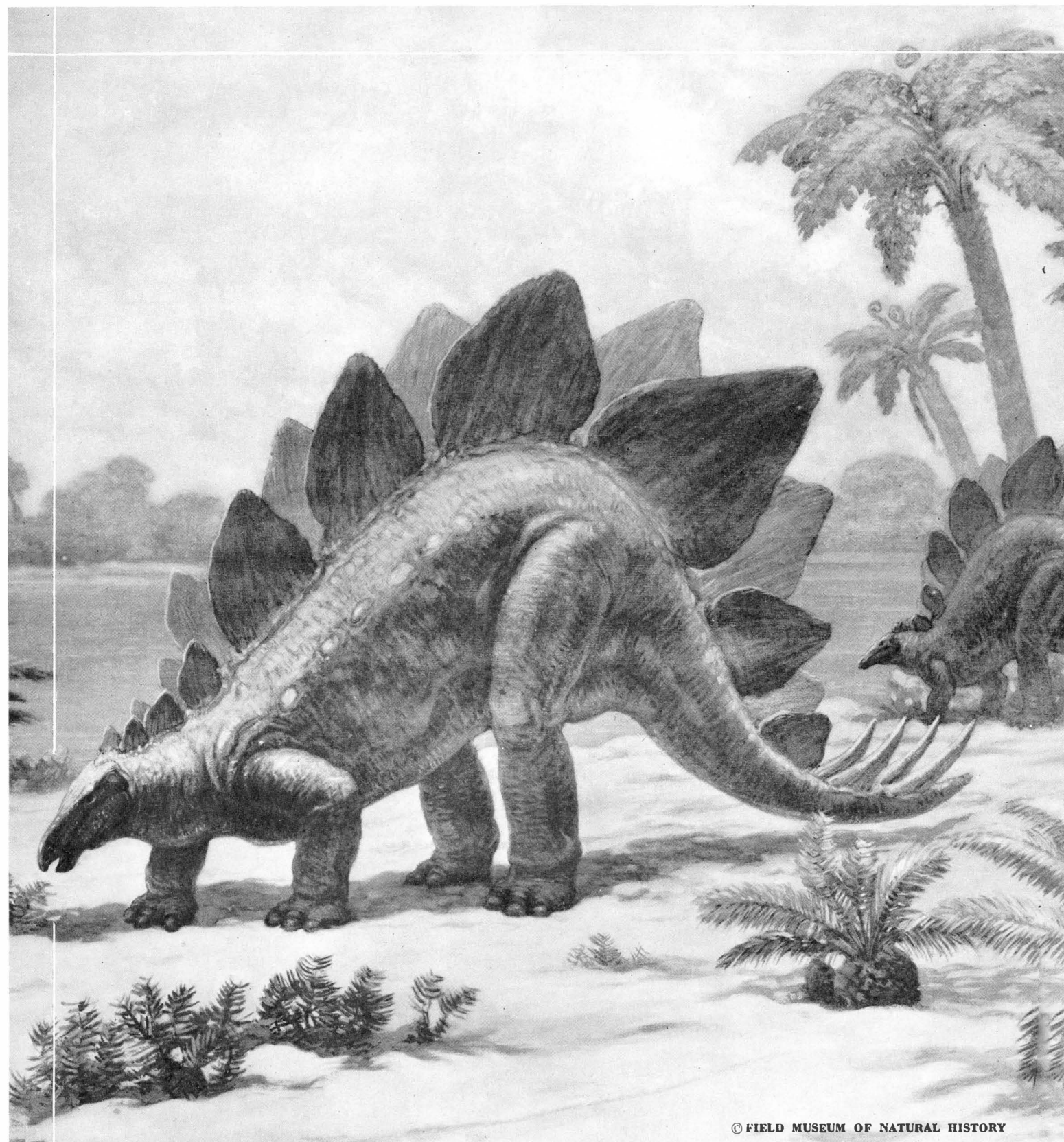


Roy Chapman **ANDREWS:** "Consider The Dinosaur"

SCIENTIFIC AMERICAN

March · 1937

35c a Copy



WHICH OF 10 FAMOUS MAKES OF MEN'S SUITS are *Best Buys?*



ALMOST ALL ready-made clothing looks all right—when you buy it—but the man who is interested in saving money has to know more about a suit of clothes than what is apparent at the time of purchase. Textile experts working under the direction of Consumers Union took apart representative suits made by 10 nationally known manufacturers; tested the fabrics and linings; examined the workmanship in minute detail, and analyzed the other factors that mean long wear and satisfactory service. The results are published in the current issue of *Consumers Union Reports*, the monthly publication of a non-profit, nationwide organization of consumers interested in getting the most for their money. This report on suits will tell you how much you should pay and what you should look for when you are buying a ready-made suit of clothes. It rates the different brands, *by name*, as “Best Buys”, “Also Acceptable”, and “Not Acceptable”. Another report in the same issue tells you which of 16 leading brands of men’s hose tested are most likely to wear longest.

How CONSUMERS UNION REPORTS *save you money*

Consumers Union Reports—telling you which brands of shoes tested will wear longest, which tires will give the most mileage per dollar, which automobiles and radios are the “best buys”, and which brands of other products are the best values—can save you money and help you to buy intelligently. These *Reports*—rating products by name as “Best Buys”, “Also Acceptable”, and “Not Acceptable”—are published by Consumers Union of United States, a nationwide organization of consumers whose chief purpose is to make accurate information about products—based on research by competent and unbiased technicians—available to its members at the lowest possible cost. Information on the labor conditions under which many products are made is also given in the *Reports*.

Incorporated in New York State as a strictly non-profit organization, Consumers Union is sponsored by many prominent scientists, educators, journalists, labor and progressive leaders. Professor Colston E. Warne, of Amherst, is president of Consumers Union, Arthur Kallet, co-author of *100,000,000 Guinea Pigs*, is director, and D. H. Palmer, physicist, is technical supervisor. The membership of Consumers Union has grown in less than a year to more than 25,000—and is increasing, at the present time, at the rate of nearly 1,000 new members a week.

PRINCIPAL SUBJECTS IN PAST ISSUES OF CONSUMERS UNION REPORTS

MAY—Toilet Soaps, Grade A versus Grade B Milk, Breakfast Cereals
JUNE—Automobiles, Gasolines, Moth Preventives, Vegetable Seeds
JULY—Refrigerators, Bathing Suits, Used Cars, Motor Oils
AUG.—Oil Burners and Stokers, Black List of Drugs and Cosmetics, White Bread, Meat, Hosiery
SEPT.—Tires, Whiskies, Women’s Coats, Shoes
OCT.—Men’s Shirts, Gins, Brandies and Cordials, Electric Razors, Dentifrices, Anti-freeze Solutions
NOV.—1937 Autos, Radios, Toasters, Wines, Children’s Shoes, Winter Oils
DEC.—Vacuum Cleaners, Fountain Pens, Electric Irons, Blankets, Nose Drops
JAN.—Men’s Suits, Children’s Undergarments, Cold Remedies, Flour, Shaving Cream

If you, too, want to make sure that you are getting the most for your money fill out and mail the membership application blank below—checking the month with which you wish your membership to begin. Principal subjects covered in past issues are given in the box at the left. The fee—which entitles you to a YEARLY BUYING GUIDE now in preparation as well as to a year’s subscription to the *Reports*—is only \$3 a year. The *Reports*, beginning from the month checked, will immediately be sent to you.

NOTE—An abridged edition of the *Reports* is also published at \$1 a year. For information please write.

Also in the CONSUMERS

Current Issue of UNION REPORTS

COLD REMEDIES

Hundreds of proprietary articles—ranging from gargles, cough drops, inhalants and ointments to pills, powders, syrups and “scientifically” formulated internal medicines—are being offered today as “remedies” or “cures” for colds. Which, if any, will do what is claimed for them? Are any of them capable of causing serious harm? These questions are answered in the current issue with lists of specific products.



CHILDREN'S UNDERGARMENTS AND SLEEPING GARMENTS

Tested and examined by Consumers Union experts, 12 leading brands of children’s cotton underwear are rated in the current issue as “Best Buys”, “Also Acceptable”, and “Not Acceptable”. This report gives the opinions of child specialists on the comparative merits of cotton versus wool underwear, and describes the features which are desirable in children’s undergarments. Leading brands of children’s sleeping garments are also rated.



SHAVING CREAMS, SOAPS AND LOTIONS

Over 30 different brands of shaving creams (both the brush and brushless types) and shaving soaps were tested for Consumers Union members. Some of these brands will meet your shaving requirements for a year for as little as 15c—others will cost you ten to twenty times as much. If you want to economize on your shaving bill read this report. It also tells you how to save money on after-shaving lotions.



Also discussed in the January *Reports* are MAPLE SYRUPS, FLOURS, and other products. All products are rated by brand name.

MAIL THIS APPLICATION

To: CONSUMERS UNION of U. S., Inc.
 55 Vandam Street, New York, N. Y.

I hereby apply for membership in Consumers Union. I enclose:

\$3 for one year’s membership, \$2.50 of which is for a year’s subscription to the complete edition of *Consumers Union Reports*.

I agree to keep confidential all material sent to me which is so designated.

Please begin my membership with the.....issue.

Signature.....

Address.....

City and State.....

The
SCIENTIFIC AMERICAN
DIGEST

Of General Interest

Drilling Rigs on Truck Chassis.....	174
Ice Bug.....	174
Whales.....	175
Plowing Wires Into Ground.....	175
New Air Conditioner Becomes Plug- In Appliance.....	175
Heat on Wheels.....	176
Determinism and Man.....	183
"A Tale . . . Signifying Nothing".....	196
Toward an Aroused Public Opinion.....	196
Ice by Wire.....	197
Where Map Students Had Their Way.....	197
On Not Being Scientific.....	197
World's Largest Vulcanizer.....	198
Electricity.....	199
Dental Cavities and Diet.....	199
Oo-o-oo!.....	200
CO ₂ Detector.....	200
Earthquake Fire-Valve.....	201
Fish-Flour.....	201
Some Pull!.....	202
Colds.....	203
Farm Woods Increase.....	203
Protective Coating for Metals.....	203
More Dust.....	203
Primitive Paradox.....	203

Transportation

Steamotive—Packaged Power.....	176
Highway Lighting.....	176
Diesels.....	177
Steam-Powered, Streamlined.....	177
Biggest Welded Ship.....	177
Pipe Lines No Pipe Dream.....	177
Icicles in a Factory?.....	178
Highways Will Be Safer: Driver Re- mains A Problem.....	201
Automatic Transmissions Pass Mil- lion Mile Service Mark.....	203

Chemistry in Industry

Synthetic Scares.....	174
Saving Shavers' Tempers.....	196
Industry Uses Precious Metals.....	197
Better Soap.....	197
Beryllium-Copper Alloys.....	198
Preventing Infection with Conditioned Air.....	199
Quality of Cigarette Smoke.....	200
Preventing Cyanide Poisoning.....	201
Fatty Oils as Motor Fuels.....	203
Removable Printing Ink.....	203

Aviation

Colonel Lindbergh's Latest Plane.....	178
The Menasco Buccaneer.....	178
A Pilot's Most Dangerous Time.....	180
Motors Tested in Sound-Proof Cell.....	181
Feeding Birds From the Air.....	181
Have Aviation Shows Any Utility?.....	182
Model Airplane Flies Four Miles.....	182
Safety Device for High Altitude Fly- ing.....	182
The Next Five Years in Aviation.....	183

The Amateur Telescope Maker

184

World-Wide Radio

German Regional Broadcasts.....	188
New Hong Kong Station.....	188
Unusual Broadcasts.....	188
Fiji Changes Wavelength.....	188
BBC Checking Station.....	188
Ears for Propaganda.....	189
Guide to Short-Wave Reception.....	189
Two-Way Radio in Ambulance.....	189

Camera Angles

Trailing the Shadow.....	190
"Zeiss Photography".....	191
Developing with Hypo.....	191
Deckle-Edge Trimmer.....	191
Underground for Pictures.....	191
New Retina.....	192
Introducing Glims.....	192
From A Moving Train.....	193
Polarization Filters.....	193
Two Developing Trays.....	194
Trees in Winter.....	194
Thermometer that Signals.....	194
Vertical or Horizontal.....	194
Tank Agitator.....	195

Current Bulletin Briefs

204

Legal High-Lights

Trade Marks—Second Hand.....	205
Expanding Symbols.....	205
Repair but Beware.....	205
In Union There Is — ?.....	205

Book Reviews

206

SCIENTIFIC AMERICAN

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NINETY-THIRD YEAR

• ORSON D. MUNN, Editor

CONTENTS • MARCH • 1937

50 Years Ago in Scientific American.....	146
Personalities in Science— <i>Carl D. Anderson</i>	147
An Intriguing Problem of Science and History— <i>Frontispiece</i>	148
Consider the Dinosaur— <i>By Roy Chapman Andrews</i>	149
There Were Dozens of Types of Dinosaurs, All of Them Short of Intellect; Just Why They Died Out We Do Not Know	
Our Point of View— <i>Editorials</i>	153
No Limitations; Coals to Newcastle; Inflation, or Deflation?	
What Brings Them Home?— <i>By John Frazier Vance</i>	154
Remarkable Feats of Long Distance Flying by Homing Pigeons Have Given Rise to Numerous Theories Regarding Their Uncanny Ability	
America's Heavy Cruisers— <i>By Walton L. Robinson</i>	158
Efficient Cruiser Fleet Has Been Developed Through Step By Step Improvements in Design, Armament, and Armor	
52-Year-Old Fire Fought by WPA— <i>By C. A. Robinson</i>	161
A 365,000-Dollar Program Has Been Started to Ex- tinguish a Fire Ignited During Labor Trouble in 1884	
The Problem of the Holy Shroud.....	
<i>By Paul Vignon, Sc. D., and Edward A. Wuenschel</i>	162
The Relatively Modern Art of Photography Has Made Possible Thorough Analysis of the Markings on the Shroud Said to be that of Christ	
Tubular Frame—Rear Engine.....	165
Details of a European Automobile That Shows Decided Advances in Design and Construction	
The Analysis of the Sun— <i>By Henry Norris Russell, Ph.D.</i>	166
The Spectroscope Has Made Possible Satisfying Progress in the De- tection of New Solar Elements. The List Now Contains 61 Entries	
Rock-Fill Dam for Flood Control— <i>By Andrew R. Boone</i>	168
San Gabriel Dam No. 1 is Being Constructed in Six Zones Con- sisting of Graduated Sizes of Rock Compacted with Water	
Enlarge—Print—Retouch— <i>By Herbert E. Hayden</i>	170
Complete Details of a Vertical Enlarger that Can Also Be Used for Contact Printing or for Retouching Negatives	



STEGOSAURUS, the 20-foot "pin-headed" dinosaur of the Age of Reptiles, from about 100,000,000 to about 200,000,000 years ago, had in its head a brain that weighed but 2½ ounces, and in its rear part a second brain! On its back were sharp plates of bone two feet high, for defense, and on its tail six heavy spines. This and all the great dinosaurs described by the zoologist, Roy Chapman Andrews, in the leading article of this number became wholly extinct roughly 99,000,000 years before man evolved.

