation figures, but scheduled flights have unfortunately been cut by nearly 20,000 miles daily, with service over a majority of the old routes radically reduced —for example between New York and Chi-



Official Photograph U. S. Army Air Corps

The *TC-13*, largest non-rigid airship ever made in the United States

cago service has been cut to a schedule of three trips daily instead of the former six. Reductions in compensation per mile have also been very severe, and the carriers' revenues have suffered drastically, with the transport companies losing money heavily as a result. The Interstate Commerce Commission has now organized a Bureau of Air Mail, and the fate of the industry now rests with I.C.C. and the Federal Aviation Commission.

An offset to the bleakness of the picture lies in the greater speed and growing effectiveness of the Pan American services between the two Americas and also in the granting of airmail contracts for service in the Hawaiian Islands.

No review of American air transport, however brief, can be made without mention of the accident report of the Department of Commerce for scheduled operation in the first half of 1934. During this period the lines flew 796,950 miles per accident, there being 27 accidents in 21,517,658 miles of flying. In six accidents passengers or employees of the lines were fatally injured. In the 27 accidents 179 persons were involved and of these 106 suffered no injury whatsoever. There were 34 minor, 10 severe injuries and 29 fatalities. Contrary to public opinion, *not* every airplane accident is fatal. (In the January—June 1933 period the miles flown per accident were only 538,794 although there were fewer fatalities.) Analysis of the 27 accidents showed the following percentages: Personnel errors, 52.04%; power plant failures, 11.85; airplane failures, 18.51; weather, 14.82; airport and terrain, 0.93; other causes, 1.85. While safety is growing, it is seen that even better personnel is the vital need.

LIGHTER-THAN-AIR. In the sphere of the large rigid airship, the year has been uneventful. The *Macon* has been conservatively handled by the Navy, with no spectacular achievements to its credit. There is at the moment but one large rigid airship in process of construction—the *LZ 129* at Friedrichshafen, Germany. In spite of Dr. Eckener's energy, completion of this ship has been further delayed. At the same time the depressing effects of the *Akron* disaster are disappearing and the proponents of the large airship are recovering courage. A number of bills to encourage transatlantic airship service have been discussed in Congress. General William Mitchell has advocated before the Federal Aviation Commission the construction of 50 large ships for use with the Navy. Dr. Eckener, encouraged by the continued success of his intermittent services across the South Atlantic to Brazil, has submitted to the same Commission a plan for a regular North American German airship passenger service with two German and two American craft to be put into service. It would appear that airship men still have not lost hope of putting large dirigibles into oceanic service ahead of the large seaplanes.

In the non-rigid airship field there is more interesting matter to report. The Army Air Corps has received from the Mercury Aircraft Corporation the *TC-13*, the largest non-rigid airship ever built in the United States, with a volume of 360,000 cubic feet and an over-all length of 233 feet. With a special landing gear of the airplane type this airship can utilize the dynamic lift of its hull, as distinct from the bouyancy of its gas, and take off with considerable overload. With use of dynamic lift the useful load is increased from 6117 to 8500 pounds. A most interesting experiment has also been made in anchorage at sea of the *TC-13* for some 75 hours, with a drag cone of large diameter connected to the airship by means of 800 feet of anchor cable.

AVIATION AND THE GOVERNMENT. American aviation has always been blessed or cursed with innumerable investigations or commissions. This year has proved no exception. The cancellation of the airmail contracts (whether justified or not) dealt a terrible blow to air transport. When the Army Air Corps took over the flying of the mails and a number of splendid young pilots were killed, the public was terribly shocked. Thereafter, as our readers will remember, came the Baker Committee, with Newton D. Baker as its chairman. Unkind critics stated that this Committee was called into being to whitewash the Army, and Colonel Lindbergh firmly refused to become one of its members. The Baker Committee's careful report led to the creation of a general headquarters air force which placed the control of every combat flying unit directly under the office of the Chief of Staff, and destroyed the authority of the Chief of Air Corps. Perhaps this was a rebuke to Major General Benjamin D. Foulois who undertook the task of carrying mail at a moment's notice—but what could a soldier do but execute a Presidential command? The feeling is that Mr. Baker's Committee helped Army air work, but it did little for American aviation as a whole.

Now the Baker Committee has been followed by a much more important body, the Federal Aviation Commission, with Clark Howell, the Atlanta publisher, as chairman; E. P. Warner and J. C. Hunsaker as the aeronautical members; and Franklin Lane and Albert J. Berres as the two remaining members, with Carroll Cone as executive secretary.

The Federal Aviation Commission will have the advantage in its comprehensive hearings of listening to the testimony of the most representative and well informed men in American aviation. It needs to be well informed since it has the formidable task of recommending to Congress legislation to stabilize the entire industry and to formulate a comprehensive five or even ten year program for the nation's defense in the air.

Here are some of the important questions which the board will have to decide:

Should we have a united air service? (As in Great Britain). General William Mitchell remains as strong an exponent of this idea as ever, and is opposed, among others, by Admiral Ernest J. King of the Navy Bureau of Aeronautics, who insists on the special duties and training required by the Naval Air Service.

Army and Navy procurement of planes and engines is another thorny matter. To buy planes by private treaty, or with limited competition, seems contrary to the spirit of American institutions; on the other hand how are public bids open to all to be reconciled with adequate reward for the designer or builder of proprietary aircraft of outstanding merit?

Our air transport surpasses that of every other country. But how can it continue to thrive on totally inadequate rates of pay for carrying mail? How can the operators plan any long-term policies with short-term contracts and fierce competitive bidding at frequent intervals?

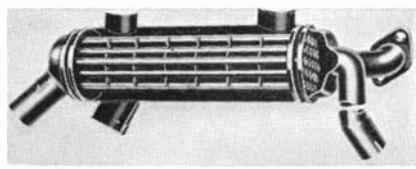
Our aeronautical research is well to the forefront, but how much duplication of effort and waste of money are to be feared in view of the many governmental agencies engaged in such research?

The universities and colleges engaged in aeronautics are doing splendid work, but find that the National Advisory Committee for Aeronautics is tending to a monopoly in scientific effort. Should not these universities be allowed to collaborate with the N.A.C.A. and be allotted research funds commensurate with their abilities and facilities?

The entire future of American aeronautics is dependent on the work and findings of the Commission.

Motor Car "Air Conditioning"

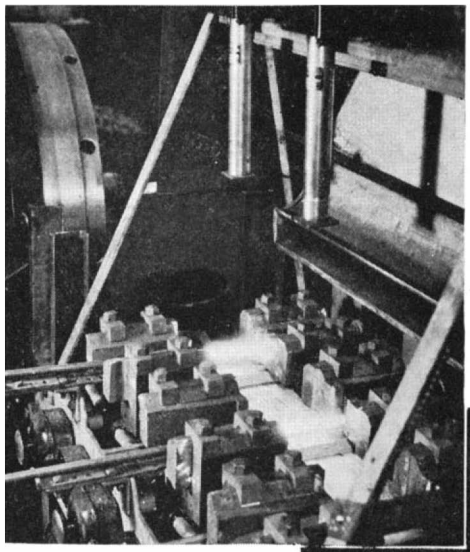
AIR conditioning, the newest wrinkle in motor car heating, is being made available by the Ford Motor Company to owners



"Air-conditioner" for automobiles

of 1933 and 1934 Ford V-8 cars, with the announcement of a new Ford fresh-air heater.

Comfortable driving, even in the coldest winter weather—with an adequate supply of fresh heated air changed every two minutes—is made possible with the new heater,



Two New Uses for Photo Cells: *Above:* The human eye is not sensitive enough to detect the slight gradations of color as a steel bar is heated and goes from red hot to white heat. Therefore, (*Continued above*) where it is necessary to determine the exact temperature of metal, photo cells may be used. In the illustration, two cells in tubes near the top of the photograph cut off the electric heating current when the steel bars below them reach the proper temperature for finishing. *Below:* Studying sewage turbidity with the Westinghouse Transometer. The sample is placed between a light source and the photo cell, the amount of transmitted light being indicated on an instrument dial in terms of relative turbidity

the announcement said. The warm air supply is as clean, wholesome, and odorless as that used for air conditioning the modern home.

The new heater is built just like a boiler, with 24 flues, each 13 inches in length, providing almost 500 square inches of heat radiating surface. The unit is a rigid, integral part of the engine exhaust line. The extremely hot exhaust gases from the engine are passed through the flue tubes. Fresh air forced through the heater by the fan is blown around the outside of these tubes, instantly heated and passed on into the car.

The heat register is installed in the right dash wall, in front of the front-seat passenger. The heat supply may be regulated or may be shut off completely by a button controlling a valve in the intake pipe, which may be operated by the foot. The heat supply also can be directed to any part of the front compartment. Provision is made for the installation of a second heat register in the floor of the tonneau if desired.

Bad Medicine

CYANIDE is one of the quickest and deadliest poisons known to man, but, believe it or not, the doctors have discovered that they can inject it into the bloodstream of a patient in order to study the action of his heart. According to the *Technology Review*, "when the medico is examining a heart and wishes to know how long it takes for the blood to circulate through a certain part of its course, he injects a minute quantity of very dilute cyanide solution into the patient's foot. Then he sits by the bedside with watch in hand. The cyanide is carried along in the blood stream. When it reaches a certain organ, it produces a momentary paralysis of the respiratory centers, and the patient gasps. In the case of an extremely inefficient heart, the elapsed time between the injection and the gasp may be as much as 90 seconds.

"Claude Bernard, the founder of experimental medicine, showed long ago that a very small quantity of cyanide if taken into the body passes through it unchanged. The cyanide does not react chemically with anything in the body but apparently poisons by being present. It perhaps affects the catalysts or enzymes which exist in the body and upon which the maintenance and coordination of bodily functions evidently depend. A simple experiment illustrates the action of cyanide upon a catalyst. If a small amount of spongy platinum is added to a solution of hydrogen peroxide in water, the liquid previously tranquil commences to effervesce vigorously with the evolution of oxygen from the decomposition of the peroxide. A few drops of cyanide solution stop the effervescence at once by poisoning the catalyst and stopping the catalytic action of the platinum.

"Cyanide kills quickly in such short time that it seems impossible for the poison to have diffused from the place where it entered the body to the place where its action would be effective. Cyanide combines readily with oxygen and with sulfur to form non-poisonous cyanate and thiocyanate. These substances are naturally present in the body, thiocyanate in the saliva and cyanate in the blood and urine. The hypothesis has been put forward that cyanide introduced into the body reaches a nerve fiber and takes the sulfur away from the thiocyanate which exists in the tip of the nerve, leaving cyanide in the nerve and itself being converted into inert thiocyanate, that the cyanide now present in the nerve acts upon the thiocyanate in the next portion of nerve fiber, in such manner that cyanide at one end of the nerve produces cyanide at the other almost instantaneously by a process similar to electrostatic induction without the transfer of actual substance.

"We have read an account of an experiment in support of the hypothesis," says *Technology Review*, editorially. "A dog was fastened securely in a two-bladed guillotine, a dose of cyanide was placed on his tongue, and as soon as possible thereafter the knives of the guillotine were made to fall. The dog's head and tail were cut off simultaneously—and cyanide was detected by chemical tests on the tail. This is a tall story, we admit. We haven't seen the experiment, and we'll believe it when we do see it."—*A. E. B.*

"GAS" AND OIL TAXES

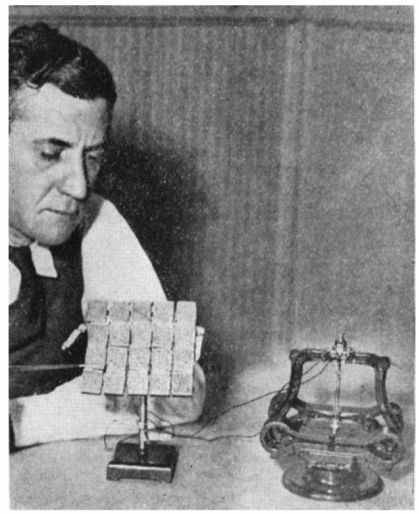
THE Federal Government derived approximately 18 percent more revenue from gasoline, lubricating oil, and pipe line taxes the first seven months of 1934 than it obtained during the same period in 1933, according to figures issued by the United States Bureau of Internal Revenue.

Power Direct from Sunlight

A SMALL electric motor, powered solely from sunlight and which will run continuously as long as the rays of the sun fall on the light-sensitive surface, has recently been constructed by a Detroit manufacturer and experimenter, J. Thos. Rhamstine. A battery of 20 small light-sensitive and power generating disks, connected together and directly to a small direct current permanent-field motor, turns the motor at a high rate of speed without the use of any source other than the effect of the sun's light rays on the disks.

As long ago as 1877, work was done in Germany with copper-oxide cells, and several years ago Lange made a rotating motor in that country, using similar cells. But what is asserted to be the greatest advance in the science of generating electricity directly from light has recently been done, and with an entirely different type of cell. The cells used in Rhamstine's motor are of a different type from those of Lange and, so far as has been determined, they will retain their generating power indefinitely.

This motor at present has no practical value, for the amount of power produced is very small. But to the scientifically minded, it has significance, since the possibilities of obtaining power directly from the sun have



A motor that derives power from sunlight; and its light-sensitive cells

scarcely been touched and in the future, as this science is further developed, more and more power doubtless will be obtained in this way. Some feel that it will in time become the chief source of power for our daily requirements.

South American Indians Chew Tooth-Blackening Plants

GLEAMING teeth are prized among certain Indian tribes of northern South America—but they gleam like jet rather than like pearl. The strange custom of chewing plants that blacken the teeth, in the belief that they are thereby insured against decay, has been reported to the Washington Academy of Sciences by W. Andrew Archer, plant explorer for the United States Department of Agriculture.

The Smithsonian Institution has specimens of two of these tooth-blackening plants, from different parts of northern South America. One of them, collected by Mr. Archer himself, has been identified by Paul C. Standley of the Field Museum of Natural History as a species hitherto unknown to science.

Whether or not the Indians are justified in their belief in tooth-preservation by these discoloring plants has not yet been determined, although ancient skulls with black and well-preserved teeth are reported from Peru. While there is no likelihood that white men will ever use these plans in dentifrices, their study may possibly shed some light on the problem of tooth decay. —*Science Service.*

Steel is Mural Motif

"BREAKFAST on the Hudson" might be the title of the attractive picture shown on this page but the scene is many miles from the big George Washington Bridge. Miss Dorothy Wilson and Royce M. Gallagher are having breakfast in the new "Steel Room" of the Union League Club in Chicago and the background is one of the Kaufmann and Fabry photograph murals which tell the story of steel from mine to finished bridges and buildings. The walls of the entire room are lined with these striking murals which help to make the interior one of the most distinctive club rooms in the country. The theme of steel is carried out in drapes, furniture, lighting fixtures, and carpet.

Striking photograph murals done in the modern manner, using steel as the motif

SHIP ELEVATOR

ELEVATORS in tall buildings for people, yes, but an elevator for a thousand-ton ship! It sounds impossible, but such an elevator is nearing completion at Niederfinow on the Oder River, in Germany. The structure will lift river steamers 120 feet in about 20 minutes and will make Berlin an ocean seaport. Including the great amount of water necessary, the actual weight lifted on each trip will be about 8,400,000 pounds. It is estimated that four 75 horsepower motors will operate it.

Research on Milk Bottle Caps

ONE hundred thousand pounds of paper are used daily to make milk bottle caps! Little wonder, therefore, that the cap manufacturers are wondering whether they can't improve on this time-honored closure. It has just been announced that the Toledo Bottle Cap Company has established an Industrial Fellowship at the Mellon Institute of Industrial Research, for research on paper milk bottle caps, bottle closures, and the study of improvements of paper packages for food and dairy products.

It is conservatively estimated that the annual retail distribution of fluid milk products in the United States requires about 12 billion paper caps of various styles. There are obviously many technical problems involved in such a program.

Director Weidlein of the Mellon Institute has appointed Marc Darrin to the incumbency of this fellowship. It is interesting to note that this fellowship has been established during the golden jubilee year of the glass milk bottle.—*A. E. B.*

Double Protection Industrial Goggles

MANY an eye has been injured or destroyed because workers whose jobs required the use of two types of goggles would take a chance rather than stop long enough to change goggles. New eye protection goggles made by Willson Products are so constructed that they furnish protection, for example, to both chippers and welders.

New double lens goggles which give protection for two types of work

These goggles are on a composition frame fitted to the face. One set of lenses is made of clear, super-tough glass and is used during ordinary chipping or in work in which particles might fly toward the eye. Hinged above these, ready to snap into position with a flip of the hand, are two dark glass lenses to be used during welding operations for protection against dangerous light rays.

Food Fads Menace Health

FOOD faddists—"the vegetarians, the meat eaters, the drinkers of buttermilk, the gnawers of apples"—insult reason and menace health. Deploring the magnifying of half truths and other devices of "high powered salesmanship," Dr. Martin E. Rehfuss, professor of clinical medicine at Jefferson Medical College, Philadelphia, recently told the American Dietetic Association: "Diet faddists have reached a point where they are a positive menace to the health of the community and an insult to the reasoning of intelligent men and women." People have become food conscious to a superlative degree, Dr. Rehfuss declared.

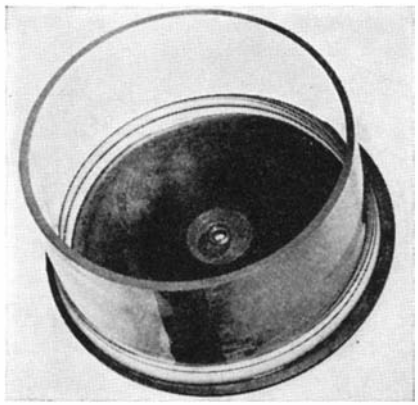
Men and women in early stages of tuberculosis, cancer, and other diseases may be found today seeking relief in diet fads, he said, and meanwhile losing valuable time in getting treatment.

Dr. Rehfuss described to the dietitians biological experiments he has conducted which disprove the recent popular suggestion that proteins and carbohydrates should not be eaten at the same meal. Dr.

Rehfuss tested the digestibility of these two kinds of food together when eaten by normally healthy people and in addition he tested 50 patients suffering from various diseases. Chopped beef was used in the tests to represent protein and mashed potatoes to represent carbohydrate. In the sick persons, some suffering from stomach disease, gall bladder trouble, nervous disorders, and other ailments, it took about three minutes longer for the stomach to digest the beef and potatoes together than the meat alone. This explodes the idea that these foods will not digest in the stomach when combined.—*Science Service.*

New Metal-to-Glass Seal

A NEW metal-to-glass seal has been developed by the Research Laboratory of the General Electric Company which, because of the certainty with which tight



Fernico sealed to a glass tube

and reliable joints can be made between glass and the alloy called Fernico, has opened up many possibilities in the development of various classes of vacuum tubes and other devices wherein leading-in wires or conducting parts must pass through gas-tight insulating seals or themselves form part of a gas-tight chamber.

Fernico can be machined, forged, punched, drawn, stamped, soldered, copper-brazed, and welded with a facility equal to that with which these operations can be performed on a high-grade nickel-iron.

The physical characteristic of Fernico which makes possible its successful fusion with glass is its expansion curve, which coincides almost exactly with that of certain glasses. For this reason, no stresses are set up in either the glass or the alloy when cooling from the fusion temperature. This lack of initial internal stresses in the completed glass-Fernico seal makes the seal permanently tight and unusually sturdy. Furthermore, no more care in cooling the combination is necessary than in dealing with glass alone.

The Impossible Trick

EPITOMIZING all the mystery of the glamourous East is the Indian Rope Trick, most famous of all of the miracles credited to the magicians of India. Nearly everyone has heard of this feat and has heard, too, that it is the one trick of the Indian fakirs that no American or European has been able to duplicate or even explain.

The trick was performed—so the ancient story goes—under a cloudless sky and in an open space, well removed from trees. The fakir, after appropriate mystic ceremony, tossed one end of a rope into the air. The rope remained perpendicular and stretched until the upper end was lost to view. A boy climbed the rope until he too was out of sight. Armed with a sword, the magician followed him up the rope. Soon the boy reappeared, but piecemeal—his legs, arms, head, and torso falling separately. The magician slid down the rope, placed the mutilated body and members into a basket. After more mystic rites, the boy emerged from the hamper, none the worse for wear.

The trick has been written about for years—for hundreds of years—and many explanations have been offered. Usually credited is the assumption, said to be erroneous, that Oriental magicians are so adept at hypnotism that they can hypnotise an entire audience to see what does not happen. Usually quoted to substantiate this is a venerable story—but only a story—of a smuggled camera that captured a picture of the magicians waiting for the spectators to come out of the trance.

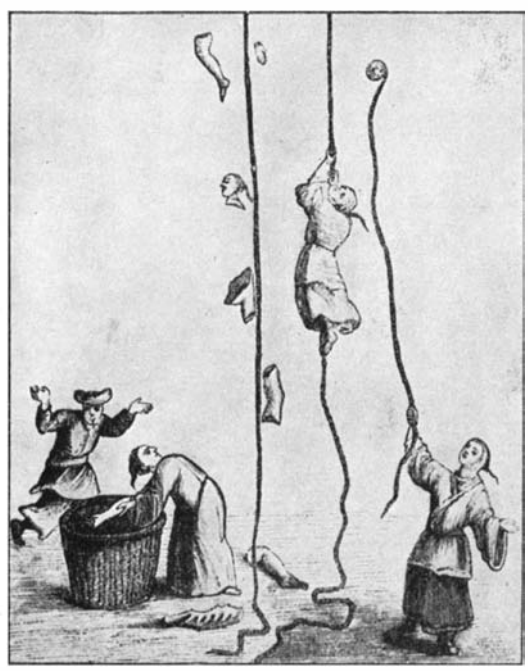
Such has been the persistence of accounts of the "miracle" that scores of magicians have celebrated their arrival at affluence by making pilgrimages to India, hoping to see the trick or at least to talk to someone who had seen it. Kellar and Thurston were among those who made such fruitless journeys. They found, as others had found, that, surprisingly, the most famous of Indian tricks is not even known in India!

The most thorough investigation of the trick is credited to John Mulholland, one of the best known American magicians who shares with Howard Thurston the honor of being the only members of the craft mentioned in "Who's Who in America." Mr. Mulholland was a member of the faculty of Columbia University before he became a professional conjurer and carried into his Indian researches not only unusual technical knowledge of the psychology of deception, but the training of a scholar skilled in modern methods of research.

Mr. Mulholland, during his visit to India, was paid the signal honor of being adopted into the Bakhsh family of magicians, conjurers famous throughout the Orient. Mulholland's Oriental "grandfather," leader of the troupe, taught him all that the family knew about Oriental magic and then asked a favor of the newest member of the family: "Will you explain what tourists mean when they ask us to do the Indian rope trick? If American magicians know how to do it, we should like to add it to our *jadoo*."

Early prints purporting to depict the trick indicate that it was at one time thought to be of Chinese origin, so Mr. Mulholland sought records of the trick in China. While Chinese magicians did not adopt him, they did initiate him into their guild, the members of which assured him that they had never heard of the trick he was trying to trace. Mr. Mulholland ended his research believing that the trick possibly had its origin in the Chinese parallel of the universally known story of Jack and the Beanstalk.

According to students of the Black Art, Indian magic is much overrated and the real home of magic and conjuring is the West and not the East.—*Oil Power.*



An old print from the John Mulholland Collection depicts the performance of the famous Indian Rope Trick — which probably never was performed —by ancient Chinese conjurers

QUEER ACOUSTICS

NOISE plays many tricks. In the great cathedrals of Milan, Cologne, and St. Peter's an organ note lasts so long that any rendition is a confused jumble. In St. Paul's in London and in the Hollywood Bowl it is possible for two people 90 feet apart to have a whispered conversation, owing to the acoustics.

The Precious Jewel

THE "precious jewel" in the head of the toad, about which Shakespeare wrote, is a gland which yields many important medicines, we are reminded by Dr. Edward Podolsky writing in the *American Scholar.* Among them are adrenalin, the greatest heart remedy at our disposal today; ergosterol, parent substance of rickets-preventing vitamin D; and other important ingredients.

The Chinese discovered the medicinal value of the toad ages ago. From its skin they prepared a drug which they called *senso* and which is in reality an impure product similar in its action to digitalis but 50 to 100 times as powerful. For centuries they have also used another remedy from the toad, a poison which they called *ch'ansu.* They used this for sinus trouble, for nose-

bleed, and for pains of various sorts. This is none other than adrenalin which physicians use today to check bleeding and to give relief in asthma.

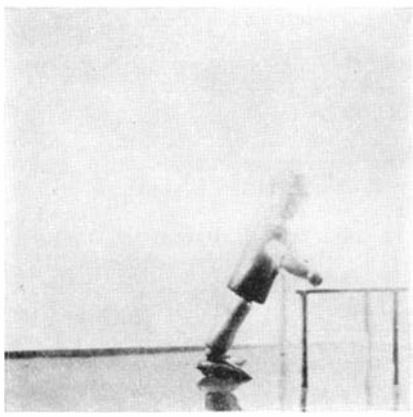
The toad carries these powerful remedies in his skin for reasons of self-protection, explains Dr. Podolsky. "When approached by an animal bent on devouring him the toad begins to secrete his adrenalin and digitalis, a taste of which usually discourages the larger animal from eating him. Should, however, the animal prove too greedy and throw all caution to the winds and devour the toad, the secretions of adrenalin and digitalis-like substances from the skin prove fatal to the devourer."

The Chinese obtained their toad medicines from the large glands located behind the toad's eyes by pressure and also by introducing garlic and pepper into the animal's mouth, whereupon it would cover its body with the secretion.