50 YEARS AGO IN . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of March, 1887)

TELEPHONE INFECTION—"At a meeting of the Caucasian Medical Society, Dr. A. P. Astvatzaturoff, of Tiflis, drew attention . . . to the danger of infection arising from the promiscuous use of the mouthpieces of public telephones. To prevent any accident of the kind, he recommends that the mouthpiece should be disinfected every time after, or, still better, before it is used."

FORTS—"Sir Henry Bessemer proposes to obviate the enormous expense of ordinary armor plates for forts by casting *in situ* the whole face of a fort or complete turret in one solid piece of steel, with all its ports and loop-holes properly shaped and formed in the act of casting."

WHALES—"It has been calculated that) "a whale 80 ft. long, weighing about 74 tons, and with a tail 18 ft. to 20 ft. across from the extreme ends of its flanges would require to exercise a propelling force of 145 horse power to reach a speed of twelve miles per hour."

ELECTRIC LIGHT—"The question as to electric lighting popularity has always been one of economy. No one ever doubted that electric lighting would be popular, but many did doubt if it would ever be cheap enough to be generally used. . . . To-day the cost of an electric lighting plant is less than one-half what it was six years ago, and there is every reason to believe that six years from now almost an equal decrease in cost will have been attained."

MACHINE GUN—"Mr. Henry M. Stanley was compelled, a short time ago, to abandon his lecturing tour through this country, and was recalled to take command of an expedition in relief of Emin Pasha. . . . Before leaving England he provided himself with one of Mr. Hiram S. Maxim's automatic machine guns, and the illustration, which is taken from a photograph, represents the great explorer in the act of firing the gun, while our compatriot, the inventor, is standing immediately behind the gun. . . . The action of the gun is automatic, each cartridge being discharged by the recoil of the shot preceding. The cartridges are placed in a belt, and the empty shells are thrown out in front of the gun, as shown in the photograph. The rate of fire is about 600 times a minute. With the shorter and smaller cartridges, such as are used in the U. S. army, the rate of firing would be about 700 shots a minute."



ELECTRIC RAILWAYS—"The Van Depoele electric street railways seem to be taking the lead in this country, being now in operation, with much success, in the following places: Minneapolis, Minn., Montgomery, Ala., Detroit, Mich., Appleton, Mich., Port Huron, Mich., Scranton, Pa.; also in Toronto and Windsor, Canada. In a short time the company will have electric cars running in Lima, O., and Binghamton, N. Y. More miles of electric railways on this system are now at work than all other systems put together."

PEPPER—"The substance known in the pepper trade as 'poivrette,' or 'pepperette,' is . . . frequently used for the purpose of 'fraudulently increasing the weight and bulk' of commercial pepper."

ATOMS—"Among the most interesting results of recent chemical investigation must rank our recognition of the fact that there exist certain so-called 'ring-shaped' groups of atoms, like those of benzol, naphthaline, anthracene, and pyridine, which are widely distributed and which are formed with exceptional readiness."

EPIORNIS—"The epiornis was probably a strictly terrestrial bird, incapable of flight. Nothing has been found to determine its conditions and way of existence, except some eggs and a few other semi-fossil remains . . . its remains occur in recent alluvial deposits, and from their recency are classified as sub-fossils. . . . Its egg is of gigantic size, as may be inferred from the cut. Its exact dimensions are given by De Chenu, in his 'Encyclopedie d'Histoire Naturelle,' Paris, 1875. Its largest diameter is 13.38 inches, its smallest diameter 8.86 inches. . . . The thickness of the shell is given by the same author as a little over one-tenth of an inch."



FARM—"In the extreme southwest corner of Louisiana lies the largest producing farm in the world. It runs 100 miles north and south, and many miles east and west, and is owned and operated by a syndicate of Northern capitalists."

UMBRELLAS—"Jonas Hanway introduced the umbrella into England more than a hundred years ago. The people all made fun of him, but maybe it was because they hadn't sense enough to get out of the wet when it rained. There are more than 7,000,000 umbrellas made every year in the United States."

PRESERVATION—"A novel and valuable application of photography has been made by the Century Company, combining the complete preservation of valuable copy against accidental loss or injury by fire or otherwise with the greatest convenience in storage and handling. Over 25,000 sheets of copy of a work on its way through the press, with interlineations, corrections, and additions, have been photographed on a reduced scale of only 1¼ x 2 in."

YELLOW PAPER—"The author contends that the yellowing of paper is due to an oxidation determined by light, and especially by the more refrangible rays. Dry air is another important condition for the preservation of paper. The author thinks that in libraries the electric light is inferior to gas, on account of the large proportion of the more refrangible rays present in the former."

PHOTOMICROGRAPHY—"The great value of isochromatic plates in microphotography (*sic*) has been demonstrated by Dr. Crookshank, who exhibited to the Royal Microscopical Society of London micro-photographs (*sic*) of bacteria obtained without staining the objects with aniline."

AND NOW FOR THE FUTURE

- ☞What is Life?, by T. Swann Harding
- ☞Competition in Battleship Construction, by Walton L. Robinson
- ☞Unscientific Measurement in Sports, by Prof. Paul Kirkpatrick
- ☞Electro-Galvanizing—A New Technique in Metal Protection, by Philip H. Smith
- ☞Immunity in the Witness Chair, By Clennie Bailey

Personalities in Science

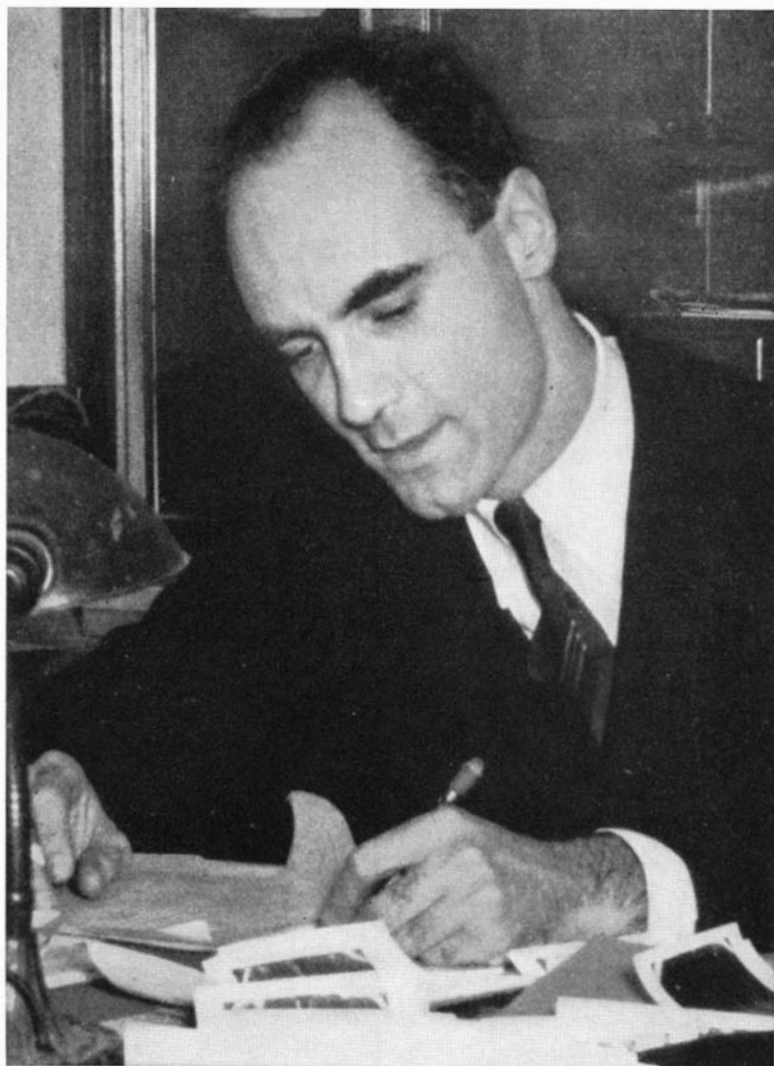
AMERICA'S latest in Nobel Science Prize winners is quiet young Dr. Carl D. Anderson, Assistant Professor of Physics at the California Institute of Technology, Pasadena. He is an entire product of the California Institute curriculum, as he took his bachelor's and doctor's degrees there.

He further honors his Alma Mater by raising the number of Nobel Prize winners on her faculty to three. The other two are Dr. Robert A. Millikan, physicist, and Dr. Thomas Hunt Morgan, biologist-geneticist. No other educational institution in the United States has attained an equal record so far.

After receiving his Ph.D. in 1930, Dr. Anderson began at once the research project that was to bring him scientific fame. For some years, Dr. Millikan has conducted a strong program of cosmic ray research at the Norman Bridge Laboratory of Physics. Together, he and Anderson designed and constructed an apparatus for the purpose of investigating the properties of cosmic rays.

An adaption of the Wilson cloud chamber was used in conjunction with a huge electro-magnet to measure speeds and energies of particles ejected from the substance through which the cosmic rays passed. Electrically charged particles between magnetic poles move in curved rather than straight lines, and a measurement of the radius of curvature enables their speed to be calculated. With this apparatus they observed high-speed electrons, many of which showed a powerful electrical charge. Months were spent studying the properties of these positively charged particles. Then Anderson inserted a lead plate barrier into the cloud chamber. Measurement of the track of a particle before and after passing through the lead plate was calculated to give definite information about the particle mass and electron charge.

This arrangement proved fruitful. Anderson obtained a photograph in August 1932, showing a positively charged particle emerging with a lower energy after passing through the lead plate. Its path curved away from the



CARL D. ANDERSON

regular paths of negatively charged particles! The conclusion was that this must be a *positive* electron. Further studies strengthened the interpretation that a *new kind of fundamental particle* had been located. The account is given at some length in the chapter on "The Positron," in Millikan's book, "Electrons (+ and -), Protons, Photons, Neutrons, and Cosmic Rays," and was described in *Scientific American*, August 1935, in a three-page article by Professor E. U. Condon of Princeton, where a photograph of the track of the positron was shown.

At the outset of this piece of research, such a discovery had not been anticipated. However, Dirac's brilliant electron-equation had predicted the possibility. The positron seemed to be the very particle corresponding to Dirac's "hole in space" hypothesis.

It is a noteworthy coincidence that Dirac, who mathematically anticipated the positron, and Anderson, who isolated it, were each 31 years of age when

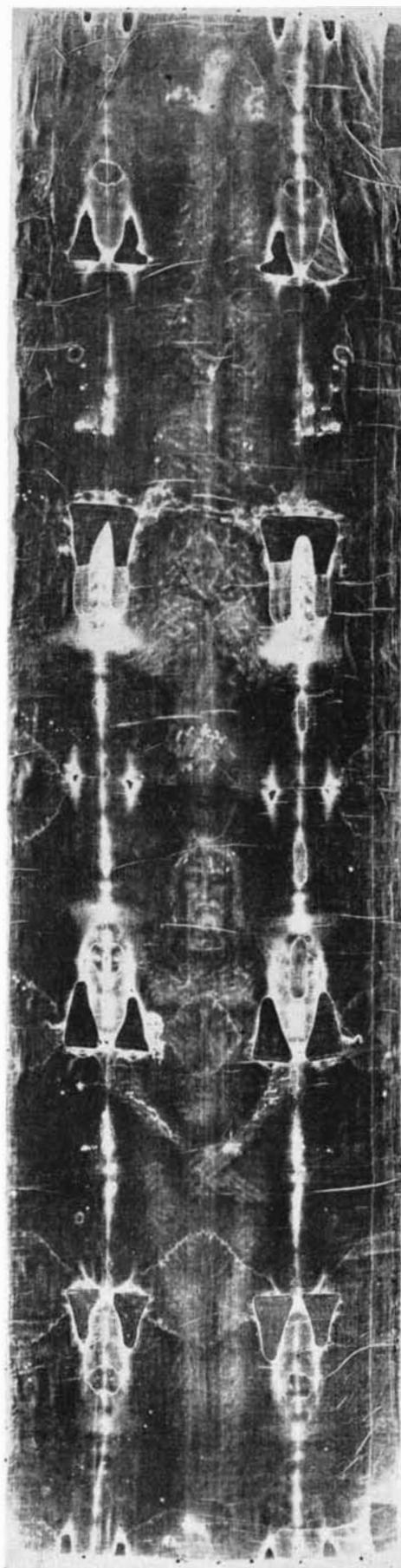
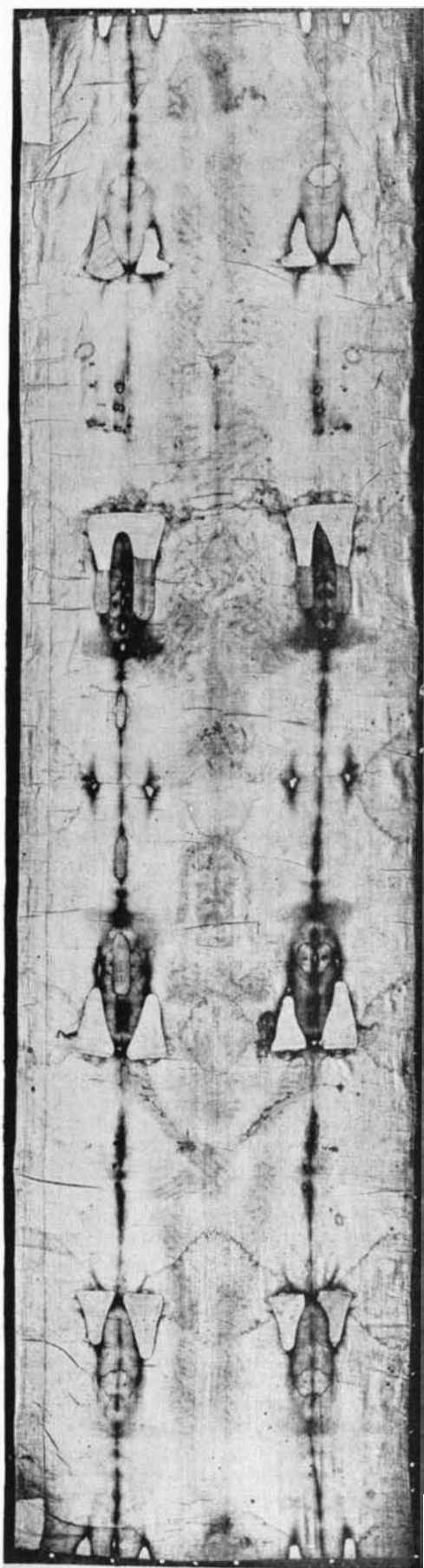
they received the Nobel award in recognition of their work. P. M. A. Dirac, well-known British scientist of Cambridge University, received the Nobel science award in 1933.