More than 20 years ago Dr. J. J. Abel of the Johns Hopkins Medical School was able to obtain adrenalin in its purest form, its crystals, for the first time, from the toad. He and Dr. David I. Macht of Baltimore obtained another powerful remedy, bufagen, from the parotid gland of a tropical toad known as *Bufa agua.* This medicine they found to have a marked action on the heart and also to increase the output of secretion from the kidney, which made it a valuable remedy in dropsy. Within recent years Drs. C. C. Chen and Hans Jensen, who started their investigations under Dr. Abel, have obtained six distinct medicines from the skin of the toad.—*Science Service.*

Paint for Better Light—Better Sight

THREE of the accompanying illustrations tell a picture story, pure and simple, of tests conducted in the paint engineering laboratories of the Sherwin-Williams Company. The three pictures show three small



rooms, identical in all respects save one —the color of the paint on the walls. One is painted white; another is painted an aluminum gray; the third is black. The light source, outside the room, is identical in all cases.

In the white room the light is reflected in all directions and evenly dispersed to make an ideal working arrangement, utilizing all the light to its fullest value. In the aluminum grey room the reflection value is lower and the light has a spotty glaring quality. A foot-candle meter reading shows a marked lowering of the amount of light obtainable in the entire room, because more light is being absorbed instead of reflected. In the black room a spotlight effect is achieved, the dark wall surfaces reflecting practically no light at all.

Notice also that glare, a detriment to good visual working conditions, increases as the light reflection value of the wall surfaces decreases. Translated to factory walls, these pictures show what proper use of white paint means in vision, economy in lighting bills, rejections, and unit costs.

Cousin-Marriages

EXAMINE carefully the family history on both sides for at least three generations before marrying your cousin, is the advice of present-day geneticists, according to Dr. Charles B. Davenport of the Department of Genetics, Carnegie Institution of Washington.

Inbreeding is not in itself the cause of defective traits. Through inbreeding, however, existing traits, either good or bad, are strengthened.

Traces of muscular abnormality, dwarfism, epilepsy, feeble-mindedness, and insanity are the conditions to be carefully looked for in the three-generation history of both cousins. If persons in either direct

The three photographs on this page show the variations in room lighting, with the same light source, when walls are in different colors

or collateral lines within the three generations are found having any of these defects, the marriage between the cousins is hazardous for the offspring.—*Science Service.*

Radium in Canada

REPORTS of a rich radium deposit in the Great Bear Lake region of northern Canada, in the same place where sensational silver discoveries have been made, have attracted the interest of the mining world. It is said that 30 tons of pitchblende concentrates, averaging 60 percent uranium oxide, have been accumulated at the refinery. This concentrate represents one gram of radium for every six tons, it is reported.

A new structure is being erected at the company's refinery in Port Hope, Ontario, to treat the concentrate, which will be brought to railhead by airplane. Silver concentrates, averaging between 3000 and 4000 ounces to the ton, and possibly crude bullion will be made at the mine where 60 men are working.

Chemical interest centers in the work of the Federal Department of Mines. A report on their investigations just published describes in detail the process evolved for the successful treatment of the Great Bear Lake pitchblende for the extraction of radium. Two methods have been developed to obtain the best results, as two types of ore were found: High-silica-gangue type pitchblende; and carbonate-barite-gangue type pitchblende containing silver. The mill flow sheet and details of the extraction process, leading to a high recovery in both instances, are described fully. A report of

the radium-measuring laboratory and an account of the precautions taken to protect workers engaged on radium ores are also included.—*A. E. B.*

OCEAN DEPTH READINGS EVERY TEN INCHES

THE Fathometer, used for years to obtain quick soundings of the depth of the ocean bottom by sending a sound from the bottom of a ship and noting the time lapse before the echo is received from the ocean bottom, has now been improved to such an extent that 20 soundings in shallow water may be made each second. This means that a survey boat cruising at 10 miles an hour can obtain soundings of every 10 inches of bottom in shoal water ranging from a depth of six to 120 feet.

Astronomers Uncertain of Next Bright Comet

THOUGH dozens of comets have been observed through observatory telescopes in the last few years, and many more as bright are expected in the near future, astronomers do not know when one brilliant enough to be conspicuous to the naked eye will appear. It is reasonable to expect "one or more great comets some time within the next 50 years but whether one will come next week or next year or not in the next ten years, no one can say." So reports Dr. Robert G. Aitken, director of the University of California's Lick Observatory.

During the 19th Century, he states, "five comets of the first rank appeared and at least six others that were fairly brilliant." One of these was Halley's, which returned in 1835. Another was the Great Comet of

1882. Halley's made its next visit in 1910, and while astronomers have not yet calculated the exact position and date of its next return, which will depend upon the amount that it is pulled by the gravitational attraction of the planets, it is confidently expected about 1985.

All the other bright comets that have appeared in the past, says Dr. Aitken, have their periods "numbered in hundreds of years, and not one is known well enough to permit the prediction of even an approximate date for its return. When one comes, it will come unheralded."

Astronomers will be able to study it with facilities not available previously, he declared. "The modern astrophysicists are far better equipped for observations in these lines than were the observers of the Great Comet of 1882 or even those of Halley's Comet in 1910. When the next great comet appears they will apply every resource at their command to study every phenomenon it presents, and they are eager to enjoy the opportunity," he said.—*Science Service.*

DESTRUCTIVE BEAVER

SENTIMENTALISTS who connect the beaver with our pioneer days have agitated for years for the return of the beaver; that is, they believe we should give beavers an opportunity to multiply. But the beaver can be very destructive. The water supply failed recently at Yellowstone Park's hydroelectric plant and the plant had to shut down. It was found that beavers had completed a new beaver dam directly on the protecting grating in the intake pipe line.

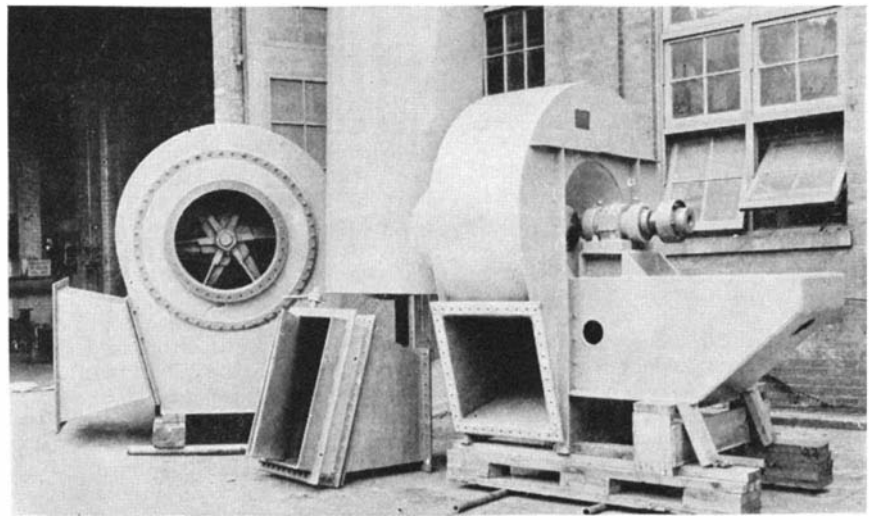
Acid-Proof Rubber Covering on Fan Units

THE bathing beauty with the skin-tight rubber bathing suit has nothing on the exhaust fan units in the illustration; they have their suits of rubber, too. And the fit is perfect, more tenacious.

The practicability of utilizing acid-proof rubber covering to eliminate destructive corrosion in many types of machinery is exemplified in large exhaust fan units recently rubber covered by The Manhattan Rubber Manufacturing Division.

This covering is a specially-developed acid-proof rubber compound applied by a perfected process to the metal surfaces of the fan unit.

The process of uniting rubber to metal holds the rubber covering in place so tenaciously that after vulcanization, the cover cannot be removed without tearing and destroying it.



Two large fan units covered with rubber to eliminate destructive corrosion

Mile-Range Flashlight

IMPROVEMENTS in flashlight batteries and cases developed by the Bond Electric Corporation, have made it possible to produce a mile-range searchlight. This "Big Bertha of flashlights" is made in two long,

The "Big Bertha" of flashlights

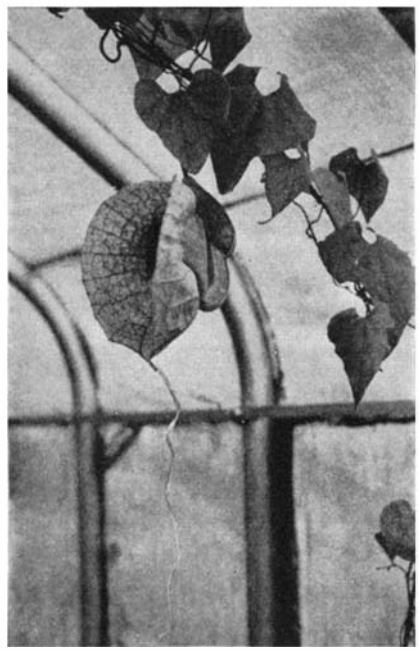
tubular fiber barrel sections, each a complete self-contained unit. It can be used as either a five cell searchlight, or a long range 10-cell searchlight by screwing the two 5-cell sections together. A large non-rolling focusing searchlight head holds a brilliant reflector, and a specially designed, 11.8 volt, tubular bulb is included to be used with 10 cells. A spare bulb carrier contains a 6.2 volt bulb to be used with the 5-cell searchlight and an extra 11.8 volt bulb.

The new mile-range searchlight is controlled by a modern three-way safety switch.

A Pelican Flower Blooms

ONE of the oddest members of the plant world was recently in bloom at The New York Botanical Garden in New York. Its curled-up tube, expanding at the end into a flat, shield-shaped, purple-veined blossom gives it the common names of pelican, swan, goose, or duck flower. It is a close relative of the common vine known as dutchman's pipe. But this particular species, which is the giant of the genus, going by the scientific name of *Aristolochia gigas*, looks in side view like the head and neck of a pelican. It is as queer among flowers as the pelican is among birds.

The flower has a long twisted tail hanging down from the expanded purple-veined



A rare pelican flower in bloom

calyx, which is six inches in diameter, and has no proper petals. The tubular calyx is bent into a puzzling maze for unwary flies attracted by the carrion scent of the bloom. The plant is a native of the West Indies and northern South America, and in its native jungles is a woody climber. It is seen only rarely in collections of unusual plants.

Childless Couple's Chance for Child Doubled

WOMEN who seek medical aid to overcome involuntary childlessness now have double the chance of realizing their natural dream of bearing children of their own, it appears from results obtained at the Evans Memorial Institute, Massachusetts Memorial Hospitals, in Boston.

The secret of success in bringing the boon of children to previously childless couples lies in recognition of the fact that childlessness may be due to multiple causes operating in both partners to the childless marriage, according to Dr. Allan Winter Rowe, director of the Institute.

Fifty out of 100 couples were helped to have children of their own by Dr. Rowe and his colleagues. Reports in medical literature show that the best results previously obtained have enabled only 25 out of every 100 couples to achieve parenthood. Working with Dr. Rowe in his efforts to overcome involuntary infertility were Dr. Samuel R. Meaker, Dr. Samuel N. Vose, and Dr. Charles H. Lawrence.

The first step in the proceedings to help the childless couples was a thorough study of the histories and physical condition of both husband and wife. These studies and examinations showed that both the men and the women were suffering from a number of constitutional and glandular abnormalities. Disorders in varying degree in both men and women were found in thyroid, pituitary, and sex gland functions. Anemia, over- and under-weight, depressed energy metabolism, low blood pressure, signs of liver injury indicating toxic conditions, and venereal, tubercular, and other infections were found in both men and women.

Only nine of the men and three of the women were adjudged normal. With some exceptions, no one of the abnormalities found would by itself have prevented the couple from having children, Dr. Rowe explained. But the combination of several of the abnormalities in both partners to the marriage were in his opinion sufficient to cause the childlessness. In order to raise the chance of the couple for having children to its very highest, all the abnormal conditions had to be corrected. The constitutional factors such as anemia, focal infections, depressed energy metabolism, malnutrition, and disordered liver function played a major rôle in contributing to the childlessness, he believes.—*Science Service.*

Amateur Radio in Sports Reporting

AMATEUR radio is being found at an increasing number of sporting events these days. For several years, radio amateurs have provided communications at the National Air Races and the National Soaring Meets. According to reports reaching the headquarters of the American Radio Relay League, during the last summer these activities were expanded to include regattas and motorcycle runs. Amateur radio is highly useful in any event where there is a long course to be run; observers are stationed at intermediate pylons, checking stations, official barges, and so on. And the "hams" get a big thrill out of doing the work.