Dr. Anderson has made still further contributions to the study of cosmic radiation by his research on the energy spectrum of cosmic rays and their energy loss in passing through matter. In the summers of 1935 and 1936, he and Dr. S. H. Neddermeyer, a laboratory associate, took their elaborate apparatus to the top of Pike's Peak and to Panama. They obtained excellent photographs on these trips.

"I intend to continue in the same field," Dr. Anderson enthusiastically states. "There is still so much to be learned of nuclear physics."

This boyish looking young professor declares himself to be totally without hobbies, and insists that he doesn't do anything. But his very approachable manner brands him as one of the more human scientists.—*Susan Hartley.*

An Intriguing Problem of Science and History



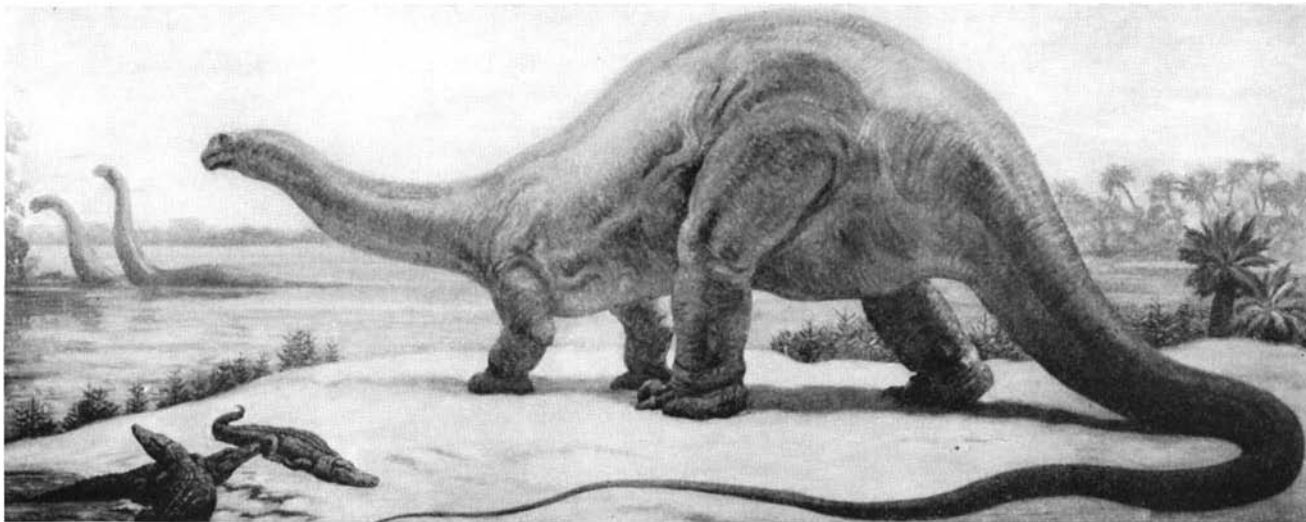
ON this page are two photographs which provide the subject of the article on page 162, by the biologist, Professor Vignon. The one at the left shows a 14-foot length of linen cloth on which are figures thought by some to be the imprints of Christ.

The hypothesis is that Christ, after prolonged suffering and death, was laid on one half of this linen and the other half was folded over lengthwise—note the corresponding, inverted figure of a back at the top. The figures have been explained by natural chemical causes. During intense suffering the perspiration contains increased amounts of urea. Later this breaks down into water plus ammonium carbonate, $(\text{NH}_4)_2\text{CO}_3$, the latter again breaking down and giving off the gas NH_3 —ammonia. The linen Shroud was impregnated with powdered medical aloes (*Aloes socotrina*) used as a preservative. Ammonia reacts with this. Thus were produced the brown stains in the fabric. There is no pigment.

The left-hand illustration shows the Shroud as it actually appears. The black marks were caused by a fire which scorched the Shroud while folded. The white triangles are patches inserted where the Shroud was burned through.

The right-hand illustration is a reproduction of the negative of a photograph of the Shroud. Since the original figure is a negative, the negative of its photograph becomes a positive. Only with the age of photography has it been possible to bring out the much more vivid positive imprint which many believe to be Christ's.

Two problems involved are: First, is this the chemically produced imprint of a being? Second, a historical problem: Was that being Christ? Professor Vignon confines his article to these scientific aspects of the question.



From a painting given to the Field Museum of Natural History, Chicago, by Ernest R. Graham

Figure 1: *Brontosaurus* as depicted by the scientific artist Charles R. Knight after detailed study of the fossils

CONSIDER THE DINOSAUR

He Was Long of Body but Short of Intellect, and He Died Out—Just Why, We Do Not Know ... There Were Dozens of Types of Dinosaurs...How We Know

By ROY CHAPMAN ANDREWS

Director, The American Museum of Natural History

THE cartoonist's picture of a gigantic creature peeking into the second story window with an expression of expectancy on its rather benevolent face is the popular conception of a dinosaur. *Brontosaurus*, the Thunder Reptile (Figure 1), is the usual subject for the sketch. He was pretty big—65 to 70 feet long, weighed about 25 tons, and ate several hundred pounds of vegetable food each day if he could get it. He was a giant in size, but a pygmy in intellect. The smallest human brain that can exist with reasoning powers is two pounds. The brain of the Thunder Reptile was not much bigger than a man's clenched fist although the animal itself weighed more than 300 times as much as a man.

But *Brontosaurus*, although the most popular, was only one of the dinosaurs. The largest of all was the *Brachiosaurus* of Colorado and German East Africa, 100 feet in length; the smallest was hardly larger than a chicken, named *Anchisaurus* (Figure 3). Two years ago Dr. Barnum Brown discovered one in Montana about the size of a jack rabbit!

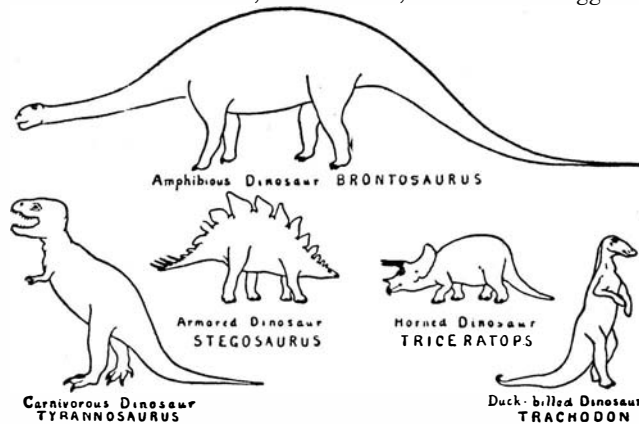
Some dinosaurs were plant eaters; others ate only flesh. Some lived on land; others in water. There were those that walked upright on two legs and dinosaurs that crawled on all fours. They dominated the earth during the Age of Reptiles in every continent.

We don't know why the dinosaurs disappeared, but the fact remains that at the

close of the Age of Reptiles none was left. Of course there are theories. *Brontosaurus* and his relative, *Diplodocus* (Figure 8), for instance, floundered along the shores of inland lakes and rivers, living partly in the water and partly out. They had to find several hundred pounds of vegetable food a day to nourish their gigantic bodies. When the lakes dried up they died. They were too highly specialized to change their habits; too big to migrate. With their tons of flesh, small heads, and feeble

teeth, it is obvious that they had been reared under such special conditions that they could not adapt themselves to even a slight change in the world about them.

Another theory is that the dinosaurs exterminated themselves. Until the Central Asiatic Expeditions, under my leadership, discovered dinosaur eggs in the Gobi Desert, it was not known how dinosaurs reproduced themselves. Dinosaurs are reptiles and most living reptiles lay eggs although some few give birth to their young alive. It was always supposed that some, at least, of the many kinds of dinosaurs laid eggs, but in the hundreds of deposits of bones in various parts of the world no egg had ever been found. Strangely enough, right on top of the first nest of dinosaur eggs which we found in the Gobi lay the skeleton of a small dinosaur. It was only four feet long and toothless. There is every reason to believe that it lived by sucking the eggs of other dinosaurs. Possibly it was in the very act of digging up these eggs



From W. D. Matthew, "Dinosaurs"

Figure 2: Five of the dinosaurs drawn to the same scale, which is given by the topmost animal—about 65 feet

when it was overwhelmed by a sandstorm and was buried on top of the nest it had come to rob. This group of toothless dinosaurs may have become so numerous that they actually exterminated their relatives by eating the eggs as fast as they were laid.

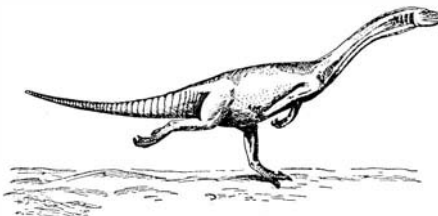
The first mammals were tiny creatures not larger than a rat. Close to the spot where the first eggs were collected we found seven skulls and parts of skeletons of these little mammals. It is thought that these tiny mammals materially aided the toothless dinosaurs in their work of extermination by eating the eggs (Figure 6).

From the skeletons of many species of dinosaurs which are well preserved, it has been a simple matter for anatomists to model the flesh and give an accurate representation of the animals' appearance in life. Moreover, we know exactly what the skin was like of *Trachodon*, the Duck-Bill dinosaur (Figure 5). In the sandstone of Montana impressions of the skin have been found. These animals apparently died and shriveled up before decomposition set in. They were then covered with wind-blown sand or else were swept into water and overlaid with silt. The impression of the skin which consisted of small irregularly hexagonal horny scutes is perfectly preserved over much of the body.

THE great Duck-Bill was 25 feet long and stood 15 feet high. A thick, heavy tail helped to balance the huge body for the reptile walked on its hind feet; the fore limbs were much reduced. Widely distributed in Europe, Asia, and America, it fed on lush vegetation in a semi-tropical climate. We even know its food for the impressions of fossil plants have been found with the skeletons. Like many reptiles, living and extinct, he was continually renewing his teeth. As soon as one was worn out another took its place. In the upper and lower jaws there was a reserve supply of about one thousand teeth arranged in layers.

The greatest engine of destruction that has ever lived was *Tyrannosaurus*

rex, King of Tyrant Reptiles (Figure 4). When standing erect on his two hind feet he was 18 feet high. The small fore limbs were equipped with enormous talons. The great mouth opened a yard wide and was armed with double-edged dagger-like teeth five inches long. Dr. Barnum Brown discovered a perfect skull of this huge beast and a fairly complete skeleton, which stands now in The



From Osborn, "The Origin and Evolution of Life," courtesy Charles Scribner's Sons

Figure 3: *Anchisaurus*, smallest of the dinosaurs. *Brachisaurus*, largest, resembled *Brontosaurus*

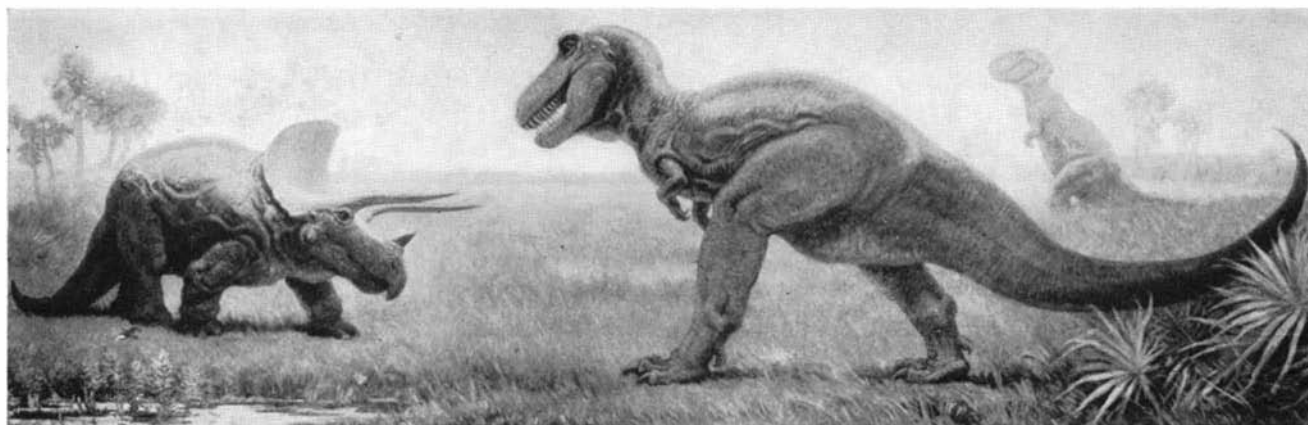
American Museum of Natural History, dominating in death all the other huge creatures grouped about it, as it did in life. Its food was the flesh of other dinosaurs. We know that it and its smaller relative, *Allosaurus*, tore the flesh from the bodies of the mammoth *Brontosaurus* for in the Museum we have the skeleton of a Thunder Reptile plainly showing the teeth marks of these gigantic cannibals. I often stand beneath the skeleton of the Tyrant Reptile and let my imagination drift to those days in the far dim past when the world swarmed with these nightmare creatures. It has a strange fascination, that beast.

No other creature that lived was a match for the Tyrant Reptile, unless perhaps it was the three-horned *Triceratops* (Figure 4). He was a massive beast, 20 feet long, weighing perhaps 10 tons and with a skull which projected backward over the neck like a fireman's helmet. The neck, of course, is the most vulnerable point of almost any animal and when the *Triceratops* threw up his head, bringing into fighting position the three great horns, it also brought the helmet down on the neck covering it like a shield. Even the Tyrant Reptile would

pause before launching itself on those murderous weapons reinforced by the defensive armor.

Certainly the most bizarre of all dinosaurs were the *Stegosaurus* or Plated Lizards [front cover.—*Ed.*]. They had tiny heads, heavy bodies, short legs, and long tails, armed on either side near the tip with two pairs of three-foot spines. From the end of the tail to the neck ran a series of large, thin, sharp-edged plates standing on edge. These plates are in pairs of approximately the same size but are placed alternately along the back, an arrangement not known to occur in any other animal. The ridiculous little head housed a brain so tiny that the creature must have had the absolute minimum of intelligence. The spinal cord doubtless took care of the mere mechanical functions of life. Moreover, in the sacral region the cord is enormously enlarged to a mass 20 times the size of the brain. When this discovery was announced by Professor Marsh news hawks immediately seized upon the idea that the animal had two brains: when the one in the head decided that it would like to move the body behind the pelvis it had to telegraph its desire to the "sacral brain" which then put the desire into action. It is an amusing suggestion which may have had some elements of truth.

DOZENS of other types of dinosaurs leaped or ran or waddled over the earth in the incredibly ancient period which is known as the Age of Reptiles. No geologist likes to state how many years ago that was. They prefer to say "it was a very, very long time," because the estimation of geological time even today is not exact enough to warrant positive statements. Yet it is a natural human desire to translate time into figures. For many years the estimation of geological time was based on the rate of deposition of sediments at certain specified places. For example, if it required 50 years for an inch of sediment to be laid down, by measuring the thickness of the sedimentary rocks an estimate was obtained of the number of years it re-



From a painting by Charles R. Knight, gift of Ernest R. Graham to Field Museum

Figure 4: The ten-ton *Triceratops* (not related to the rhinoceros!) preparing for battle with *Tyrannosaurus rex*

quired to form those strata. But this was obviously an extremely unsatisfactory determination for deposition does not proceed at the same rate in different places or at all times. Based upon this method scientists believed that the whole history of life covered only about 40,000,000 years. No one could claim that this was more than an estimate, and a pretty unsatisfactory estimate at that, for it just didn't give time enough for the amazing changes in the life history of the earth which fossils revealed had taken place.

The modern criteria for the estimation of geological time are chemical. One of the most trustworthy is the radioactivity of igneous rocks.

With the discovery of radium 38 years ago, a real "clock" appeared which has yielded remarkable results. The atoms of radium, and its parent element uranium, are explosive, forming other elements, the last of which is lead. If lead and radium are found in the same rock you may be sure that the lead was produced by the radium. Knowing how long it takes a given quantity of radium to form a given quantity of lead, the age of a rock sample may be determined by the proportions of radium and lead which it contains. The earliest rocks measured by the radium time clock indicate approximately 2,000,000,000 years as the age of the oldest rocks. Probably life appeared about half a million years after the most ancient strata were laid down.

The dinosaurs, of course, did not develop until long after life had started on the earth and in its waters. The duration of the Age of Reptiles was about 110,000,000 years.

THERE seems to be an idea that all a scientist needs is a single bone not only to build a skeleton but virtually to tell what the beast ate at his last meal. Certainly a good deal can be told from the teeth and from some bones, but it needs much more than that to reconstruct a skeleton. As a matter of fact, one usually works backward. Until more or less complete skeletons of dinosaurs representing different groups had been discovered it was impossible to do much reconstructing of imperfect specimens. Suppose part of a dinosaur's skeleton has been found. The first step is to determine what were its nearest relatives among the already known forms. Once that is done, because the general anatomical

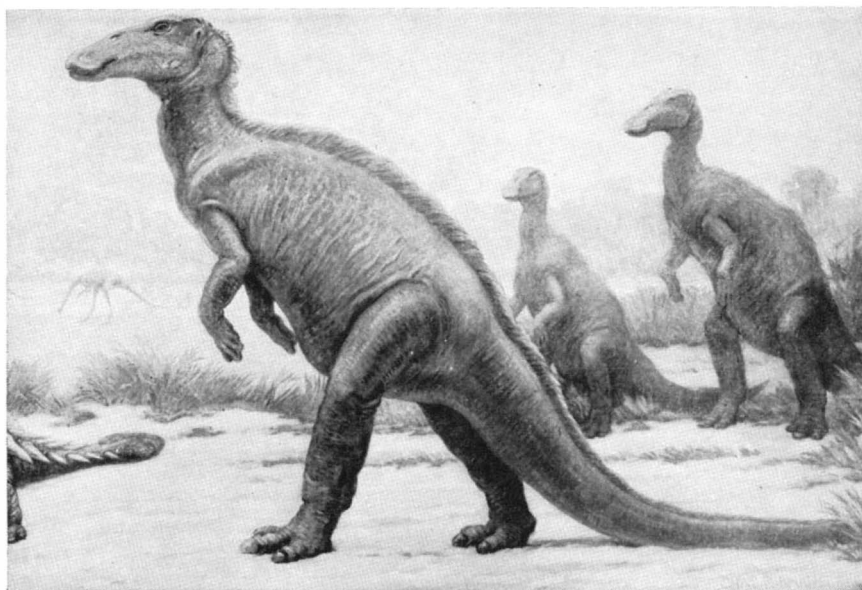


Figure 5: *Trachodon*, the Duck-Bill. Painting by Charles R. Knight, presented to the Field Museum of Natural History, Chicago, by Ernest R. Graham

structure of related animals is similar, the skeleton can be assembled without much fear of wrong determinations except in details.

It is seldom that absolutely complete specimens are found. Some of the bones may have been dragged away by predatory animals; some may have been lost by water action if the beast died near a lake or was swept into a river; often many of the parts have been crushed by earth movements. If one is lucky enough to have a front and hind limb the missing ones may be reconstructed by copying those which were preserved. Often one side of a skull is more or less intact and the other side can thus be built up from the parts we have.

In the case of the *Baluchitherium* (Figure 7), a gigantic hornless rhinoceros which my expedition discovered in the Gobi Desert, the skull was in 600 pieces. Fortunately many of the massive parts were present and attached, thus giving a framework on which to build. Assembling those 600 fragments was exactly like doing a jigsaw puzzle. Bit by bit they were fitted together until all had been placed. But there were still gaps and these were modeled up to fit the general outline of the cranium. It took one man seven months to put that great skull together. But it was done so accurately that although two other skulls have since been discovered it has not been necessary to make more than minor

readjustments in the original specimen.

Even if we have only a few teeth and some of the important bones there is still a great deal of general information about the animal that can be gained from their study. Leg bones are most often preserved, for they are heavier and less easily broken than other parts. If the bones are solid it means a sluggish creature or one of more or less aquatic habits. If they are hollow it indicates certainly an active land animal. If the hind legs are disproportionately long the inference is that the beast walked erect. Even one tooth will tell a lot. Certain kinds of food always demand definite tooth structure. A sharp-pointed or double-edged tooth could not be used for eating grass; therefore we know that the animal was carnivorous. A claw may give a definite hint. A blunt claw is decidedly not adapted for rending flesh; it suggests a creature with an herbivorous diet. If the claw is pointed downward it tells that in the living animal the sole of the foot was a thick, soft pad. Foot bones are among the most useful of all for giving hints as to the sort of animal that wore them, while vertebrae and ribs are of but comparatively little help as story-tellers or in determining the relation to living or known forms.

Such great collections of fossils now

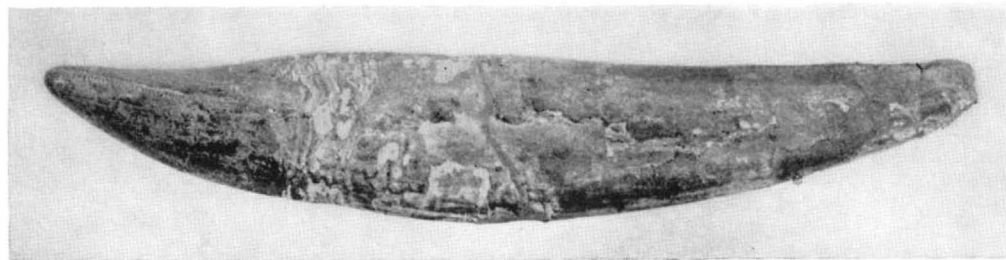
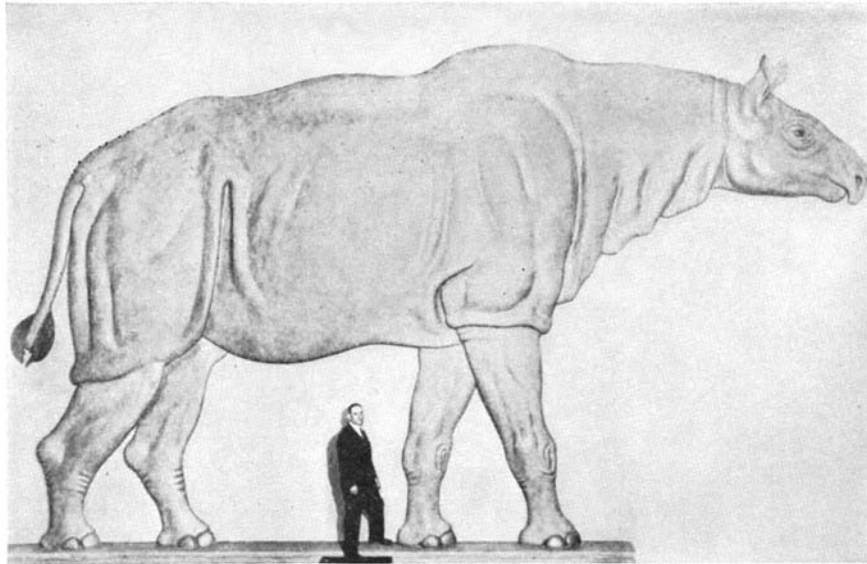


Figure 6: Little David whips big Goliath. Jaw, $1\frac{1}{2}$ times natural size, of an early mammal that may have helped wipe out the mighty giants in the world of about 100,000,000 years ago, and, left, a single tooth of *Tyrannosaurus*, $\frac{3}{8}$ size



Photograph by American Museum of Natural History, New York

Figure 7: *Baluchitherium*, not a dinosaur (reptile) but a mammal. Not even a contemporary of the dinosaurs, for it thrived only 35,000,000 years ago

exist that it is seldom that a specimen is discovered which does not show a definite relationship to known forms. If that rare event does take place we do our best to learn as much as possible from the remains in hand and then wait until more complete specimens turn up, as they are almost sure to do eventually.

In the case of the *Baluchitherium*, C. Forster Cooper of Cambridge, England, found the first remains in Baluchistan, India, in 1911. They consisted of only a few bones including one foot bone and two neck vertebrae. Yet from those few bones he concluded that they belonged to the largest mammal that ever existed and that the beast was probably an aberrant rhinoceros. Thus the matter rested for 11 years until we discovered the skull and part of the skeleton of a similar individual in Mongolia. Cooper was proved right on all the deductions he had made from these few bones.

THERE is another way in which we are helped properly to pose dinosaurs which lived a hundred million years ago. That is by the tracks which have been left in soft mud of some long vanished lake bottom, on the bed of a river, or the sands of an ancient sea shore.

The finest dinosaur foot prints in America are from the Connecticut Valley. The estuary was subject to great fluctuations of water level, stretches of the flats being left dry and again covered by turbid water which deposited mud on the bottom. During the dry periods dinosaurs wandered along the muddy shores, leaving behind them hundreds of tracks of many different kinds and sizes. Strangely enough, they all lead from west to east as if the animals were following a well defined route to their feeding grounds. Some of the tracks show clearly where a dinosaur squatted down to rest or walked slowly on all



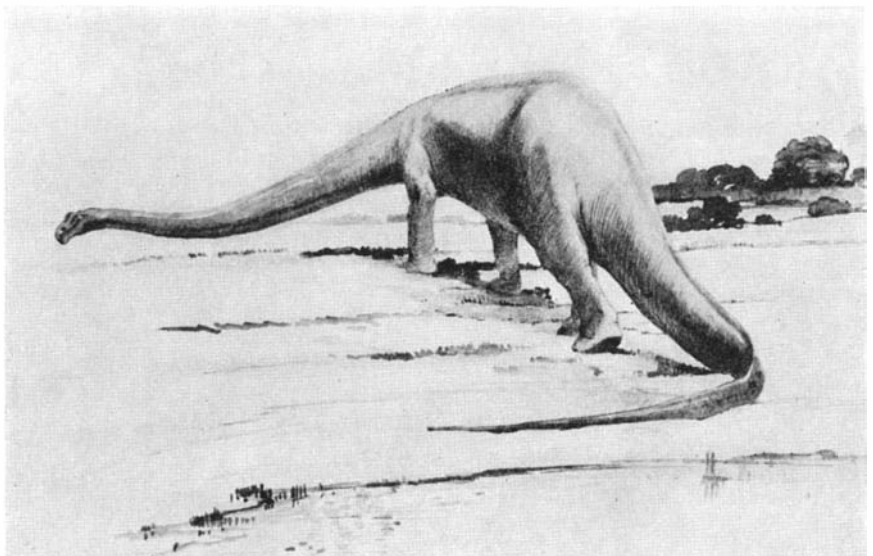
Figure 9: Small pebbles in *Protiguanodon mongoliense* skeleton

fours, touching just the toes of the front feet to the ground like a kangaroo. From tracks in the snow the Indian can deduce a chapter. Likewise the scientist from these ancient mud tracks.

Footprints have been very valuable as aids in determining the correct attitude of several species of dinosaurs and in furnishing proof that some walked erect. In Belgium, where a great number of *Iguanodon* skeletons, a species related to the Duck-Bill, have been found, the natural moulds of the feet show that those dinosaurs walked like birds on the toes alone, and not flat-footed. Moreover, they must have carried their tails well up from the ground, counterbalancing the body, for otherwise there would have been a continuous furrow between the footprints. Where some of the short-limbed dinosaurs waddled along the tail furrow shows clearly.

Another glimpse of the personal habits of some species of dinosaurs is furnished by the stomach stones which have been found associated with skeletons. Chickens and other birds we know swallow pebbles to help digest their food. Some small vegetable-feeding dinosaurs did the same. In the Gobi Desert we found the complete skeleton of a small dinosaur beautifully preserved in red sandstone. It lay stretched out just as it had died. In the abdominal region right where the stomach lay was a neat little group of well worn, rounded pebbles which had undoubtedly been swallowed by the reptile. (Figure 9.)

When I watch the excavation of a dinosaur skeleton or a quarry, I always think that it is like translating a book from a little known language. For those who can read it the story of the rocks is often as plainly written as though it had been inscribed in stone. Every time a new creature is discovered it adds a few more words to the history of life upon the earth which we are endeavoring to translate for all to read.



Photograph by American Museum of Natural History

Figure 8: *Diplodocus*, resembling *Brontosaurus* but longer and swifter moving

OUR POINT OF VIEW

No Limitations

LOOKING back upon that momentous naval date, January 1, 1937, with the bewilderment of minds engrossed in weightier problems of the day and hour, all except the most rabid pacifists are rather ashamed of their dire naval prophecies of that date. It was to have been the beginning of the end of civilization, for the several naval limitations treaties expired on midnight, December 31, and hark ye! "tomorrow will begin a monstrous naval building race which will spell ruin to the world!" The experts were as guilty of this calamitous logic as were radio commentators and newspaper columnists and writers.

We say "looking back" as though New Year's Day were long past. It is! In terms of world events, it is almost forgotten in the mad rush of crisis after crisis. The few actual weeks that have passed have served to show that the tons of newsprint used in predicting a world naval upheaval were wasted so far as any effect upon the public is concerned. Naval boards go ahead with their ship plans, will lay down new ships, will build efficient, well-rounded fleets "for national defense," while the people (of every nation) go about their business of recovering from a depression, "sitting down" in factories, parading on Unter den Linden, riding on snow trains, uplifting Ethiopians, kidnapping their boss-generals, working hard, killing their brothers, and meddling in the private lives of everybody else. To this varied mob, navies don't seem to matter; the feeling seems prevalent that war vessels will be built anyway, so why let the question disturb!

There is a doubly tragic fact. No matter how much effort is expended to prevent it, war vessels *will* be built; and, except for a few sincere believers in limitations, individuals and countries briefly pay lip service to the limitations theory for expediency's sake and then complacently abandon it.

The United States, with all her faults (and may we enter here a modest denial of the holier-than-thou accusation!), more closely lived up to the letter and the spirit of the several naval treaties than did any other nation concerned. We sincerely believed in the practicality of limiting navies by agreement among the nations. We still do! Others, not quite so sincere; vacillating in their theory of government; peculiarly jealous of national honor; deluded by their own sense of importance; or (to be

fair) forced by the actions of other nations—for these reasons, others caused the breakdown of all efforts to achieve naval limitations.