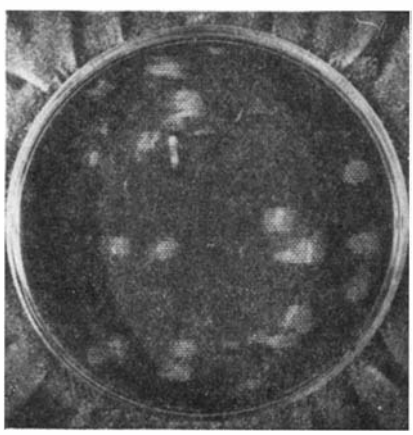
Moths by the Thousands

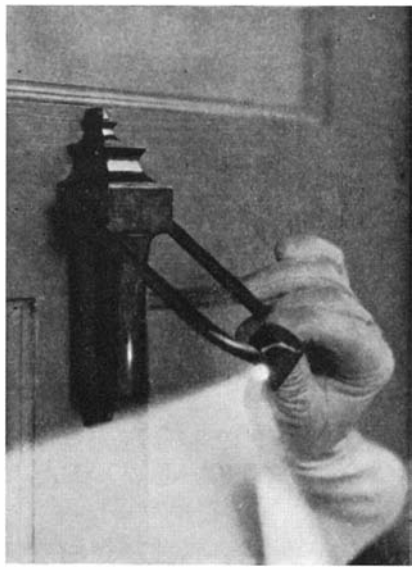
A LABORATORY that uses moths and moth larvae instead of guinea pigs, rats, or white mice is boasted by the Collins & Aikman Corporation, large upholstery manufacturers. The "moth-room," containing tens of thousands of moths, eggs, and larvae is located in the company's Philadelphia plant.

According to Mr. W. F. Bird, in charge of research, it is no easy matter to find moths for test purposes—a statement that the average housewife might dispute. However, Dr. Bird declares that the company employs a fair-sized corps of moth-catchers who are paid five cents for each specimen of the genus *Tineola biselliella Hummel*, or the *Tinea Pellionella L.* delivered alive to the laboratory.

Once in the laboratory, the moths are quartered in the greatest luxury. They are kept in a chamber that is unique in scientific research, but which would give the orderly housewife aggravated nightmares. It is literally alive with moths, which are fed the choicest of animal yarns. Since moths like warmth and darkness, the room is electrically heated and lights are switched on only when a laboratory worker enters the room. Special insulation serves two purposes—it helps maintain the temperature and keeps the larvae from getting out.

Although the moths are pampered to the greatest extent, they are in effect betrayers of their kind. Their purpose is to prove the efficiency of mothproofing processes developed by the corporation. Largely as a result of the yeoman service done by the moths, the company was recently able to guarantee all their mohair furniture upholstery against moth depredations for five years—and back up the guarantee with an insurance policy underwritten by a large insurance company.





If for any one of several possible reasons, you have trouble in finding the keyhole at night, the Knocker-Lite will solve your problem. Just lift the knocker and a tiny lamp lights up the keyhole. Two small batteries provide the current

Left: **What moths can do to untreated mohair fabric.** ***Right:*** **"Hand-raised" moths starved to death on moth-proofed mohair fabric**

Warns Against Two New Drugs

WIDESPREAD use of two dangerous drugs—one which destroys the liver and the other which kills the white corpuscles of the blood—has brought a warning from the Federal Food and Drug Administration. These drugs are cinchophen and amidopyrine. Cinchophen, a chemical anodyne and sedative, is sometimes used by sufferers from neuralgia, rheumatic pains, neuritis, and similar conditions. Amidopyrine is frequently found in headache remedies and other pain killers.

"Current medical literature contains many reports which clearly indicate that these drugs are dangerous to health and life," says W. G. Campbell, Chief of the Food and Drug Administration. "The gradual development of serious poisoning from the use of these drugs is often so insidious that the danger is not recognized by the user. Cinchophen causes a degeneration of the liver cells. Amidopyrine may cause a reduction in the number of white blood cells, a condition called agranulocytosis."

In issuing the warning, Mr. Campbell made it plain that he was not implying that all headache and rheumatism remedies contained these dangerous drugs. But the fact that some of them do is sufficient reason for the public to be careful. Several manufacturers declare on their labels the presence of these drugs in their medicines, but others do not. There is no provision in the Food and Drugs Act to compel manufacturers to declare either of these drugs.

The Federal Food and Drugs Act requires manufacturers to declare upon the labels of their products the presence of several narcotic drugs. When the law was passed, cinchophen was unknown and the dangerous effects of amidopyrine had not been recognized. For these reasons these drugs were not included in the list.

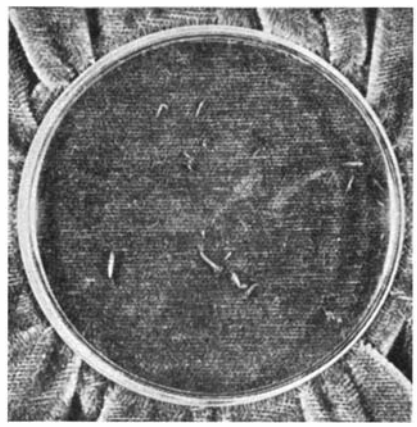
Under present conditions buyers should observe two precautions, says Campbell. First, read the label and look for statements of the presence of these drugs. If they are not declared and there is any doubt ask the druggist or write to the Food and Drug Administration in Washington and ask for the facts.

CITRUS FRUITS IN ALUMINUM

AN agricultural experiment station in Florida, having tested various wrappings for citrus fruits, finds that aluminum foil and Cellophane are "clearly and consistently superior to the common tissue and oil papers" now in use. Their advantage lies in their ability to decrease the loss of moisture from the fruit. They have kept fruit in firm, sound condition for long periods.

Rare Metals Respond to Ultra-Violet

RARE metals, having healing and curing properties, will add many years to human and animal life, as well as improve and increase the nutrition in food products and eventually control production of crops. These rare metals, uranium and thorium, scientists' contribution to mankind, scarcely known outside of the research laboratory,



now are used in photo-electric cells, glow tubes, and X-ray targets, Dr. J. W. Marden, Assistant Director of Research of the Westinghouse Lamp Company, told members of the Electro-chemical Society at their recent 66th Annual Meeting.

Seventeen years ago, when Dr. Marden started his researches on rare metals, pure uranium and thorium were not available at any price but they are now gradually becoming more common.

"Thorium and uranium," said Dr. Marden, "find a use in special photo-electric cells where no other metals can be substituted. Each metal becomes active to light at its own specific wavelength; that is, uranium will detect one portion of ultra-violet light while thorium will detect another portion. Several hundred grams of thorium are used every month in glow tubes employed for measuring devices which determine accurately the amount of radiation given in a portion of the spectrum. Not only do these meters estimate the intensity of radiation at a given time but they also show the total amount of radiation falling for any period of time. The uranium photo-electric cell is used for measuring the ultra-violet radiation which causes tan and for measuring radiations such as are used for producing vitamin D in food products."—*A. E. B.*

Age Does Not Determine Vitality of Farm Seeds

HOW old can seed of grain and forage crops be and still grow? Over and over, farmers ask this question of seed men in the United States Department of Agriculture. "The vitality of any seed cannot be stated in terms of age," replies Edgar Brown, in charge of the Division of Seed Investigations. "Any attempt at generalization as to what percentage of any seed crop will germinate at any age, in any climate, is futile. No rules can be laid down. In general, older seeds do not germinate so well as fresh seeds." Seed deteriorates more rapidly where the climate is warm and moist than where it is cool and dry.

Many examples prove that age does not determine the percentage of seeds which will grow. At the Ohio Agricultural Experiment Station, seeds of different field crops were collected for a series of years, put in corked glass bottles and stored under identical conditions. In February and March of 1920, all were tested. Alsike clover seed from the 1915 crop germinated only 62 percent while seed from the 1910 crop had 90 percent germination. But germination from the 1911 crop was only 13 percent. Field corn from the 1915 crop germinated 3 percent; that from the 1912 crop, 57 percent. Field peas from the 1912 crop had a 95 percent germination; from the 1915 crop only 26 percent grew. Only one percent of the 1917 timothy crop grew, but the germination of the 1916 crop was 83 percent. Seed of good quality originally, if properly stored, will keep its germinating powers much longer than poor quality seed.

Electric ranges were never made to be used in this manner, but since this new Westinghouse range has a welded body like that of a modern automobile, it can support great weights; that is, it is rugged. No bolt or screw heads are in evidence. Mass production methods are used

OIL UNDER THE DEAD SEA

GEOLOGISTS have at length come to the conclusion that oil pools may underlie the bitumen areas in the Dead Sea region, and representatives of various petroleum companies are now engaged in systematic exploration of the district.

Canned Reducing Diet

SO widely was the banana-and-skimmed-milk reducing diet publicized that a commercial food has been developed to supply it in combined form, reports *Food Industries*. The new product consists of dehydrated bananas and dried skimmed milk, with approximately 400 units of vitamin A and 200 units of vitamin D added per ounce to give higher health value.

Ripened in an air-conditioned room, the bananas are dehydrated, 12 pounds of fruit making about 1 pound of powder. Two parts of this powder are then mixed with three of the dried skimmed milk, after which the vitamin, concentrated from cod-liver oil, is added to produce the combination known as Banola.—*A. E. B.*

Reflectors Catch Wild Bird Songs

THOSE queer looking groups of what appear to be huge loudspeaker horns which were used during war time for detecting the approach of airplanes have been put into use in an interesting peacetime study. At least the sound reflectors used by Paul Kellogg of the Laboratory of Ornithology at Cornell University are similar in principle. With such portable units he has captured for the purpose of further study the songs of wild birds in their native habitats. In cases where birds were frightened, he has carried a microphone on a long cable some distance from the "sound truck."

Baby's Cuff

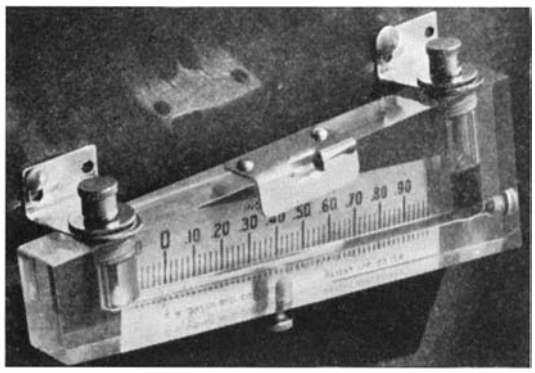
TO prevent babies from sucking their thumbs or other fingers, a practice said by pediatricians to deform the teeth and the roof of the mouth as well as the fingers, a device known as the Bo-Peep Cuff has been developed. It is made of the transparent, non-inflammable du Pont material named "Plastacele," with an elastic wristlet to hold it on. As illustrated, the cuffs make it impossible for the child to get his thumb or fingers into his mouth, although he can see his hands and hold a rattle or other object. They also prevent the baby from scratching an infection or rash.

Cuffs keep baby from thumb sucking

'Ware of Highfalutin' Words

"IT seems," says W. W. Coblentz, Ph.D., of the National Bureau of Standards, in making a report to the American Medical Association on sources of ultra-violet and infra-red radiation, "as though there has never been such a widespread attempt as today to foist on an unsuspecting and trusting public all sorts of alleged physical cure-alls to relieve people's ills and to keep them in health. Prominent among these panaceas is the exploitation of ultra-violet and infra-red rays. The mere mention of 'infra-red rays' creates in the mind of many persons a feeling that this is something new and mysterious that they have missed, when, as a matter of fact, it is difficult to think of a warm object that does not emit infra-red rays.

"When an object is heated to a higher temperature than its surroundings, an ex-



A clear, water-white plastic is used in this transparent draft gage. The inclined tube and oil chambers are accurately reamed in the solid Resinoid casting. Since there is no metal casing, all parts are fully visible and the leveling bubble is free from shadow and is very easy to read

cess of infra-red rays passes from it to the surrounding objects. Examples of sources of infra-red rays are arc lamps, incandescent lamps, coal fires, steam pipes, and hot stoves. Because of the low temperature, the infra-red rays emitted by hot water bags and electrical heating pads are of low intensity, and hence they are insignificant in comparison with the amount of heat that is obtained by conduction, by having the hot pad or hot water bottle in contact with the body. Of course it sounds more impressive to speak of infra-red rays than to speak of the application of heat by conduction, by direct contact of the pad with the body.

"There is nothing new or mysterious about the ultra-violet and the infra-red rays. A person is always exposed to the infra-red rays when standing near a steam radiator, an open grate fire, or even an electric toaster. The spectral quality and total intensity of the infra-red rays emitted by the radiant heaters for warming rooms are essentially the same as emitted by the infra-red lamps sold for therapeutic purposes, except that the latter have smaller reflectors and have more elaborate adjustable mountings, which cost more money."

Aircraft Flare

A FLARE for use in connection with aircraft and which will give a light intensity of approximately 350,000 candlepower for a period of three minutes is being

350,000 candlepower for three minutes

used by the larger airlines in the United States as well as in China and Sweden.

The flare, as shown in the accompanying photograph, consists of a section of aluminum tubing of approximately 28 by 5 inches which contains several pounds of inflammable material including three pounds of aluminum powder.