Seven nations are now powers on the seas—or are prospective powers. Besides ourselves, they are Great Britain, France, Japan, Italy, Germany, Russia. These seven are all building new ships outside the former limits of the treaties, or are planning to build. The cost to some *will* be ruinous, as the predictions stated. But perhaps it is a good thing; perhaps it will *save* civilization. Paradoxical? Only on the face. Some of us can outbuild the others two to one, or ten to one if need be; and we who can afford the race are the ones, fortunately, who most desire limitations. The others, their backs broken under the enormous burden of expense involved, may sue for stoppage of the race. Then may come that lasting international accord that will bring the world closer to the peace for which it has striven so hard and seemingly so futilely these past few years.

Coals to Newcastle

PROGRAMS of "swing" music broadcast on short waves from a German station for the special benefit of American listeners provide the keynote of an anomalous situation that might be laughable if it did not have more serious aspects. The development of short-wave broadcasting—reflected monthly in the "World-Wide Radio" department published in this magazine—has opened avenues of communication that have far-reaching possibilities. Leaving aside the obvious opportunities for spreading insidious propaganda—a first thought in these troublous times in European politics—there are the more important phases of knowledge and culture that can be developed for the masses by means of short-wave programs. But these programs must be planned with an eye to these phases, and should not include such things as "swing" music for American audiences who are surfeited with this type of "entertainment" from their own stations.

When we consider that 6,700,000 radio receivers in the United States are capable of receiving short-wave programs from all parts of the world, it is easy to visualize the potential audience for foreign programs that are adequately planned to offer something worthwhile. Station directors in far-off lands will do much toward making their stations famous, and at the same time

will do a notable service in bringing to the world a better understanding of their native lands, if they will so arrange those programs directed especially to foreign audiences that the music and other features will enable the listener for the nonce to transport himself, as it were, to the land where the program originates. Odd native musical instruments, folk songs, current events with a commentation in the language of the country to which the program is directed—these are some of the first-thought possibilities.

The few attempts that have been made in broadcasting cultural programs from foreign stations show what can be done, given the proper start. Our own powerful short-wave stations would do well to initiate a series of programs based on American life, culture, and progress, rather than to rebroadcast some of the commercial "plug" programs that clutter our broadcast band today. Such "plugs" hold little interest for foreign listeners, and only serve to give a distorted view of American life to these listeners who constitute the large majority of the audience.

Inflation, or Deflation?

HAS the expanding universe hypothesis, even now but a few years of age, already reached the limit of its own expansion or inflation and begun again to contract or "pull in its horns"? There are signs on the horizon that what unfriendly critics of recent trends in science have called the maddest craze of all is scheduled soon to make way for a return to what they would regard as a saner point of view, a static universe hypothesis. This, of course, would vastly please all those (and there are many) who foolishly attempt to judge scientific matters merely according to their own intuitions of what "makes sense" and what doesn't. The same people often object to relativity on similar grounds, but such grounds come pretty close to being mere wishful thinking.

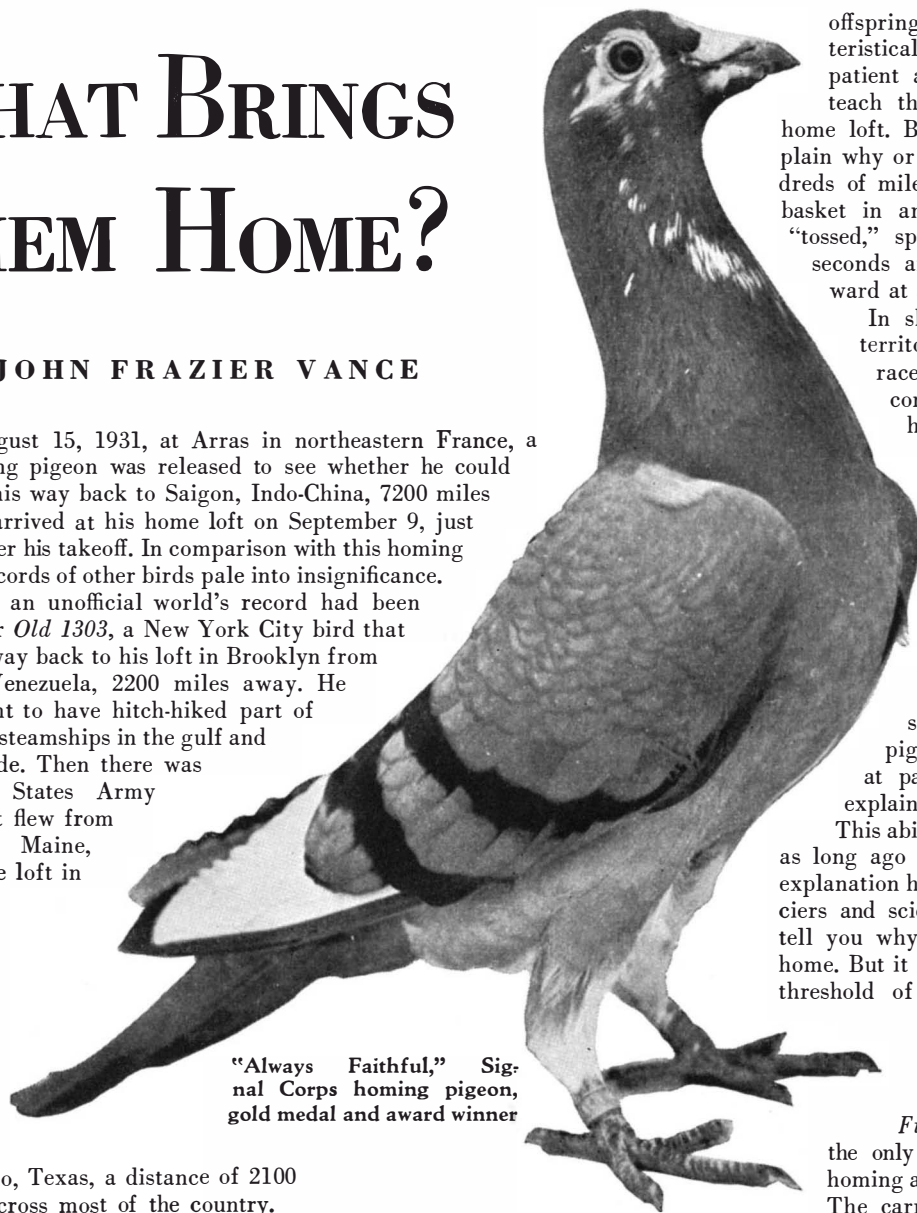
Science, however, must always be like a hound dog, faithfully following the scent wherever it leads; and in deciding which scents to follow, the evidence of actual experiment or observation (the scientific method) is the final guide.

Therefore, whether some of us happen to like an expanding universe, or whether we find a static one more pleasing, is of little real consequence. There is hope that the 200-inch telescope will finally settle the matter—and by the scientific method.

WHAT BRINGS THEM HOME?

By JOHN FRAZIER VANCE

ON August 15, 1931, at Arras in northeastern France, a homing pigeon was released to see whether he could find his way back to Saigon, Indo-China, 7200 miles away. He arrived at his home loft on September 9, just 24 days after his takeoff. In comparison with this homing feat, the records of other birds pale into insignificance. Previously, an unofficial world's record had been claimed for *Old 1303*, a New York City bird that found his way back to his loft in Brooklyn from Caracas, Venezuela, 2200 miles away. He was thought to have hitch-hiked part of the way on steamships in the gulf and coastal trade. Then there was a United States Army pigeon that flew from Vanceboro, Maine, to his home loft in



"Always Faithful," Signal Corps homing pigeon, gold medal and award winner

San Antonio, Texas, a distance of 2100 miles, or across most of the country.

However, once a pigeon has been carried outside the circle within which he might be expected to recognize landmarks, distance becomes a marvel of stamina as well as of instinct and intelligence. Breeding for brawn is a subject about which something is known. The marvel of the homing instinct is, however, quite another matter. Nobody knows how to account for it; some pigeoners even deny that it exists.

Among these is Thomas Ross, the pigeon expert of the Fort Monmouth, New Jersey, Army Signal Corps Training School. In his opinion, a pigeon's ability to find its way to its home loft is merely a result of training. Teaching him from the time he is first ready to leave his nest that food will be found only in the loft establishes his first impelling association. When mating time comes, the loft acquires another lure for the pigeon that is a monogamist and pre-eminently domestic in tastes and habits. Finally, when the young are hatched, the strongest bond of all is forged, and as pigeon parents share

equally the responsibilities of squab-raising, the nest within the loft becomes the pole of the parents' private world, and they are drawn by it as invariably and irresistibly as is the needle of a compass by the magnetic pole.

"THESE three things: feeding, mating, and raising their young," says Mr. Ross, "are the chief motives which bring pigeons home. So what is popularly called the 'homing instinct' is not really an instinct at all. It is largely an acquired trait and a matter of education."

However, those fanciers who insist that the homing instinct does exist point out that Mr. Ross has merely described three primary and powerful elements of the homing instinct and has not at all disproved its existence. For, they contend, every instinct is complex, and every instinctive animal reaction has its own end motivation. No one will dispute that a homing pigeon comes home because he has been taught that in his home loft he will find food, his mate and

offspring. And pigeons are characteristically so stupid that it takes patient and persistent training to teach them to go directly to the home loft. But these facts do not explain why or how a pigeon, taken hundreds of miles from home in a wicker basket in an express car will, when "tossed," spiral upward for some 20 seconds and then streak off homeward at 50 miles per hour.

In short flights over familiar territory (and most pigeon races are flown under such conditions) it could be that he sets his course by landmarks, that he spirals until he sees a familiar tree or steeple or pond and thereby gets his bearings. But a sufficient number of successful flights are made every year over routes entirely new to the competing birds to demonstrate that the homing pigeon has a unique ability at pathfinding that cannot be explained so easily.

This ability was recognized at least as long ago as Solomon's day, but its explanation has consistently eluded fanciers and scientists. Today no one can tell you why a homing pigeon comes home. But it may be that we are on the threshold of finding out, for certain things are *known* about homing pigeons and what they can do. Of them, the most important are:

First: The homing pigeon is the only type which possesses the homing ability in any useful degree. The carrier pigeon's name is deceptive; he is now only a show bird. Racers and carriers now are all homers—they are racers when racing, carriers when carrying something.

Second: The homing trait has been greatly developed and the range of flight remarkably increased during the last few centuries by breeding and training. Basically, today's homer is descended from the sturdy, far-ranging wild rock pigeons of Europe. But he is a cosmopolite, indeed. Crusaders brought home with them to Europe veterans of the Pigeon Post of the infidel sultan Noureddin Mahoud; their descendants became famous as the English dragoon. The rock pigeon and the dragoon; the swift, low-flying ratta, a breed developed by the Mogul emperors of the East; and the India-born calumlet—all are ancestors of today's homer. (And, remarkably, so also is the owl, one of the pigeon's natural enemies.) These are the genealogical sources of his speed, his stamina, his sharp vision, his homing instinct and, as well, of his stupidity and stubbornness.

Third: He may be trained in this way (as he is by Thomas Ross at Fort Monmouth): As soon as the fledgling, or "squeaker," is ready to leave the nest he is fed corn and peas within the loft at regular intervals. When he is six weeks old, he is taken outside the loft and put back in again through a trap door. He is immediately given corn and peas. This is repeated until an association is firmly established: inside the trap-door, food! He is never fed outside the loft, and the corn and peas are always rattled loudly in a tin cup as he comes through the trap.

WHEN he has reached the age of 12 weeks, he is taken a little distance from the loft and released. Immediately he hears his corn and peas rattling in the tin cup in his trainer's hand inside the loft. He listens for a few seconds and then flies in. Day by day he is released at increasing distances from the loft and he acquires the habit of entering through the same trap each time.

When mating season comes, and later when the squeakers are born, the birds' training is intensified. They are taken from the loft one at a time and taught by repetition that the mate and the young will be found beyond the trap door that leads to the corn and peas banquet hall. Fanciers always try to enter in races birds that are courting or setting or raising young. This is comparatively easy in a loft of any size because pigeons mate at any season.

Fourth: Homing pigeons do not fly "bee-line" from the tossing point to the loft. They will fly around storms and fog, and will follow the easiest route.

Fifth: They do not, as a rule, fly in darkness. In that they are quite sensible. For one thing, a pigeon that has flown at a speed of about 50 miles per

hour from dawn to dark has well earned a night's rest; for another, his most formidable enemies (after the thoughtless hunter who blazes away at anything that flies) come out at night.

Sixth: The average life of a homing pigeon is eight to ten years, although some live to twice that age. Their best racing and carrying feats are performed between their second and fifth years.

Seventh: They do not require a bird's-eye view to find their way home. Staff Sergeant Herbert E. Smith, of Fort Monmouth, tells of an instance at Fort Bliss near El Paso which demonstrates this fact. A bird released at some distance from the fort did not return on schedule. Days later he returned *walking*. In the interval he had been caught by someone who wanted to keep him, and who clipped his wings to guard against his straying away. But the bird came home anyway.

Eighth: Their ears are similar to human ears in that they contain a system of semi-circular canals. Some persons insist that through these canals flows the secret of the homing instinct. It must be, they say, that for the pigeon the aural canal does more than it does for man. It must be the center of his unique power, because if his ears are stopped or the canals injured he seems to lose it.

Ninth: Pigeons generally, and the homing pigeon in particular, have remarkable eyesight. Their only blind spot is the 10-degree segment directly behind their heads. Experiments also

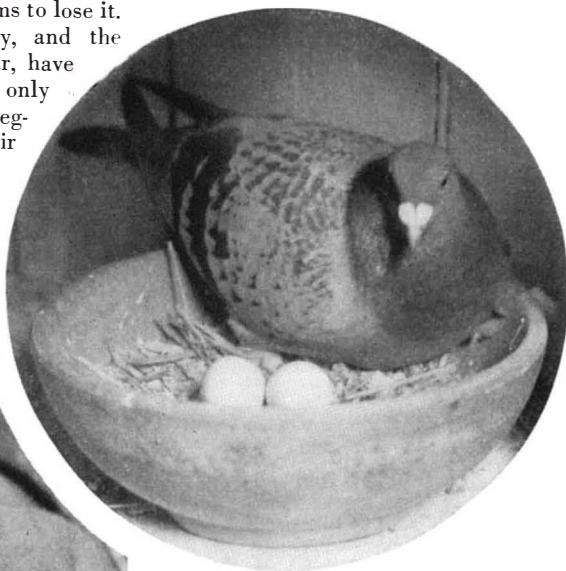
tend to prove that pigeons can see many times as far as human beings can.