A Guide for Inventors

A LONG felt want is satisfied in the establishment of an intelligent and dependable organization for guiding American inventors. The genius of the American inventor is, of course, proverbial, but he often lacks the practical knowledge to enable him to develop his inspiration properly and assure his share of profits. The Inventors Foundation, recently opened, is the first effort of its kind in the long history of invention to awaken a fuller realization of the pleasures and gain to be derived from inventive achievement.

The opening of the Foundation in New York follows painstaking research at Stevens Institution of Technology and New York University, in association with the International Correspondence Schools. It has been found that inventors are often surprisingly ignorant of the patent laws, and of the most efficient methods for protecting their own interests to secure adequate returns. The Inventors Foundation, which is conceived on broad philanthropic lines, offers courses in these educational institutions and by mail in all details of invention and patent methods. The inventor in New York or any part of the country can thus receive expert training and practical guidance.

The inventor is first instructed concerning the best protective methods for original ideas, and the practical application of this information throughout every stage of the development of an invention. The pitfalls are carefully charted so that the inventor, however inexperienced, may avoid them. The inventor is likely to be a dreamer and unfamiliar with business methods and the Foundation gives him practical instruction and guidance when he is most in need of it.

The courses include an intelligent study of the inventors' market for the particular product in hand. The most idealistic and unbusinesslike inventor thus becomes expert in safeguarding his own interests. In all these details he has the advantage of the experience of men skilful in every phase of invention. The Foundation, in short, is prepared to answer all the inventor's questions and satisfactorily solve his many perplexing problems.

The Inventors Foundation has been founded by Henry J. Gaisman, himself a veteran inventor, and the creator of some of the best known inventions in the world. Having learned by much bitter experience the dangers which beset the young inventor, Mr. Gaisman has established regular courses of instruction in patent procedure at New York University and at Stevens Institute and by mail.

"Laytex"

LAYTEX, a new insulation for wires which promises to contribute largely to the electrical industry and to play an important part in the progress of more than a score of allied industries, was announced recently by the United States Rubber Company.

Included among the industries which seem destined to make use of Laytex are the automotive, aviation, building, chemical, contracting, engineering, machine, marine, mining, petroleum, paper, power, plumbing, heating, radio, refrigeration, railroad, textile, welding, and others.

Laytex is said to possess properties so superior to those of ordinary flexible insulation that in time, the manufacturer believes, all existing codes and specifications on wire insulation will have to be re-written. For example, compared with ordinary insulation, Laytex is claimed to be more flexible, and to permit thinner but superior walls which make possible finished conductors lighter in weight and smaller in bulk.

Laytex is derived directly from latex, the milk of the rubber tree. Through patented processes are removed all proteins, sugars, and water solubles—the materials which are susceptible to moisture and which make a "sieve" of ordinary insulation.

A conductor is then run through a series of baths of liquid and during each bath the conductor takes on a film of insulation which is almost immediately converted from liquid to solid. The liquid is solidified on any given section of the conductor before

(*Please turn to page* 48)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

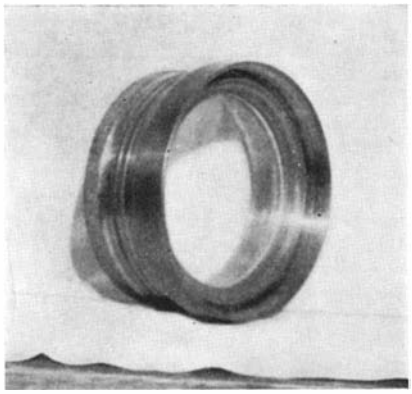
THE article on the design of telescope sights for rifles, by Alan R. Kirkham of Tacoma, which was begun in last month's number, is concluded this month as follows:

THE actual grinding and polishing of small lenses is well described by Porter in the book "Amateur Telescope Making," beginning at page 66. The eyepieces may be mounted without any tests. The objective and each component of the erector should be tested, with crowns facing the light, by the method given at bottom of page 444. The curving of the Ronchi bands, indicating hills or hollows, should be interpreted exactly opposite to the descriptions on page 264, which apply to mirrors. The objective may be figured by making a little pitch tool on a board, and polishing by hand in such a manner as to hit the high spots. The erector lenses are seldom much over a half inch in diameter, and will nearly always be found perfect if made with reasonable care. Should a distinct error be found in one, it will probably be best to regrind and polish it. Before testing, the lenses should be "dummy-cemented" with glycerine, to take the place of the balsam which will finally be used. Figuring done on cemented surfaces is practically without effect. Try the crown both ways (if it is equi-convex) and leave it the way it will require the least figuring. When the errors are all removed, and the Ronchi bands are practically straight, the lenses are ready to be balsamed together.

The balsam sold by most opticians, for cementing microscope cover glasses to slides, is satisfactory. Clean the lenses absolutely spotless, put a drop of balsam on the flint, and lower the crown squarely over it. Finally press them together, being careful not to let them slip around on one another, until all surplus balsam is squeezed out of the edges, which may be wiped clean frequently with a rag *barely moistened* with xylol. The lenses are then baked for three or four hours at a temperature just above what the hand can bear.

LITTLE will be said about the mounting, since it would be almost futile to attempt the job without some knowledge and skill in mechanics. The mounting presents nothing unusual in the way of lathe work, but the lenses should be rather firmly mounted, with quite a wide rim for a seat, in order to withstand the recoil. The reticule is situated at the focus of the eyepiece, and should be adjustable to and from it, for paxallax. Focusing may be accomplished by moving the eyepiece and reticule together, or by moving the erector lenses as a unit, the latter being the prevailing practice. The reticule could be moved by screws or levers for windage and elevation.

Two questions are likely to arise. First, how much distance



A cell, housing a 5½-inch objective lens, made by the author

should be allowed between the erector lenses, if they are separated? Separation of the lenses a certain amount is supposed to improve the color correction under some circumstances, though it has other effects, both good and bad. Practically, it seems to make little or no difference, and the builder may suit his whims, up to half or three quarters of an inch. Secondly, the designer is almost sure to find that the exit pupil diameter and the magnification he picks in the beginning, will require an unreasonably large objective. This is a far more important consideration than the first. Since the second part of the formula given last month for the objective diameter depends only on the width of field, this is another reason for not trying to obtain extremely wide fields. One should make careful drawings, after the plan of Figure 2 (see last month's installment), and study them in order to deduce what changes can be made.

Of course the formula mentioned represents the ideal, with which all parts of the field will be equally bright. Obviously, if all of the rays, when traced backward as in Figure 2 from the stop at F_2, do not succeed in getting through the objective, the only effect will be a slight diminution of brilliance at the edge. With large exit pupils, one could afford to lose perhaps half of the light at the extreme edge of the field, and the effect would not be detectable to a casual user.

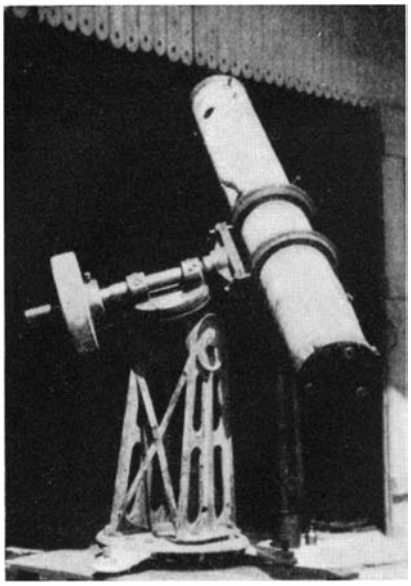
It is necessary to cut and try, in designing these systems, and one is almost always forced to make compromises either in the brilliance of the edge of the field or its width, if he is to obtain either large exit pupils or wide fields. It is often difficult for the layman to realize that these systems are always designed either by whim, or by an ordered effort along experimental lines, in order to obtain desired ends, and that there are no magical formulas which will answer the question, "What kind of sight do I want?"

THIS concludes Mr. Kirkham's article, but in a subsequent communication to your scribe he recommended that no unusual designs be attempted as the first job. There will be enough grief in the usual types, no doubt, to satisfy most workers.

Commenting at our request for data on spotting telescopes—that is, instruments used by the marksman to inspect his target after firing on the range—Mr. Kirkham writes: "A spotting 'scope is merely a small refractor of rather short focus, equipped with Galilean eyepiece, an erecting eyepiece, or a three-prism erector and standard eyepieces. The Galilean is by far the simplest and cheapest, but not very fancy (small field of view—*Ed.*). Erecting eyepieces have many bad traits and are not used much now, being almost wholly supplanted by three-prism erectors employed in connection with standard eyepieces and this permits the use of ordinary kinds of positive eyepieces, which are highly developed. The worker should make the objective according to the instructions by Ellison in 'Amateur Telescope Making,' and the eyepieces according to Hasting's dope in the same book, and for the erector system, buy cheap prisms, with hypothenuse side twice as long as the diameter of the field lens in the largest eyepiece he wishes to use."

A science teacher, Miss Catherine Cassidy, and three science students, the Misses May Hearn, Ida May Nance and Florence Sinclair—all of the East Carolina Teachers College at Greenville, North Carolina, and a telescope they jointly made. The college electrician helped with the mounting job

THERE are no short cuts to the consummation of the telescope sight job, and the worker who has omitted to develop background—or what might be called "optical gumption"—by doing various jobs of a simpler nature, such as making a reflecting telescope with mirror, will probably sweat more profusely over a telescope sight than the other fellow who has built up some experience over and above



An old reflector made as a stock product by the late John A. Brashear and picked up years later by L. A. Baldwin of Troy Hills, N. J. The professional design may be of interest. Note rugged declination axis, yokes, and connecting parts. No shimmying in this mount

that which may be gained from reading books. But the satisfaction of shooting with your own sight would be worth it.

THE following note is from E. Lloyd McCarthy, the same whose focograms appear on page 389 of A. T. M. Mr. McCarthy is now an assistant at the Yerkes Observatory, in Williams Bay, Wisconsin, and he writes: "In casting about for simple means of testing a lens I have been computing, free from coma and spherical aberration, it occurred to me that the autocollimation test could be performed with a vertical set-up and a pan of mercury for the optical flat. Perhaps the idea has been suggested before. I examined the figure of a cheap field glass objective by this means, and found that the tool marks were readily visible. Setting the pan of mercury on a concrete basement floor, I had no trouble with vibration. If you think the idea is new and any good, it might be welcomed by those amateurs who, like me, are forced to economize in their optical work." Mr. McCarthy's set-up is the same as Figure 10, page 121, of A. T. M., with the pan of mercury substituted for the plane mirror *P*, and the whole thing turned to a vertical position so that the eye looks downward.

SO many are the separate groups of amateur astronomers and telescope makers around San Francisco Bay that they have organized their various galaxies into one super-galaxy. C. R. Tinsley of Berkeley tells us that the Amateur Telescope Makers of San Francisco, under the leadership of Dr. Frances W. Epley of the Flood Building, that city, and the Amateur Telescope Makers of Berkeley under the chairmanship of Dr. W. P. Bush, American Trust Building, Berkeley, California, with clubs in Oakland and other Bay cities, have federated into the Amateur Telescope Makers of the Golden Gate, and will meet quarterly. It will be hard to beat that name.

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 45)

the section is in physical contact with any mechanical support, and because of this, mechanical defects are avoided.

Elongation tests show that Laytex has a stretch of 750 percent, which establishes it as the most flexible insulation known. This extra stretch naturally provides an important margin of safety.

The tensile strength of this new insulation is 5000 pounds per square inch, which approaches the tensile strength of non-flexible types of insulation. It is possible that Laytex, on account of its great strength and resistance to compression may be adapted to service conditions in which non-flexible metallic coverings are now necessary.

Owing to the purity and uniformity of Laytex, it has the highest dielectric constant of any known flexible insulation. Its insulation resistance constant is more than twice as high as that of the best grade rubber compound required by the American Society of Testing Materials specifications.

Partnership or Debating Society?

THE 50-50 marriage has a much greater chance of success than does the marriage in which either the husband or the wife takes the leading rôle. But this sort of marriage should be co-operative, not competitive. This is the conclusion of Dr. Paul Popenoe from his experience with thousands of married couples at the Institute of Family Relations.

"Among 13,000 clients of the Institute of Family Relations, virtually every one who complained of unhappy marriage also revealed failure to co-operate successfully in homemaking, with incessant conflict growing out of that failure," Dr. Popenoe said in a report to the *Journal of Home Economics*.

The general idea of young couples who wish to attain a co-operative marriage is that co-operation consists of talking over each problem as it arises until some sort of decision is arrived at. This is the wrong way of going about it, Dr. Popenoe indicated. The only way to attain true co-operation in marriage, he believes, is through division of labor. For both husband and wife to work together on every family matter virtually turns the family into a debating society.

"It means unlimited argument over all sorts of inconsequential points. It is the feeling of most married men, I believe, that their wives attach too much importance to this process. In his study of marriages, G. V. Hamilton asked his subjects what they found most annoying in their respective mates. Most of the husbands said their wives talked too much. Most of the wives said their husbands did not talk enough."

If either one of the partners in a marriage is to be dominant, the ascendancy of the husband is most likely to result in happiness. The figures show 61 percent of marriages happy when the man is boss, 47 percent happy when the wife is boss, but 87 percent happy in the 50-50 marriage.

"When the man dominates the marriage it is partly because he has a dominant personality, partly because economic and social conditions give him an advantage," Dr. Popenoe said. "He is also greatly aided by the fundamental disposition in most women to admire a strong and dominant man and to be willing, in fact happy, to accept his protection and leadership."—*Science Service.*

AMBERGRIS OUTDONE

HERETOFORE no fixatives known to the perfume industry have equaled musk, tonkin, civet, ambergris, and castoreum, products obtained from animal and plant life. Recently, following a discovery by du Pont chemists, a new product called Astrotone has been developed, and this aromatic now looms up as a potential leader. Because it is a water-white liquid and does not discolor, it may be used in many preparations other than perfume. Astrotone sells for approximately 200 dollars per pound.

Research Makes For Safer Transport

SAFER motor cars, airplanes, and railroads may be expected as the result of new research on metals. While industry has been making such things as steel for years, the metal had varying sizes of crystals. This made for unevenness of properties of the manufactured product and made it necessary to have large factors of safety in elevator cables, steel buildings, and similar equipment.

Such factors of safety were really factors of engineering ignorance; they were the margin of safety by which engineers allowed for their lack of knowledge about a metal's strength. It has now been found that a decrease in the size of metal grains makes for toughness in the metal.

New work in the last two years has shown, for the first time, how the grain size can be controlled. The public may expect safer motor cars, airplanes, and railroads as a result.—*Science Service.*

Pictures by Radio

A NEW radio facsimile system which reproduces entire messages, maps, and pictures directly on ordinary paper at the rate of a full letter-sized sheet every eight minutes, was described recently by Charles J. Young, research engineer of the RCA Victor Company.

While Mr. Young emphasized that it is premature to attempt to evaluate all of the practical uses to which the new development might be put, he suggested that such a simplified system could be used to flash messages in their entirety, from city to city, exactly as written by the sender, to supplant the present method of sending such messages, letter by letter, in the comparatively laborious Morse code. He pointed out that the new facsimile system should prove useful in police and crime detection work. Fingerprints, identifying photo-

graphs, and other useful information could be exchanged by police departments to aid in the apprehension of criminals.

The recorder system developed by Mr. Young in the RCA-Victor laboratories dispenses with the cumbersome processing, or photo-developing required by other facsimile systems, by utilizing ordinary carbon paper to print directly on ordinary white paper. Continuously feeding rolls of both the carbon and the paper are led past a metal cylinder, on which a single spiral of wire projects slightly above the surface. The fluctuations in the intensity of the incoming signals press the paper and carbon together against this spiral to make marks corresponding to the lights and shades of the original at the transmitter. Since the receiver and the transmitter are synchronized, an exact reproduction results. The facsimile recorder described by Mr. Young traverses a standard width letter size page, measuring 8½ by 11 inches, at the rate of 1.2 inches per minute. Thus, a full-sized page filled with single spaced typing is completed in eight minutes, or at the rate of 100 words per minute.

DARNED HIS LEG WITH HORSEHAIR

THE Australian bushman or farm worker seldom lacks initiative. Badly cut in the leg by a wire rope, a farm worker near Dorrigo, New South Wales, could get no immediate medical attention. So a fellow worker pulled four hairs from a horse's tail, and using a darning needle stitched up the wound. A cork proved a failure as a thimble, but a penny was quite successful.

The injured leg has now healed completely, without after effects.

Rare Element Found in Siberia

THE rare chemical element, gallium, has been extracted from minerals found in the Altai Mountains of Siberia, Prof. V. E. Zviagintzev, of the Russian Academy of Sciences, has revealed.

Gallium is a metal which melts at 30 degrees, Centigrade, or 86 degrees, Fahrenheit. Its boiling point is greater than 1600 degrees, Centigrade, nearly 3000 degrees, Fahrenheit; mercury boils at 356.9 degrees, Centigrade, or 675 degrees, Fahrenheit. It is therefore more useful than mercury in the manufacture of thermometers for use at high temperatures. Gallium is also used in medicine.

The existence of gallium was predicted in 1869 by the Russian Mendeleeff, who developed the periodic table of chemical elements. It was discovered two years later by the French chemist, Lecoq de Boisbaudran. So far only relatively small quantities of gallium have been available, extracted mainly in Germany and in the United States.

In 1931, Prof. Grinberg of the Institute of Platinum of Leningrad suggested that the zinc ores of the Ridder deposits in the Altai Mountains might contain the rare element, as do the Canadian deposits. The Institute of Rare Metals of Moscow took up the suggestion. Spectroscopic analysis of the Ridder zinc ores showed the presence of gallium, and treatment of zinc concentrates yielded a small amount of gallium oxide. Prof. Grinberg is now leaving for the Altai Mountains to study on the spot the best methods of extracting this important rare metal.—*Science Service.*

Explain Storage Changes in Eggs

AN egg deteriorates in storage because it is digesting itself. Recent work by food chemists of the United States Department of Agriculture shows that trypsin, one of the enzymes present in the pancreatic juice of the human body, is present in egg white and is quite probably responsible for the changes that occur in eggs when they are stored for several months. The function of trypsin in the human body is to digest protein foods. Presumably that is just what it does in the egg white.

For years scientists have suspected that trypsin or some other proteolytic enzyme was responsible for two of the important changes that take place under storage—a weakening of the membrane around the yolk, causing it to break more easily, and an increase in the amount of thin white.

The search for trypsin in egg white was complicated by the presence of a substance in the thin white which inhibits any further action of the enzyme. As a result, tests of mixed thick and thin egg white have failed to show the presence of trypsin. The Department chemists next separated the thin and thick white and tested each. They found trypsin then in the thick white without any difficulty.

As a check on their conclusions the investigators took a fresh egg, punched a small hole in the end and injected trypsin into the thick white with a hypodermic needle. Fresh eggs so treated took on in a few hours the characteristics of eggs held in storage for many months. The whites became thin and watery and the yolks became fragile. Within two days it was almost impossible to break the egg without breaking the yolk.

This diagnosis of one of the contributing causes of the changes that take place in storage eggs provides a starting point for further research. Now that the cause is known the next step is to try to find a remedy which may be put into application commercially.

Sodium Lamps Have No Advantage for Close Work

THE new lamps filled with sodium vapor which are gradually coming into use for highway illumination have no special advantages or disadvantages for indoor clerical use. This is the report of Dr. James E. Ives, senior physicist of the U. S. Public Health Service, in announcing the result of a three months' test to learn whether the yellow-glow lamps held special merits for indoor work.

C. W. A. clerical workers served as test subjects for the investigation held in New York City.

By checks on speed and amount of work accomplished, and comparison tests of the eyesight of the subjects before and after

undergoing the test, the following results are reported:

1. Sodium light has no permanent effect on the eyes which could be detected by clinical tests after the subjects had worked for 4 hours a day over a period of 12 weeks in the yellow light.

2. No significant difference in the amount of work performed by the groups of men working under sodium and tungsten lamps could be observed.

While there is a definite gain in economy in using sodium vapor lamps, the single color of the light makes it impossible to perform any type of task dependent on color. Curious effects are obtained when color work is attempted under the yellow lights. On highways so illuminated, for example, green leaves all appear white, and a green field looks as if it were covered with snow.—*Science Service.*

Honeybee as Wild as Ever

THE honeybee is often spoken of as domesticated, but this is far from true. Although men and bees have been closely associated since the dawn of history, the honeybee is apparently as wild today as it was centuries ago.

Other wild animals have yielded to man's influence and many of them are now as dependent upon man as man is upon them; but the bees in apiaries are as wild as are their cousins in dense forests.

Bees taken from a bee tree and placed in a modern hive are as much at home there as though they were descended from generations of hive-raised bees. On the other hand, a swarm that has left a modern apiary and settled in a hollow tree fares as well in its new environment as did any of its ancestors in cave or forest. Bees are no more domesticated than are the bats in the barn or attic.

Bee specialists of the United States Department of Agriculture explain this unchanging trait in bees by stating that the queen and the drone that mates with her—the only bees having the power of reproduction—have no contact with the outside world and therefore have no new experiences to pass along to their offspring. The worker bees, who are constantly subject to new conditions, have no offspring and no opportunity to pass on to future generations the benefits of their experiences.

In recent years bee specialists in the Department of Agriculture have been able to impregnate queen bees by the use of delicate instruments. It is expected that by this method of artificial insemination changes can be brought about in honeybees that will render them still more useful to man. (See September, 1933, SCIENTIFIC AMERICAN.)

Penguins Use Air Conditioning

A LETTER from the Byrd Antarctic Expedition has just been received by the B. F. Sturtevant Company, makers of air-conditioning equipment, advising that the expedition will attempt to bring back from the ice fields live European Penguins in a special air conditioned room on the *Jacob Ruppert.* The Sturtevant Company, which has supplied various equipment for Little America and Byrd ships, has furnished for the purpose blower equipment for distributing refrigerated air throughout the "penguin stateroom," which will measure about 10 feet long, 8 feet wide, and 6 feet high.

THE CHEMICAL INDUSTRY IN 1934

By A. E. BUCHANAN, Jr.

[*The following paragraphs give a comprehensive review of progress in the various fields of chemistry during the past year. Of necessity some of the items mentioned have been described in more detail in preceding issues of* SCIENTIFIC AMERICAN. *Their importance in their own fields, however, makes it necessary to repeat them briefly in order to make the picture more complete.*—The Editor.]

WHILE still showing the effects of the depression when compared with boom years, the chemical industry in 1934 showed a general improvement in production and in profit. This industry has had the distinction of being almost the only basic industry of the country that has come through the depression without any of the major companies in the group reporting a deficit. It was also one of the first industries to show a definite up-turn. The repeal of prohibition was a boon to the chemical companies, particularly the alkali producers because the increased production of bottles called for larger quantities of soda ash. Automobile production stepped up the consumption of solvents, lacquer materials, and glass. The automobile manufacturers have also been responsible for the production of new alloys for special purposes to an extent that indicates that the "age of alloys" is just beginning.

The industry has maintained its research activities, improved its manufacturing processes and the quality of its output, and has developed new and useful products. Thus, for example, improved methods for the manufacture of phenol have made this basic organic chemical available at a much lower cost, resulting in stimulation to the plastic industry. New plastic materials made from phenol are being developed for the building trades and are expected to hasten a revival in that basic field.

Some of the larger corporations disclosed a renewed tendency to broaden their lines and consolidate production by absorbing smaller industrial units as, for example, the American Cyanamid Company, which, during the year, acquired the General Explosives Corporation and the Maryland Chemical Company. Bold confidence in the future of the chemical industry was also revealed by the establishment of six new chemical plants in the south; namely, the Ethyl-Dow Chemical Company, Wilmington, North Carolina; the Southern Kraft Corporation, Panama City, Florida and Mobile, Alabama; the plant of the Freeport Sulphur Company, Lake Grande Ecaille, Louisiana; the Solvay Process Company, Baton Rouge, Louisiana; the Mathieson Alkali Works, Lake Charles, Louisiana; and the Southern Alkali Corporation, Corpus Christi, Texas.

HOME-GROWN PAPER. The results of several years of patient experiment by Dr. Charles H. Herty, looking toward the manufacture of newsprint paper from the wood of the slash pine, native to the southern coastal states, were evident during 1934 when the experimental plant in Georgia proved itself able to operate commercially. For his pioneer work in this enterprise, Dr. Herty was made the recipient of the Charles H. Herty medal, an award which was established a few years ago in his honor and which, appropriately enough, was awarded to him this year as having made an outstanding contribution to chemical research.

OUTSTANDING CHEMISTS OF 1934. Exceptional work in the field of chemistry is recognized by the award of medals, the award usually being named for some distinguished chemist of revered memory. One of the most highly prized of these is the William H. Nichols medal bestowed annually by the New York section of the American Chemical Society, which was, for 1934, awarded to Professor Henry C. Sherman, of Columbia University, in recognition of his achievements in vitamin research.

The Willard Gibbs medal for 1934 was awarded to Harold C. Urey, of Columbia University, for his brilliant work in the discovery of the hydrogen isotope called "deuterium." His discovery supplied the impetus for widespread work on the so-called "heavy water."

The Theodore William Richards medal, bestowed annually by the Northeastern Section of the American Chemical Society, was awarded to Professor Gregory P. Baxter, of Harvard University, in recognition of his achievements in the measurement of atomic weights for which Dr. Baxter has also received the Nobel prize in chemistry.

The Schoellkopf medal for 1934 was awarded to James C. Downs for his work in the development of the Downs sodium cell, in which most of the world's sodium production is now made by the electrolytic decomposition of salt.