Tenth: Pigeons are baffled by radio broadcasting activity. Again and again instances have been reported in which well-trained birds have been confused, thrown off their course, or even forced to abandon flight merely because a broadcasting station lay in their path. Birds tossed from the roof of a broadcasting station while the station is idle, will go through their conventional 20-second spiral ascent and start for home. But let the broadcasting begin and the birds will circle helplessly for several minutes and finally settle to the ground again.

So much for the things we *know* about the homing pigeon which may relate to his homing instinct. Armed with them, we can venture into the realm of surmise and conjecture in which science, on a speculative lead furnished by Harlan T. Stetson, is searching for facts.

The remarkable bird which flew from Arras to Saigon will be a helpful example for us. He traveled in a wicker basket in the hold of a ship around India, through the Red Sea and the Mediterranean. He had no opportunity to select landmarks. He certainly could not see

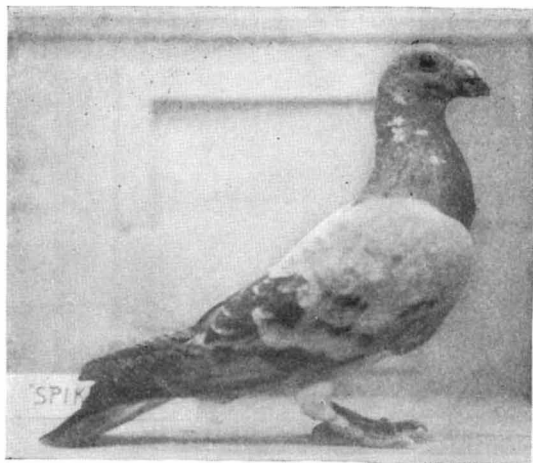
A setting hen homing pigeon at the right; and, below, a pair of pin-feathered squeakers three days old



7200 miles! Either thing was impossible.

But, suppose that the aural canals or some other part of the pigeon is in reality a living earth-inductor compass. That was the conjecture cautiously made by astronomer Stetson, who does not claim to know about pigeons but who can explain the earth-inductor compass clearly.

"On Lindbergh's flight to Paris," he says, "this renowned aviator made use of the so-called induction compass, which was merely a device utilizing a coil of wire carried by the airplane through the earth's magnetic field. Thus it generated a certain amount of current, which in



Three heroes of the World War, of no particular pedigree. Top: "Spike"; and center: "Cher Ami"—both discussed in the text. Bottom: "President Wilson," a bird that, entrusted with an important message, arrived at his loft with a wounded leg and a bullet hole through his breast

Journal's City Editor, however. The ancient Greeks broadcast the winners of the original Olympic Games by pigeon post. And in 1850, New York's newspapers banded together to set up a pigeon news bureau at Sandy Hook. Within a half hour after a boat's arrival at Sandy Hook, this news was delivered to member newspapers in Manhattan by pigeons. This method was used for nearly 20 years.

In Milwaukee, Los Angeles, and San Francisco, pigeons are also used today for carrying the news in difficult circumstances. Spectacular recent service was rendered by homing pigeons in maintaining communication with the outside world when Pittsburgh's telephone service was deadened during the flood.

Until comparatively recently, the sport of pigeon racing and the art of training were largely confined to Belgium. It is to the Belgian immigrant during the last quarter of the 19th Century that America

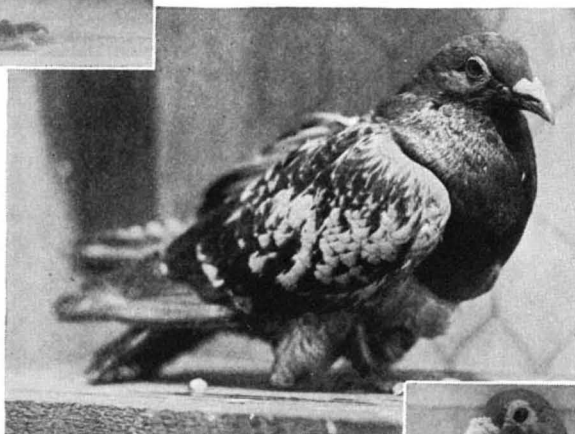
turn was recorded by a sensitive meter on the dashboard. If the plane got off its course, this coil would cut through the magnetic lines of force in a slightly different direction, resulting in a change in the amount of current generated. This would at once be indicated by the meter."

Now, returning to the bird which accomplished the 7200-mile flight: If nature has given him such an electro-magnetic device, all the way from Saigon to Arras he would be busily recording the direction of travel in preparation for his homeward flight. When the bird was finally tossed on that September afternoon, he would have only to find again the direction in which he had been carried from Saigon, and then fly in the opposite direction to get home.

It is a pretty hypothesis. It would explain so many things. It would explain why pigeons are confused by radio waves. It would explain why the El Paso bird found his way home on foot. It would fully explain the homing instinct. But it can only be proved by repeated experiments and observations, if at all.

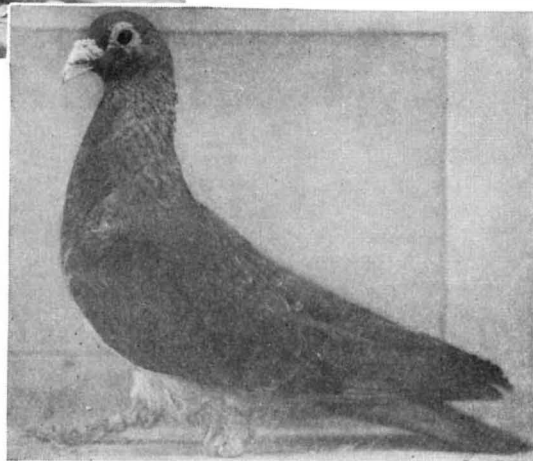
AND whether it is proved or not, the pigeon will go on performing his wonders with increasing frequency and efficiency in a world which is constantly finding more work for him to do. Today, the homing pigeon, one of the oldest instruments of war, is being more and more widely used for the preservation of human life, the dissemination of knowledge, and the practice of a harmless outdoor sport in which competitors of all ages can participate on an equal footing. In recent months pigeons have won life-saving honors in the fishing fleets off Long Island. Large numbers of them have taken up the profession of journalism and often can get the news and even pictures through to headquarters more rapidly than any other means of communication.

And throughout the world there are literally hundreds of thousands of persons who revel in the hobby of pigeon



racing. American racing pigeon enthusiasts are organized in clubs, at least one of which will be found in every city of any size throughout the country. They require four different magazines to record their activities. In the 5590 pigeon races flown under the supervision of the American Racing Pigeon Union in 1935, more than 1,200,000 birds competed.

It was doubtless the discovery by Americans during wartime that transportation of messages by homing pigeons was so fast and reliable (the Army Signal Corps reports that 90 percent efficiency was maintained by its flying messengers under fire) that has been responsible for the rapid development of pigeon lofts in the last few years. Even in New York City, where every type of communication known to modern science is more readily available than anywhere else in the world, the pigeon has found a niche. Since early 1935, the *New York Evening Journal* has been using pigeons in gathering its news. The *Journal's* ship news reporters take pigeons with them when they go to Quarantine, 14 miles down the bay, and release them with reporters' dispatches and films of arriving celebrities. These pigeons make the return trip to the roof of the Journal Building in about 12 minutes, whereas publishers of rival newspapers must wait two hours until the ship docks. News-running by pigeons is not an idea original with the



All photographs courtesy Signal Corps, U. S. Army

owes her present knowledge of the homing pigeon and the breeds which have been developed here.

In November 1917, the Adjutant of the American Army authorized the establishment of a Pigeon Section of our Army Signal Corps, and the birds were first used by our forces in the Aisne-Marne offensive, with mobile lofts near the front line. Seventy-two birds were employed, and in the period from August 29 to September 11 they carried 148 test messages and 78 messages of vital importance, maintaining a 100 percent efficiency. So remarkable was their performance in this first trial, that 567 birds were used during the St. Mihiel drive.

Members of the famous "Lost Battalion" of New York's 77th Division have particular reason to be grateful for the establishment of the Pigeon Section, because it was a message borne by *Cher Ami* that saved them from annihilation. This same bird carried 12 messages from Verdun to Rampont before he was dis-

abled by a shot which tore off one of his legs. On that flight he continued to the loft at Rampont with the message still dangling from the bleeding stump. He was idolized by the service, of course, and retired as an honored veteran.

Stories of remarkable performance by other pigeons under fire have frequently been told. There is the case of the famous *Spike*, an American Army bird bred and trained in France. Whereas most pigeons have pedigrees as formidable as any blooded stock, *Spike's* ancestry was largely unknown. Nevertheless he maintained a 100 percent average, delivering 52 messages under fire.

Then, there is the story of *The Mock-er*. On September 12, 1918, with one eye destroyed by a shell splinter, he struggled home to his loft from the Beaumont front in the St. Mihiel sector.

IT is perhaps unkind to insist, in view of these remarkable performances, that the pigeon is lacking in courage. It must be admitted, however, that his continuance in flight after he has been injured is more probably due to an innate stubbornness which he exhibits under all conditions than to any nobler instinct. But whether courage or stubbornness brings him home is of slight importance, for the American Army does not propose to dispense with the services which the homing pigeon can render.

Although the homing-pigeon contingents were greatly reduced after the Armistice, training stations have been maintained, principally at Fort Monmouth, New Jersey, where, contrary to all previous experience, considerable success has been achieved in training them to fly at night. The lofts are darkened and the birds are taken out only after dusk. A light is kept in the loft and the birds, having eaten nothing since morning, fly back to their familiar loft for food. Night after night, as the distances are increased, they become more proficient in finding their way in darkness, and the Signal Corps confidently

expects ultimately to develop a breed which can be relied upon to carry messages at night as well as in the day time.

In Germany, a war college is maintained for pigeon training which goes further than our American Army methods. These birds are trained to carry, on a special harness, a small panorama camera which makes exposures at predetermined intervals as the bird travels his course. This performance makes him still more valuable to an army in the field.

So the Dove of Peace is still being used and trained for the uses of war. It has even been suggested that the owners of the 900,000 privately owned birds in this country be carefully registered and inducted into a Signal Corps Reserve which can be called upon in time of emergency to multiply the Signal Corps Pigeon Section manifold.

But the peace-time uses of the homing pigeon are growing with equal rapidity. For example, the fishing fleet which makes its headquarters in the harbor of Freeport on Long Island uses them to send back for assistance in case of trouble. The forest patrol uses the homer for reporting fires. And flyers who do not have adequate radio-sending apparatus frequently carry one or two birds in the cockpit to enable them to communicate with their home field in case of accident.

When birds are returned to their lofts at unexpected times for assistance, it is simple enough to rig a signaling device to announce their arrival. Such an electrical alarm, set in operation

automatically, is used by the Freeport fishing fleet.

Greater and greater peace-time uses will be found for the pigeon if the sport of falconry is not too actively revived and if the type of hunter who likes to take a pot-shot at anything that flies can be persuaded to exempt this useful bird. There is scarcely a single important pigeon race from which one or more do not return with shot-gun pellets lodged in breast or wings, and many a fancier hesitates to "toss" a valuable bird when these hazards exist.

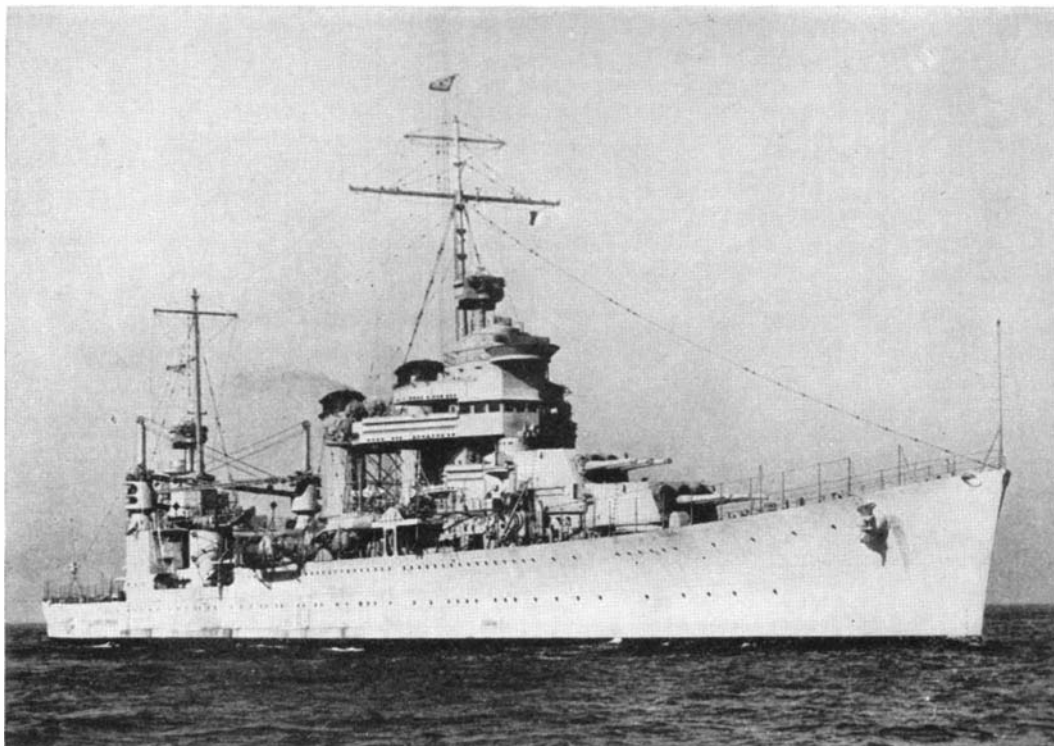
Pigeons with pedigrees bring 25 to 50 dollars a head as a usual thing, although they have sold for as high as 6000 dollars. The cash investment in birds, plus the labor of training, which is considerable, makes the pigeon fancier's wrath at the pot-shot hunter understandable. His defense against them and against the duck hawk is merely the pigeon's natural fecundity. A fancier's hope is that



Two birds, above, being placed in the basket in which they will be carried out to sea before release. At left: Message capsule on a pigeon's leg. Below: Some of the pigeon lofts at the training station, Fort Monmouth, N. J.



the homing breed will not follow the passenger pigeon into oblivion. This handsome breed 50 years ago nested in countless multitudes in the wonderlands of our middle western states, particularly in Indiana, Ohio, and Kentucky. However, hunters succeeded, in the course of years, in exterminating the passenger pigeon entirely, the last specimen having died in the Cincinnati Zoo in 1914. With this example freshly in mind, the publications devoted to pigeon culture make a consistent effort to educate the public to protection of the pigeon because of its tremendous value as a messenger in time of peace as well as in time of war.



Commissioned last year, the U.S.S. *Quincy* is our sixth of the *Minneapolis* class, the ships of which are exceedingly well protected in contrast to the earlier *Augusta* and *Pensacola* classes

AMERICA'S HEAVY CRUISERS

Step by Step, Design, Armament, Armor Have
 Been Improved with Each New Cruiser Class
 . . . We Now Have An Efficient Cruiser Fleet

By WALTON L. ROBINSON

WITH the commissioning for service last June of the U.S.S. *Quincy*, the number of available heavy cruisers of the United States Navy was increased to 16. The new ship is similar in design to the five completed in 1934—the *Minneapolis*, *Astoria*, *New Orleans*, *San Francisco*, and *Tuscaloosa*. Including the light cruisers of the *Omaha* class, our navy now possesses 26 modern cruisers totaling 223,000 tons.