Some of the many significant or interesting developments in the field of applied chemistry during 1934 are outlined briefly below:

HEAVY WATER. The newly discovered isotope of hydrogen, "deuterium," which has created so much interest among scientists, was made commercially available during the year by the California Isotope Company, of Berkeley, California, formed specifically to manufacture "heavy water." The capacity of this company's plant is about four grams of pure "heavy water" per week. The "heavy water," which is more correctly known as deuterium oxide, sells for 80 dollars per gram.

GOLD FROM SEA WATER. The extraction of the minute quantities of gold, known to exist in ocean water, was again suggested as a commercial possibility as a result of the success of the unique plant of the Dow Chemical Company, near Wilmington, North Carolina. This plant was erected to extract bromine from sea water, the bromine being in demand because of its use in the manufacture of anti-knock compounds for motor gasoline. It is successfully recovering 60 of the 65 parts per million of bromine which is the average concentration of that element in sea water. The successful extraction of this substance has inspired hopes that some process may be developed for the recovery of the even scarcer precious metal.

GRAPEFRUIT PERFUME. Grapefruit rinds discarded by Florida canners can be used as raw material for valuable essential oils used as flavors and perfumes as a result of experimental work by chemists of the United States Department of Agriculture.

ACCELERATED AGEING OF LIQUORS. The legalizing of liquors and the consequent sudden demand for properly aged whiskey raised a neat research problem for the chemists. Their studies threw considerable light on the mechanism of the mysterious natural process of "ageing" and through these studies they have been able to develop four different methods of speeding up the mellowing process. The four methods involved are (1) treatment with oxygen or ozone, (2) ultra-violet light, (3) electrolysis, and (4) the use of catalysts such as finely dispersed copper, nickel, and titanium.

LARGEST GLASS EYE. The attention of the scientific world was turned toward Corning, N. Y., on March 25, 1934, when 20 tons of molten white-hot glass, at a temperature of 2400 degrees, Fahrenheit, was poured into a mold, 17 feet in diameter, to form the reflecting mirror that was to be used in the world's largest telescope. In August, when the glass was partially annealed, it was discovered that some imperfections were present and preparations were made for casting a new disk.

BETTER CELLULOID. New synthetic products of the glycol ether-ester type have been developed during the year. These synthetized chemicals are used as plasticizers in cellulose acetate and cellulose nitrate, being superior for the purpose because of their stability to light and heat.

TEXTILE LUBRICANTS. A water soluble lubricant for the treatment of worsteds and wool in textile manufacture has been developed. While still somewhat more expensive than conventional lubricants for this purpose, the new substance, perfected by chemists at the Mellon Institute, has the advantage of being entirely miscible with water—a characteristic that eliminates scouring before dyeing—and it gives a yarn that is white and soft.

STAR SPANGLED PAPER. Research into special types of decorative paper for greeting cards, and so on, has produced an attractive novelty consisting of paper with minute metallic particles dispersed throughout the sheet.

INSULATING LIQUIDS. That synthetic organic compounds will soon replace mineral oils as insulation for high-voltage transformers, was forecast in a symposium held by the Electrochemical Society. The absence of sludging and the non-inflammable nature of the vapor are points strongly favoring the new type of insulating material.

LARGE MOLDED VESSELS. Progress in the molding of large items of chemical engineering equipments in single pieces

The Chemical Industry in 1934

(Continued)

from the phenolic resin "Haveg" was described at the main meeting of the American Institute of Chemical Engineers. Using a plastic mixture of resin and asbestos fiber, tanks as large as ten feet in any dimension can be built without seams and with maximum resistance to solvents and corrosives. Pipes and fittings of the same material are also available.

VISUALIZES NEW INDUSTRY. Carleton Ellis, distinguished petroleum chemist, visualized for the American Institute of Chemical Engineers a great new industry based upon the utilization of petroleum compounds which may rival the synthetic chemical industry built upon coal tar derivatives.

GROWTH OF AMERICAN DYES. That the United States is fast becoming independent of foreign sources for synthetic dyes and medicinals was evidenced during 1934 by figures compiled by the United States Department of Commerce, showing a marked decline in the importation of these substances and a healthy increase in Uncle Sam's exports.

PAINT SALES GROW. A healthy increase in the production of paint and varnish was registered during the past year over 1933 when sales touched the lowest level for some time. While industrial sales accounted for a considerable part in the increased business, the major portion was due to customer purchases stimulated by "paint up" campaigns and federal home loans.

OIL EXTRACTION. A continuous process for extracting oil from soya beans, cotton seed, tung nuts, linseed, castor beans, copra, meat scraps, and so on, is expected to revolutionize the standard and accepted process. Not only is the continuous process superior to the old batch process in efficiency, but a higher percentage of recovery is obtained.

PRESERVING SERUMS. A method of preserving life-saving serums for pneumonia, diphtheria, typhoid fever, and so on, so that they retain their potency, was announced by Dr. E. W. Flosdorf before the American Chemical Society. The preserving process involves the removal of 99.9 percent of the water from the serums by freezing them in solid carbon dioxide and removing the water by distillation in a vacuum. The dry, solid serum crystals keep indefinitely and are ready for use when dissolved in distilled water.

99.92 PERCENT PURE IRON. Going Ivory Soap one better, chemists have produced an iron of extreme purity at commercial prices and find that at a purity of 99.92 percent the metal exhibits properties that open an entirely new field of usefulness for iron.

THERMOPLASTIC CEMENT. A new type of cement, water-proof, flexible, resistant to oil and grease and not subject to embrittlement on ageing, was introduced. Heat and pressure are necessary to produce the bond, which is of exceptional strength and applicable to a wide variety of materials.

SPEEDS UP VEGETABLE DRYING. Vegetables may be dehydrated in one third the time usually required by a new method in which the product is revolved rapidly in a draft of warm air, utilizing centrifugal force to throw moisture to the surface. Fruits, meats, fish, and cheese can be dried this way.

RADIOACTIVE TEXTILES. Radioactive fabrics have been woven from rayon made with minute quantities of radium sulphate incorporated in the silk spinning solution. Repeated wearing and washing have no appreciable effect on the radioactivity of the fabric.

NEW TYPE WINDOW GLASS. Corning Glass Company announced a new type of window glass, called Aklo, which passes light but holds back 70 percent of the heat rays.

BUBBLY RUBBER. Said to be the lightest solid substance known, Onazote, a patented insulating material made of "rubber and bubbles" is the most perfect insulator against noise yet developed.

SYNTHETIC ANILINE. Professor Franz Fischer, eminent German chemist, announced a new process for the synthesis of aniline by the catalytic combination of phenol and ammonia. The reaction is carried out under 10 atmospheres pressure and at 450 degrees, Centigrade. The significance of this announcement is the possibility that cheap aniline may be commercially available soon.

IODINE FROM OIL-WELLS. Exhausted oil-wells in southern California are capable of producing sufficient iodine to meet the entire present requirements of the United States. The iodine is present in very dilute solution, but modern methods permit its extraction at commercially feasible cost.

POWERFUL GERMICIDE. A powerful new agent for destroying bacteria which is said to be equally deadly to all types of germs but absolutely harmless to body tissue was reported to the American Chemical Society. The new compound, azochloramid, promises to be a valuable aid in surgery.

"GASSING" FRUIT. Fruit growers and shippers continued to experiment with artificial atmospheres to improve the preservation of their products. Carbon dioxide gas has been found to decrease losses by rot and other diseases during shipment in refrigerator cars. Nitrogen trichloride gas effectively curtails the action of mold spores on oranges during shipment.

NEW POISON GAS. A new type of poison gas discovered by accident was announced to the American Chemical Society by Dr. George H. Cady. Composed of nitrogen, oxygen, and fluorine, the gas is deadly when inhaled and explodes violently when heated.

SALMON-LIVER OIL. Chemists of the United States Bureau of Fisheries discovered that oil extracted from the liver of

salmon contains more vitamins than cod-liver oil. According to their tests, the salmon oil is approximately five to twenty times as potent in vitamin A and twice as potent in vitamin D as cod-liver oil.

METAL-TO-GLASS SEAL. A new alloy called Fernico was developed by the General Electric Company to make possible tight and reliable joints between glass and metal. The expansion curve of Fernico coincides almost exactly with that of certain glasses. Fernico can be machined, forged, punched, drawn, stamped, soldered, brazed, and welded with a facility equal to high-grade nickel iron.

CURRENT BULLETIN BRIEFS

CHEMICAL GUIDE-BOOK FOR 1934. The tenth edition of this useful book of addresses is complete in that it gives even telephone numbers of concerns. It also gives information as to chemicals, including the chemical formulas, physical properties, tariff, and prices. *Chemical Markets, Inc., 25 Spruce St., New York.—$2.00.*

CONCRETE ROAD DESIGN, by Frank T. Sheets, describes the great advances made in the last 12 years in the science of designing concrete pavements. *Bulletin 135A, Scientific American, 24 West 40th Street, New York City.—3 cent stamp.*

THE BAKELITE REVIEW is a periodical digest of Bakelite achievements interesting to all progressive manufacturers and merchants. *Bakelite Corporation, 247 Park Ave., New York, N. Y.—Gratis.*

LINK-BELT ROLLER-CHAINS (Data Book 1457). In this book the proper selection and application of finished steel roller-chains and wheels are described for the fields of usefulness to which they are best adapted. There are many excellent tables. *Bulletin 135B, Scientific American, 24 West 40th Street, New York City.—3 cent stamp.*

BUILDING THE MUSEUM GROUP (Guide Leaflet No. 82), by Albert E. Butler, describes how the groups are made in our great museums from the foundation to the finished product. All the accessories are described and the method of fabrication is described.—*American Museum of Natural History, 77th Street and Central Park West, New York City.—15 cents.*

WOOD WORKING PRODUCT MANUALS deal with circular saws, files, machine knives, and "carboloy" products. State what you are interested in. *Bulletin 135C, Scientific American, 24 West 40th Street, New York City.—3 cent stamp.*

THE COMPARATIVE LIFE, FIRE, AND EXPLOSION HAZARDS OF COMMON REFRIGERANTS gives a comprehensive report on the explosion hazards of common refrigerants. There is of course no hazard presented as long as the refrigerant is confined within the mechanical system. The properties constituting the hazard of the refrigerant are those relating to its toxicity, its flammability and explosiveness. The report was made by the Underwriter's Laboratories and the tests were exhaustive. *Kinetic Chemicals, Inc., Wilmington, Delaware.—$2.25.*

GUARDITE describes how the problem of insect infestation can be prevented either in food products or tobacco. *The Guardite Corporation, Chicago, Illinois.—Gratis.*

THE YELLOW STRAND, Volume 59, Number 4, describes the deepest well in the world, 11,377 feet deep in which an enormous quantity of wire rope was used. *Bulletin 135D, Scientific American, 24 West 40th Street, New York City.—3 cent stamp.*

THE DU PONT COMPANY AND MUNITIONS is the title of a 42-page booklet that gives the essential facts of the du Pont Company's position with respect to the manufacture and sale of munitions of war. *Stockholders' Relations Division, du Pont Company, Wilmington, Del.—Gratis.*

THE SHARPLES SUPER CENTRIFUGE IN INDUSTRY refers not to a particular machine but to a family of machines. Each type within the family is unique in that it is specially designed to accomplish most effectively a specific centrifugal operation. This pamphlet gives sectional drawings of the devices, and pictures of installations. *Bulletin 135E, Scientific American, 24 West 40th Street, New York City.—3 cent stamp.*

WIRE ROPE by Wickwire Spencer gives some excellent hints on the use and treatment of wire rope (Catalogue No. 128). *Wickwire Spencer Steel Company, 41 East 42nd St., New York City.—Gratis.*

VINYLITE, THE VERSATILE PLASTIC describes a resinous material that can be formed by heat and pressure into almost any desired shape and color. *Bulletin 135F, Scientific American, 24 West 40th Street, New York City.—3 cent stamp.*

SYNTHETIC ORGANIC CHEMICALS. Information regarding certain of the characteristics and uses of these synthetic compounds has only recently become available. The data suggests new uses. *Carbide and Carbon Chemicals Corporation, 30 East 42nd St., New York, N. Y.—Gratis.*

IT PAYS TO OWN A FIREPROOF HOME—HERE'S HOW IT'S BUILT. A well illustrated pamphlet giving details of construction of houses, terraces, swimming pools, et cetera. *Bulletin 135G, Scientific American, 24 West 40th Street, New York City.—3 cent stamp.*

LITTLEFORD ROAD MAINTENANCE AND CONSTRUCTION EQUIPMENT (Catalogue J) describes machines for spraying, surface heaters, and distributors, as well as metal pots and the miscellaneous tools used by asphalt workers. *Littleford Bros., Cincinnati, Ohio.—Gratis.*

Books SELECTED BY THE EDITORS

APPLIED OPTICS, Vol. II

By L. C. Martin, D. Sc., A.R.C.S.

THE first volume of this work appeared several years ago but the second, now published, may be obtained and used separately without any embarrassment. Alan R. Kirkham, of Tacoma, to whom the review copy was forwarded, writes concerning it: "This is probably the most usable and practical book on optics ever written for the amateur telescope maker, because it is entirely about telescopes and microscopes, instead of giving merely the usual one or two sketchy chapters. If you want to know the right way to design an achromatic objective; if you are puzzled over anything about telescopes; or if you merely want to use optical instruments intelligently, you can do no better than to obtain it. In most cases, knowledge of arithmetic is all that is needed, along with the ability to understand formulas. There is no deep mathematics. The book is not exhaustive, but is fully bibliographed so that one may pursue any branch further."—$6.20 postpaid.

ELECTRONS AT WORK

By Charles R. Underhill, E.E., F.A.I.E.E., F.A.A.A.S.

WHILE many people undoubtedly think of vacuum tubes mainly in connection with radio receivers, there are an increasingly large number of industrial applications of these facile instruments. The present book is designed to give the reader not only a comprehensive background of the subject of electronics but also a fundamental knowledge of the varied applications of all types of vacuum tubes. The make-up of the book is such that these applications are segregated in separate chapters and are treated at length. Thus the reader can refer directly to any one or more specific phases of electronic tube use and will find at his finger tips most of the available information.—$3.20 postpaid.—*A. P. P.*

ELECTRON TUBES IN INDUSTRY

By Keith Henney, Associate Editor, Electronics

WHILE this book covers approximately the same ground as "Electrons At Work," by Charles R. Underhill, it is more advanced in its treatment. Although the fundamentals of electronic circuits are given in the opening chapter, the author presupposes that the reader has a thorough background in electricity. The text gives a complete presentation of the more practical aspects of electronic tube applications and describes in detail various types of tubes and methods of using them for producing desired results. The chapters dealing with photo-electric tubes are to be especially recommended. The first of these tells in detail of the various types of photo-cells while the second chapter describes their applications to various industrial purposes. This book will be of great assistance to the industrial engineer, and to the more advanced student of practical electricity. Well illustrated with charts and diagrams which amplify the text, and supplemented by an excellent index.—$5.20 postpaid.—*A. P. P.*

CONFESSIONS OF A SCIENTIST

By Raymond L. Ditmars

DR. DITMARS is a well-known scientist whose main job seems to be in the tropics collecting specimens for his reptile house in Bronx Park, although he is also chaperone among other things to a family of ill smelling and pestiferous small mammals. He recounts many of his adventures in this book, such as the story of the first vampire bat which he captured in a murky tropical cave and which he was enabled to exhibit alive. Dr. Ditmars writes interestingly always, even of his experiences on the lecture platform when his "exhibits" sometimes get away from him. Withal a sense of humor pervades the book whether he deals with the Loch Ness Monster, a white rattlesnake, or only a tree frog.—$3.65 postpaid.—*A. A. H.*

AUTOMOBILE SERVICE SHOP MANAGEMENT

By C. Edward Packer, B.C.S., and J. A. Ahlers, M.E., B.C.S.

HERE is a book written for the specific purpose of training the reader in a definite business. It begins with the consideration of servicing automobiles on a practical basis and takes up such things as starting the business, possible income, financing, management, merchandising, and advertising. These various points are taken up in detail and give the best possible leads to the operation of a satisfactory business arrangement between the service station manager and the public. Equipment and its arrangement are given considerable space and the book is completed with a check list of all the things that are needed in an up-to-date and completely equipped automobile service station. The book will be found valuable not only by those who are contemplating going into this particular field but also by service station managers and employees who have ambition enough to want to keep abreast of the times. 5½ by 8½ inches, nicely printed on heavy stock, 150 pages.—$1.65 postpaid.—*A. P. P.*

THE NEW WORLD OF SCIENCE

By A. Frederick Collins

THE inspiration for the present book was obviously furnished by the recently closed Century of Progress Exposition in Chicago. In fact, almost the whole book is devoted to the description and analysis of the many marvels of science which were on display at that Exposition. In one or two cases the author breaks away from the World's Fair and injects something about other scientific developments. If you visited the Century of Progress, this book will undoubtedly tell you of many things that you missed. If you were not fortunate enough to have been able to attend this Exposition, the book will to some extent make up for this failure. 5½ by 8½ inches, 308 pages, with a comprehensive index. Thoroughly illustrated with drawings and photographs. — $2.70 postpaid.—*A. P. P.*

EXPLORING WITH THE MICROSCOPE

By Raymond F. Yates

THIS is a practical book for the beginning microscopist. In a chatty, friendly style it tells how to go at the hobby in a simple manner and, taking its reader by the hand, conducts him along some of the paths of fun the hobby affords. Anyone who does the various stunts this book describes will have a barrel of fun and can follow up with more technical books later on.—$2.15 postpaid.—*A. G. I.*

SHORT WAVE RADIO HANDBOOK

By Clifford E. Denton, B.S., E.E., M.E., M.A.

FOR the radio enthusiast who is particularly interested in short-wave set construction or in the improvement of his present equipment, this book will

prove to be a gold mine of technical information. The author has avoided as much as possible any complicated mathematics and has drawn upon a comprehensive background of experience. The book is compact—6½ by 8½ inches—contains 128 pages, lavishly illustrated with pertinent drawings and illustrations. Data are given which will enable the reader to construct various types of experimental receivers, and what is more important, learn how to operate them. Throughout the book are scattered numerous tables giving information which is usually difficult to find elsewhere.—$1.00 postpaid.—*A. P. P.*

CHALLENGE TO THE NEW DEAL

By 35 different writers

IN this book the New Deal is challenged not, as one might possibly conclude, from the right, but from the left. It is no conservative Republican (or Democrat) who does the challenging but 35 radicals, and their challenge is based on their assertion that the New Deal does not even go far enough. Readers who are curious to know what Max Eastman, John Dos Passos, Philip La Follette, Upton Sinclair and so on, want done to the rest of us, will find it in this book. At that it is a pretty sane presentation—as such things go. Particularly so is the chapter by the Treasurer of South Dakota, Alfred S. Dale, entitled "Radicals Give Me a Pain in the Neck," which must have been included because the radicals who will mainly read the book ought to hear it. This book tells what is going to happen next in the U. S. A.—if you believe everything you hear, and are inclined to have nightmares in the daytime.—$2.70 postpaid. —*A. G. I.*

THE ADVANCE OF SCIENCE

By Science Service Writers

THIS book is packed with short, well-written, authoritative accounts of scores of recent developments in science and industry, ranging from cosmology, through atomic physics and the biologies, to anthropology and other sciences. It is a valuable record of current scientific and industrial advance, written mainly by half a dozen Science Service writers and edited by the capable director of the same organization.—$3.70 postpaid.—*A. G. I.*

THE GREAT DESIGN

Edited by Frances Mason

MRS. MASON, who is in love with the concept of a divinely directed universe, and order and progress in nature, has prevailed on several men of science having similar leanings, as well as some others, to contribute chapters to this book, and it makes most interesting reading. The late J. Arthur Thomson contributes the introduction, J. P. Crowther of Cambridge writes on radiation, A. S. Eve of McGill writes in a philosophic vein about the universe as a whole, the seismologist Baily Willis discusses the earth as the home of man, Lloyd Morgan writes on the ascent of mind, MacBride the English biologist on the oneness and uniqueness of life, Gager the Brooklyn botanist on the plant world, Metcalf of Oberlin sees design and purpose in the universe, Younghusband finds mystery in nature, while Fraser-Harris finds in it not mystery but unity and intelligence. Driesch believes there has been a breakdown of materialism and says so, while J. Arthur Thomson writes concerning the wonder of life. For those who lean toward mysticism in science, this book will be a rare collection of encouragement in that direction. —$2.70 postpaid.—*A. G. I.*

SCIENCE FOR A NEW WORLD

Arranged by J. Arthur Thomson. J. G. Crowther, Editor

THE late Sir J. Arthur Thomson, noted popularizer of science, planned this book and was able to obtain as contributors to it 15 of the world's ablest men of science, each of whom contributes a chapter. For example, Hogben writes on heredity and human affairs, MacKenzie on medicine, Eve on the trend of physics, Dingle on astronomy, Birkhoff on mathematics, and others on anthropology, biology, psychology, sociology, theology and science, chemistry, logic, and philosophy. These are all essays, largely philosophical in nature, on the new sciences, and the sum is a notable book.—$3.95 postpaid.—*A. G. I.*

MY BODY AND HOW IT WORKS

By Dorothy Baruch and Oscar Reiss, M.D.

THIS little book is a physiology, very elementary and in story form, for youngsters of about 9 to 14. Its authors are respectively assistant professor of education at Whittier College and chief of the pediatric staff of Los Angeles County Hospital, and their book has been strongly endorsed by prominent child health specialists and professors of pediatrics in leading universities. Different child dialogs, very clever and witty, bring out "what happens" when you eat, when your heart beats, when you breathe, when you see and hear things, and so on. Reading on, one wonders how this book, so widely recommended by modern educators, will deal with reproduction. It deals with it frankly, telling things in the way that is now being recommended by best authorities—that is, plainly giving the real names of things, instead of using the various subterfuge words, always suggestive because they were subterfuges, which we oldsters were taught to use in an uncandid generation. A little book which deserves a big niche.—$1.65 postpaid.—*A. G. I.*

CHEMICAL ENGINEERS' HANDBOOK

John H. Perry, Ph.D., Editor in Chief

THIS timely handbook contains 2609 pages filled with practical suggestions for the construction of chemical equipment. The 30 sections deal with such subjects, for example, as distillation, absorption, mechanical separations, crushing, grinding, and pulverizing, movement and storage of materials, fuels, mechanical and other power transmissions, refrigeration, electrochemistry, accounting and cost finding, safety and fire protection. The illustrations, while small, illustrate the text admirably. No chemist should be without this book and for the chemical engineer who really builds plants it is indispensable. It is needless to say that there were many contributors—63 in all.—$9.35 postpaid.—*A. A. H.*

LIBERIA REDISCOVERED

By James C. Young

NOW that Harvey Firestone is preparing to produce rubber in our de facto protectorate, Liberia, every well informed American will want to become posted on that land and the Firestone development, since both will come to the front increasingly in the next few years. This book contains in readable form all the information the average man would be likely to ask for in order to understand Liberia.—$1.65 postpaid. —*A. G. I.*

THE TWILIGHT OF PARENTHOOD

By Enid Charles, Ph.D.

THE author of this alarming book believes, as do many others, that the western world may soon decline in population because of changing social conditions which have altered our attitude regarding parenthood. Just why a smaller population will be a detriment to the world we shall leave to the reader to figure out—the author evidently takes it for granted.—$2.65 postpaid.—*A. G. I.*

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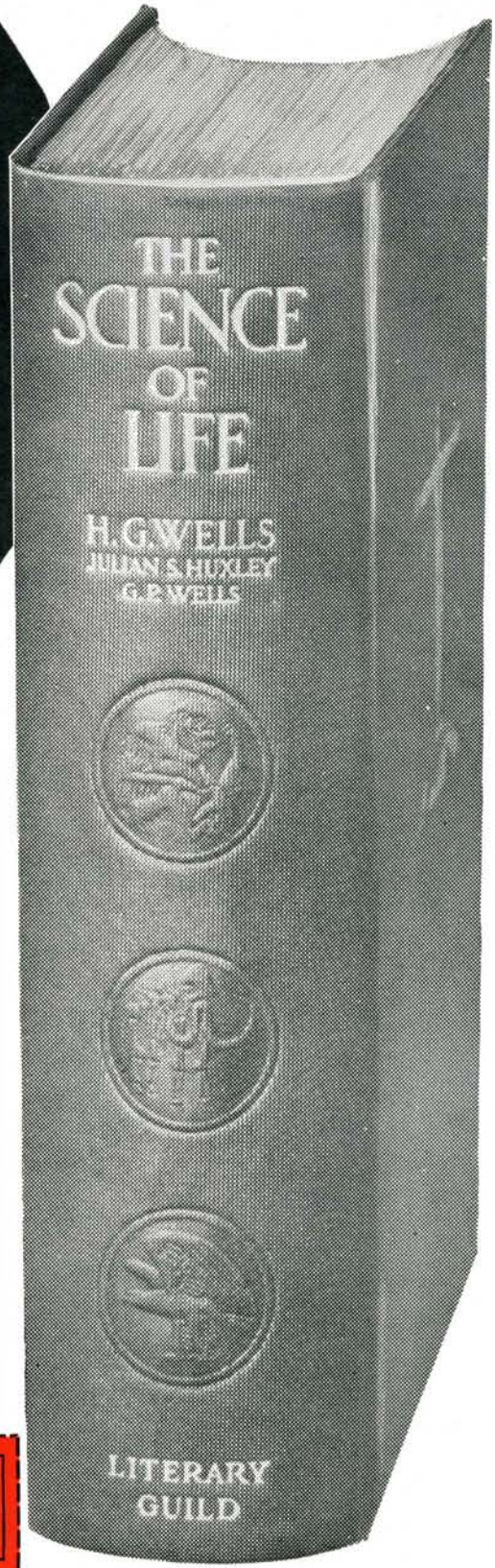

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