The *Quincy* and her five sister ships (officially known as the *Minneapolis* class) are the last word in modern cruiser design according to American ideas, and they compare most favorably with contemporary foreign cruisers. It will be recalled that the Washington Naval Conference of 1922 fixed the maximum standard displacement of future cruisers at 10,000 tons and the size of their guns at eight inches. During the past seven years this country has completed 16 ships of this type. Each succeeding group has embodied improvements over the preceding one.

Our first two 10,000-ton cruisers—the *Pensacola* and the *Salt Lake City*—were not very successful men-of-war, although certain alterations made since their completion have improved them greatly. Their strongest point is their main armament of 10 8-inch guns, but this imposing offensive power was obtained at the expense of adequate pro-

tection. Those two ships are of rather awkward appearance with their lofty tripod foremasts, flush decks sheered up sharply from amidships to the bow, and high fore and after shelter decks, upon each of which is mounted a triple 8-inch-gun turret or gun-house. Four airplanes are carried, and for the launching of these, two catapults are provided. The armament is composed of 10 8-inch guns, four 5-inch anti-aircraft guns, and six 21-inch torpedo tubes. The engines develop 107,000 horsepower for a speed of 32.7 knots.

IN the construction of these ships, as in all subsequent heavy cruisers, the greatest possible economy of weights was practiced. Aluminum alloy fittings replaced steel, and aluminum paint is used internally. Welding was employed wherever possible instead of rivetting. These two cruisers suffer from their low freeboard, and, as first completed, vibrated badly. This has been corrected, but they still roll a good deal at low speeds, although above 20 knots they

are very steady, even in bad weather.

In the *Augusta*, *Chicago*, *Houston*, *Northampton*, *Chester*, and *Louisville*, which followed a year or so later, the design was altered radically. The main armament was reduced by one gun, nine 8-inch guns being mounted in three three-gun turrets. This reduction in offensive power made possible the addition of some much-needed armor over the vital spots of the ships. A notable improvement was made with the provision of a hangar for the four planes carried. The hull lines and superstructure were modified considerably and these six cruisers have a distinctive silhouette. The sheered flush deck of the *Pensacolas* gives way to a broken deck with a rather short forecastle, and there are but three gun-houses instead of four. The anti-aircraft and torpedo armament in these ships is the same as in the preceding class.

All-in-all, the *Augusta* and her sister ships may be regarded as quite an improvement over the *Pensacola* class; however, they have not proved particu-

larly successful. Because the center of gravity was placed too low, they roll considerably, just as do the earlier ships. The *Chicago*, *Houston*, and *Augusta* are fitted as flagships, extra accommodation being secured by extending the fore-castle aft to the catapults.

The next two ships, the *Portland* and *Indianapolis*, are simply improved copies of the *Augusta* class. The anti-aircraft armament was doubled, eight 5-inch guns being mounted instead of only four. Torpedo tubes were provided in the original designs, but the ships, as completed, do not carry any. Various modifications also were made in hull design, and the superstructure was considerably reduced. As a result, both ships behave very well at sea. Additional protection was also worked into the design. These ships can readily be distinguished from those of the *Augusta* class by their short tripod foremasts and their light tripod mainmasts. The *Indianapolis* is fitted as a flagship, with extended fore-castle.

The *Portland* class was followed by the six cruisers mentioned in the opening paragraph. The design of these marks a distinct breakaway from that of the three earlier classes. Only in such general characteristics as displacement, armament, and speed is there any similarity. In silhouette, the new ships are quite unlike anything which previously has appeared in our Navy. Aside from these alterations in appearance, which will be described fully in a later paragraph, the most important change, and one invisible to the eye, is the amount of armor protection carried by the new vessels. In this respect they form a striking contrast to the *Pensacola* and *Salt Lake City*. Whereas these two latter ships are but very indifferently armored, the new cruisers have been given some fairly good protection. It is reported that armor of five inches or more in thickness is carried

over vital parts, while even the bridges have been given a patch of thin plating. These ships are much better protected than Great Britain's fine, ruggedly-built 10,000-ton cruisers of the *Kent*, *London*, and *Dorsetshire* classes, and are also somewhat superior in this respect to France's latest heavy cruiser, the ungainly-looking but sturdily armored *Algérie*.

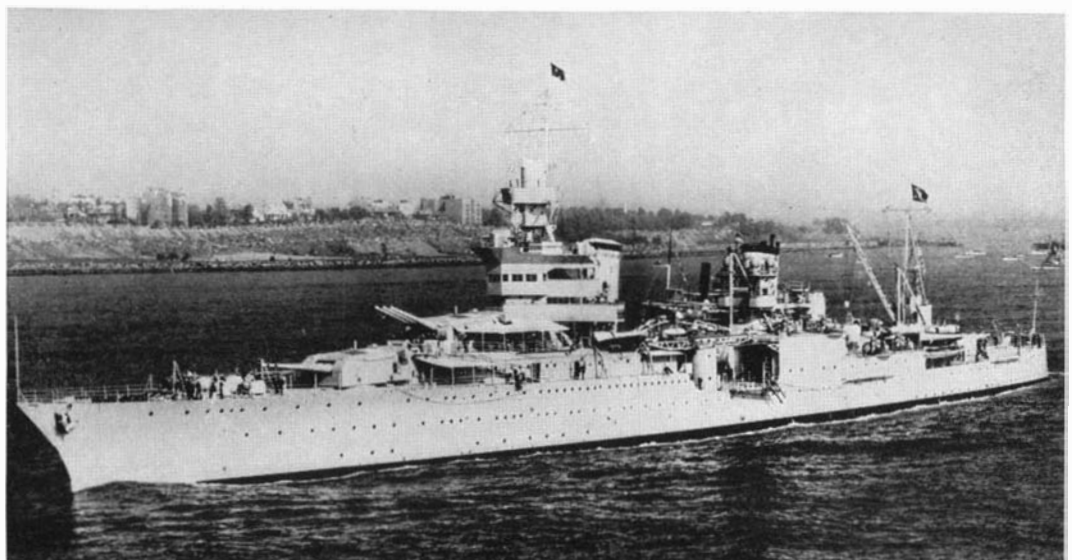
THE *Quincy* and her five sisters carry the same armament as the preceding ships of the *Portland* class, i.e., nine 8-inch guns and eight 5-inch anti-aircraft guns. The torpedo armament has been suppressed entirely; it was not even included in the original plans. These are among the very few modern cruisers which do not carry torpedo tubes. In their 10,000-ton cruisers, England, France, Italy, and Spain have mounted, respectively, eight, six, eight, and twelve torpedo tubes. Japan has placed eight tubes on four of her heavy cruisers, and twelve on the remainder. Germany's all-too-famous 10,000-ton "pocket battleships" of the *Deutschland* class are each provided with eight tubes, while her pair of eight-inch gun cruisers, now building, are expected to carry twelve. Aside from our new cruisers of the *Minneapolis* class, and the two *Portlands*, only six modern cruisers are at present without a torpedo armament—the 6670-ton *Java* and *Sumatra* of the Royal Netherlands Navy, and Italy's four 10,000-ton cruisers of the *Zara* class. In view of the almost universal practice of providing cruisers with a torpedo armament, the decision of American naval authorities to forego this weapon on our latest cruisers may well be regarded as a rather bold step. It is understood that the Navy Department intends to remove the tubes now mounted on all our earlier 10,000-ton cruisers. The weight and space thus saved will be employed to augment the anti-aircraft batteries of these ships.

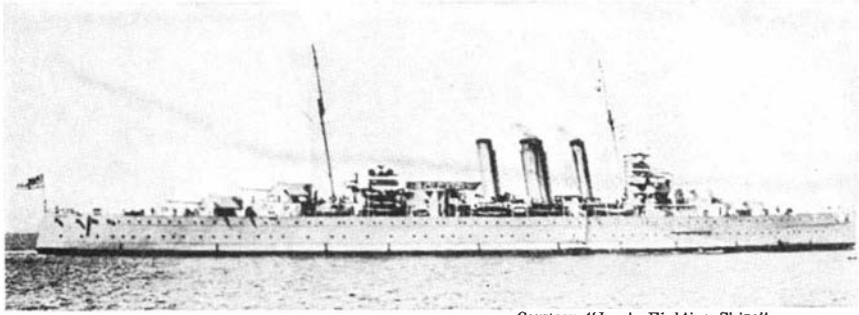
Torpedo tubes will be retained, however, by the ten 7050-ton *Omaha* class, light cruisers now in service.

As mentioned briefly in a previous paragraph, the general appearance of the new cruisers differs radically from that of the earlier ones. Instead of the pronounced over-hanging yacht or clipper bows of the older ships, the newest ones have almost straight stems—only a slightly curved overhang. The fore-castle deck is much longer in the new ships and is sheered up noticeably from the foremost gun-house. The tripod foremast with its heavy director tower and searchlight platforms has been abolished, and its place taken by a light pole rig. The directors have been shifted to a position atop the towering bridgework, and the searchlights to a lofty platform between the pair of raking funnels. These are both extremely tall, though of unequal height (the fore-funnel is several feet taller than the second one) and rather close together. Behind the funnels are two airplane catapults. On the older ships these were placed between the funnels, which were located quite some distance apart. Aft the catapult, and forming part of an imposing after-superstructure, is the plane hangar. Atop this are two cranes for handling the planes and small boats, as well as a light, short, raking pole mainmast, director tower, and other equipment.

Under the terms of the London Naval Treaty of 1930 (which expired December 31, 1936), this country will have in service in the course of the next few years 18 10,000-ton cruisers armed with 8-inch guns. Of this number, all but two are now completed and in active service. They have all been described in the foregoing paragraphs. Of the remaining pair, the *Vincennes* is at present under construction at the Fore River yard of the Bethlehem Shipbuilding Corporation and the *Wichita* is under construction at the Philadelphia

The U.S.S. *Indianapolis* forms, with the *Portland*, the third group of heavy cruisers built by this country. She is the flagship of the Scouting Force, and has served on several occasions as the Presidential flagship





Courtesy "Jane's Fighting Ships"

H.M.S. Cornwall, typical of Britain's thirteen 10,000-ton cruisers. Note high free-board; flush deck; four gun-houses, mounting two 8-inch guns each; and single catapult to be seen amidship

H.I.J.M.S. Nachi. Japan's other seven heavy cruisers are of similar appearance. Due to low free-board, heavy armament, and excessive top hamper, these behave badly at sea. Note five two-gun turrets

Navy Yard. The first is due for completion in 1937 and the second in 1938. In all probability, the design of these ships will closely follow that of the *Minneapolis* class.

The London Naval Treaty of 1936, signed by this country, Great Britain, and France, provides for a holiday in the construction of additional 10,000-ton cruisers armed with 8-inch guns; hence the *Wichita*, when completed in 1938, will probably be our last cruiser of this type for some years to come.

The United States Navy also has at present under construction seven other cruisers of 10,000 tons displacement, but as they are to carry 6-inch guns instead of 8-inch, they are light cruisers and not heavy ones. Thus they do not properly enter this discussion and it will be necessary to dismiss them with a few brief remarks. Suffice it to say that they are expected to carry no less than 15 6-inch guns mounted in five triple gun-houses. All are due for completion in 1937. Funds for the construction of two additional light cruisers have been appropriated. Unlike their British and Japanese counterparts, these nine cruisers will not carry torpedo tubes.

With the completion in 1934 of the five ships of the *Minneapolis* class, and in 1936 of the *Quincy*, the United States Navy possesses the most homogeneous heavy cruiser force in the world. All 16 vessels have been designed for a



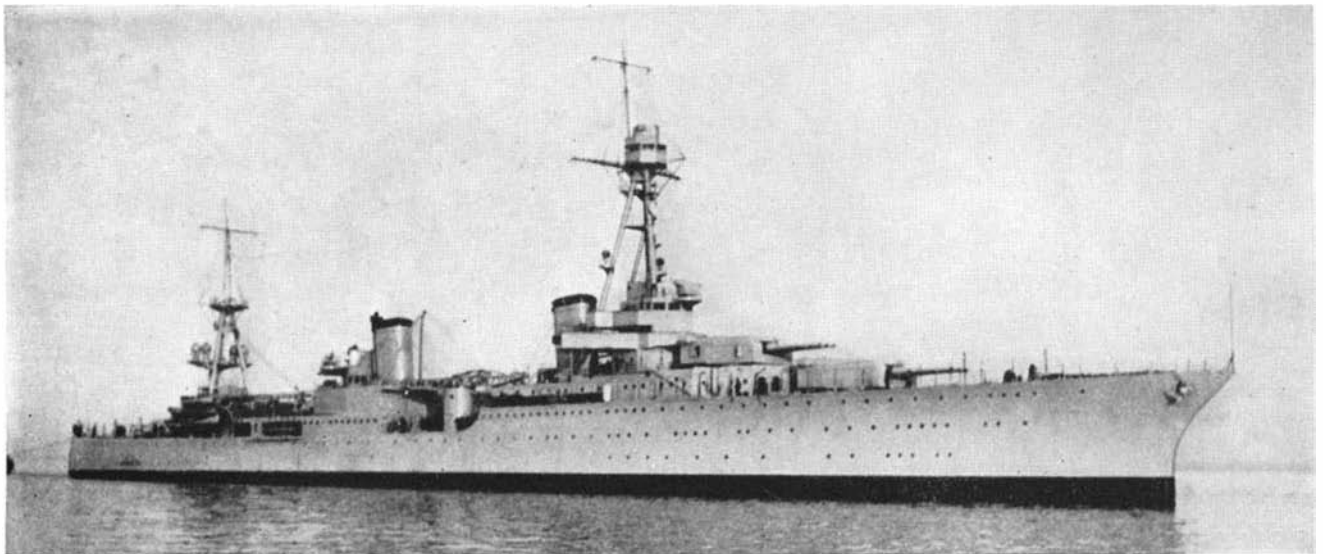
uniform speed, and all save the earliest two carry nine heavy guns arranged three to a gun-house, two of which are in a position to train directly forward, one aft, and all three on the beam.

THE foreign navies, on the other hand, have not been as consistent in the design of their eight-inch gun cruisers. Of Great Britain's 15, 13 are of 10,000 tons and mount eight guns. Of these ships, seven are capable of a speed of 31.5 knots, and the remaining six of 32.25 knots. England's list of post-war heavy cruisers is completed by two 8400-ton ships carrying but six 8-inch guns and able to steam at 32.25 knots. Of France's seven 10,000-ton cruisers, two are good for more than 35 knots, four can make but 33, and one only 32 knots. Three of Italy's heavy cruisers can steam from 35 to 36 knots, and the remaining four only 32 knots. Each of these French and Italian ships carry eight 8-inch guns. All of Japan's 12 heavy cruisers are designed for a speed of 33 knots, but four of them are of

only 7100 tons displacement and mount only six 8-inch guns. The remaining eight ships displace 10,000 tons and carry 10 8-inch guns in two-gun turrets.

The markedly superior homogeneity of our heavy cruisers in armament and speed, and especially in the latter, is of the utmost value, and it is to be earnestly hoped that this policy of giving all our cruisers a uniform speed will be continued in the future. At present, not only are all of our 10,000-ton cruisers designed for 32 to 32.7 knots, but also our 10 7050-ton, 6-inch gun, light cruisers of the *Omaha* class, while the 10,000-ton light cruisers, now building, are expected to do 32.5 knots.

Summing up, therefore, we find that in active service the United States Navy has a force of 26 modern, well-armed, fairly fast cruisers, while 11 additional ones are under construction or soon will be. The development of this splendid force of heavy and light cruisers has been an important step toward the attainment of the government's goal—a navy second to none.



The U.S.S. *Augusta*. Compare with *Quincy* and *Indianapolis*

52-YEAR-OLD FIRE FOUGHT BY WPA

By C. A. ROBINSON

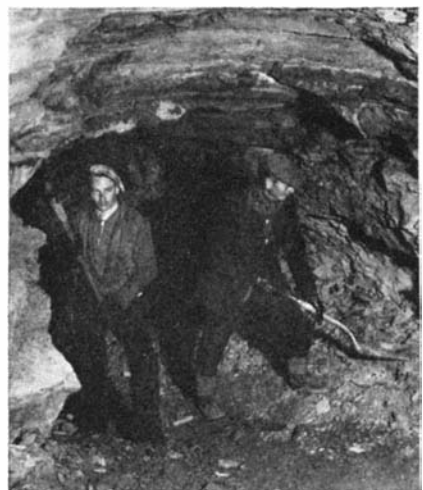


Flames burst through a tunnel of a recently worked small wagon mine

FAMILIES that have lived for generations on the slopes of Mount Vesuvius have become accustomed to the presence of molten rocks, steam and gases. So it is with the residents of the Hocking Valley of Ohio who have lived for 52 years over a burning coal mine. This fire, which was started during labor trouble in 1884, has spread underground to great distances and often burns through the surface at unexpected places. So far, something like 50,000,000 dollars' worth of high-grade coal has been destroyed, and additional fields worth a billion dollars are menaced. In the past, much time and money have been unsuccessfully expended in trying to stop this destruction.

A determined effort will now be made to choke the fire by limiting the fuel on which it feeds. Three projects are now in hand to cost 365,000 dollars, and WPA workers are making rapid strides in their fight to extinguish the fire.

Two types of barriers have been proposed to confine the fire to an area of about seven square miles. Where the coal is close to the surface, steam shovels will remove the coal as in "strip" mining. A ditch barrier will then be dug wide enough to stop the progress of the fire, this ditch being filled with dirt after the coal is removed. The other type of barrier is a tunnel which will be driven through the coal seam to divide it. To prevent the fire from jumping across the tunnel, holes will then be driven down to it from the surface and through these holes will be pumped a stream of mud until the tunnel fills.



WPA workers preparing the way for a steam shovel in an old mine



A crater in the hillside that spouts steam and water at regular intervals



A cave-in caused by burning away of supporting coal layer underground



A steam-shovel stripping off the overburden preparatory to the digging of a deep trench, later to be filled with dirt



Something that happens in unexpected places! This farmer found smoking fissures in his cornfield one morning



Photo by Cav. G. Enrie

Detail of the face, showing negative imprint and weave of the cloth. The transverse lines are shaded wrinkles

THE PROBLEM OF

By **PAUL VIGNON, Sc.D.**

Professor of Biology at the Institute Catholique, Paris
Secretary General of the Italian and the French Commissions of the Holy Shroud

Translated from the French by

EDWARD A. WUENSCHEL, C.S.S.R., S.T.D.

light, for long periods at a time, and on several occasions were allowed to handle it. Afterwards two Commissions were formed, one in Turin and the other in Paris, to study the question from every angle. In 1933, during another exposition of three weeks, the Shroud was again examined by many critical eyes, and the Commissions continued their investigation with additional data to guide them. Though they have not yet completed their work, they have made considerable

unknown or poorly grasped until comparatively modern times. It is hard enough to carry out these principles in an ordinary positive painting, in which the lights and shades have their normal values. On the Shroud, they are perfectly illustrated with the lights and shades reversed, though it takes a photograph to reveal the fact. Even today no artist can paint so exact a negative. No artist, in fact, has yet succeeded in making an exact copy of the negative figures on the Shroud, though competent artists have made the attempt.

IN 1902 the Scientific American¹ reprinted a report which I submitted to the Academy of Sciences at Paris relative to the remarkable cloth known as the Holy Shroud. This cloth, preserved in Turin, Italy, is venerated as the winding-sheet of Christ. Upon it are two figures, which represent the front and the back of a human body and are believed to be the imprints of the Body of Christ. In 1898, when the Shroud was photographed for the first time, it was discovered that the lights and shades of these figures are reversed as in a photographic negative. This led me to make a series of studies and experiments, in which I was assisted by several colleagues at the Sorbonne. Our findings in the laboratory tended to confirm the traditional belief about the figures on the Shroud. On the basis of several historical documents, however, many scholars, Catholic as well as non-Catholic, maintained that the figures (page 148.—*Ed.*) are paintings, dating from about the middle of the 14th Century.

Since then much light has been shed upon the question, both for the scientist and for the historian. In 1931, when a public exposition of the Shroud was held, Cavaliere Giuseppe Enrie made some excellent photographs of the entire Shroud and of all the details of the figures, the work being done in my presence and partly according to my suggestions. During the exposition, which lasted three weeks, we saw the Shroud repeatedly in different conditions of

progress.

It is quite certain that the figures on the Shroud are not paintings of the 14th Century. There are many representations of Christ, notably the image of Edessa, which could have been derived only from the Shroud. A careful study of these copies, which I completed recently, shows that the present Shroud of Turin was in Constantinople during the 12th Century, and that the face visible upon it served as a model for artists as early as the 5th. The artists did not copy slavishly, but tried to interpret the face, translating the mask-like features into a living portrait, which was still a recognizable copy of the original. This disposes of the only positive objection ever brought forward in the name of history.

The figures on the Shroud, in fact, are not paintings at all. As already stated, they are negative images, and the idea of a negative became known only through the invention of photography in the 19th Century. No artist of any earlier period, therefore (certainly none of the 14th Century and, above all, none before the 5th), could have conceived the idea of painting a negative.

The figures, moreover, are very exact negatives. When they are photographed, they appear on the film with the natural proportions of a full-grown man, with a true perspective, with a noble, impressive countenance, and with a minute fidelity to nature even in minor details. Each one of these points involves principles of science and of art which were

SINCE the figures are not paintings, since they could not have been produced by any other artificial means, it remained to investigate whether they could have been produced by some natural process. After analyzing the first photographs of the Shroud and making our experiments in the laboratory of the Sorbonne, we concluded that the figures are the direct imprints of a human body. It was obvious at once that they were not produced by mere contact, for contact between the pliable cloth and the irregular surface of a human body would have caused considerable distortion, and there is little or no distortion in these figures. They could have been produced only by the action of vapors given off from the surface of a body, the action being most energetic where the reliefs of the body touched the cloth or were very close to it, less and less energetic at the concavities and the sides as the distance between the body and the cloth increased. That is why the resulting stains have such a delicate diffusion, shading off gradually till they fade away entirely. That, too, is the reason why the figures are negatives, the reliefs having caused a darker stain than the cavities and the depressions.

With the aid of Lieutenant-Colonel Colson, then Professor of Physics at the École Polytechnique, I was able to determine what kind of vapors had acted on the cloth: humid ammoniac vapors, resulting from the fermentation of urea, which is exceptionally abundant in the sweat produced by physical torture and by fever. We also determined that the

¹Vol. 86, pages 367-8, May 24, 1902.

THE HOLY SHROUD

vapors had reacted with aloes, which were spread on the cloth and sensitized it to the action of the vapors. The detail photographs show that the aloes were in powder form. In my experiments I found that it was sufficient—favorable, in fact—that only a small amount of the aloes should remain on the cloth. I obtained imprints like those on the Shroud by placing cloths prepared with aloes over plaster figures soaked in a solution of ammonia. I proceeded in this way because it is impossible to have a human body in the requisite condition—one recently done to death by torture, as was the body which caused the imprints on the Shroud.

The conclusions which we reached after our first investigation have been confirmed by the new evidence derived from the two examinations of the Shroud itself, from the more exact photographs taken in 1931, and from subsequent experiments by members of the Commissions. It is now established also that there are particles of blood on the Shroud, so well preserved that they still show the composition of the blood. Beyond doubt, the two figures on the Shroud are the imprints of a human body.

This body was evidently that of a man who was crucified. The wound in the hand which can be seen (page 148) is placed (contrary to the universal practice of art) where the anatomy of the hand requires. Before crucifixion the man was scourged. From the markings I have reconstructed the scourge that was used. It was the kind called *flagellum*, having two or three thongs, each of which was provided with a metal ball at the end and with another about an inch and a quarter from the end. The man was also wounded about the head, as is shown by the trickles of blood and by several distinct punctures on the brow. There is a wound in the right side, such as would be caused by the stroke of a lance. Pierre Barbet, M.D., of the French Commission, has shown that the weapon entered between the fifth and the sixth rib and pierced the right auricle of the heart. The doctors of both Commissions are agreed that serum flowed from this wound with the blood, and that this is a sure sign that the man was dead when the wound was inflicted.

Briefly, the imprints on the Shroud are those of a man who was tortured exactly as is recorded of Christ in the Gospels. But was this man really Christ? In the present state of the question, this is the only problem to be solved.

At the very outset it would seem that these cannot be the imprints of Christ. On the brow and at the back of the head there are the traces of many small drops of serum, indicating the first stage of decomposition. Of Christ, however, it is written that He was not to see the corruption of the grave. This is true; but just as the death of Christ resulted from natural causes, so was His dead Body subject to the operation of natural causes as long as He remained in the tomb. These signs of an incipient decomposition, therefore, are no difficulty.

Neither is there any difficulty in a cloth being preserved intact for 19 centuries. The Shroud, which is made of linen, is actually in a good state of preservation, except where it was damaged by fire²; but there are Egyptian linens 3000 years old which are still as good as new. There is just as little difficulty in the fact that the Shroud is woven in a twill pattern, for the ancients wove twilled fabrics of excellent workmanship, and the art of weaving was highly developed at the beginning of the Christian era.

BUT there are gaps in the history of the Shroud. We have no complete record by which we can trace this cloth back to Christ. At most, this is a negative objection. For one thing, there were various reasons, of prudence and of religion, for the silence of the very first centuries. It is very likely, too, that early documents referring to the Shroud were lost or destroyed. The copies of the Shroud, however, to which I referred above, supply to a great extent for the lack of written records, since they prove that our present Shroud, with the imprints, existed at the beginning of the 5th Century. A text from the "Illatio," the Preface of the ancient Spanish Liturgy for the Saturday after Easter, shows that it was known in Spain in the second half of the 7th Century that the Shroud of Christ bore the imprints of His Body. A cloth which was venerated as the Shroud of Christ was pre-

²This fire occurred at Chambéry, France, in 1532. The Shroud was folded several times in a silver case and was scorched along the edge of the folds, whence the two dark lines enclosing the imprints. One corner of the folds was burned through by a portion of molten silver where the triangular patches now are. The Shroud also received several water stains through the middle and along the sides.



Photo by Cav. G. Enrie. ©1935. Redemptorist Fathers of New York

How the face appears when the lights and shades are reversed by photography. Above the head is a water stain

served for many years in the Imperial Palace at Constantinople. Here it was not put on exhibition; but about 1203, when it was kept in the famous chapel of Our Lady of Blachernes, it was stretched out at full length every Friday, so that all could clearly see "the figure of the Lord." In 1204, when Constantinople was pillaged by the Crusaders, the Shroud disappeared. About 1355 we again find it, at Lirey, near Troyes in France. This was undoubtedly our present Shroud, for from this point onward it has a clear and continuous history. There are no documents to prove that it is the same as the Shroud of Constantinople, but certain copies of the Shroud, made at Constantinople, prove it, and prove it despite the silence of Lord Geoffrey I de Charny, who brought the Shroud to Lirey, as to how it had come into his possession. It is to the point, moreover, to note that Lord de Charny went to the Orient as a Crusader in 1346.

In 1453 the Shroud was entrusted to the care of Duke Louis I of Savoy, residing at Chambéry. Ever since then the House of Savoy, now the Royal House of Italy, has guarded it with the greatest honor. In 1578 the then reigning Duke of Savoy had it transferred to Turin, where it is now enshrined in a magnificent chapel adjoining the cathedral.

History, then, does not prove that the Shroud of Turin is the identical cloth in which the Body of Christ was wrapped, though it does show that it has every chance of being that cloth. We do

not depend upon extrinsic sources, however, to decide the question. The Shroud itself, by reason of those remarkable imprints, is a document of the highest value, which the eye of science can read as clearly as if it were a manuscript written and signed by him who caused the imprints.

Before reaching a final conclusion we considered this question: Can the imprints be those of some other person besides Christ? In the end we had to grant that this is impossible. All the conditions necessary to produce the imprints were fulfilled in Christ, and could not have been fulfilled in anyone else.

THE imprints show that the man was scourged, crowned with thorns, crucified, and pierced through the side. From the Gospels we know that all this was done to Christ as the result of exceptional circumstances. It is hardly likely, therefore, that the same series of outrages was inflicted on someone else. The man, moreover, was already dead when his side was pierced, as is shown by the blood and serum which flowed from the wound. The Gospels state that Christ was dead for about an hour when the soldier drove the lance into his side—"and immediately there came forth blood and water." It is still less likely that this occurred in some other case, the more so since it was something unusual in connection with crucifixion.

The manner in which the body was enclosed in the Shroud was also exceptional. It was customary for the ancients to wash and anoint a corpse and to swathe it in linen bands, besides wrapping it in a shroud. In this case the corpse was simply enveloped in the long sheet³, upon which there was a certain amount of powdered aloes; and though the corpse was covered with sweat and blood, it was not washed or otherwise prepared for burial. This is exactly what happened with the Body of Christ. It was laid in the tomb enveloped only in the "clean linen cloth," just as it was when taken down from the cross. With the cloth there was a mixture of spices containing aloes, which were in powder form when used for such a purpose in the ancient Orient. The Body of Christ was treated in this summary fashion because the Sabbath was about to begin, making it necessary to postpone the ritual burial. It is hard to imagine the same combination of circumstances and apparent accidents in any other case.

Finally, the body could not have been enclosed in the Shroud long enough for decomposition to advance beyond the first stage, otherwise the imprints would have been destroyed. The Gospels relate that this condition was

³The Shroud is 3 feet 7 inches wide and 14 feet 3 inches long. It was once longer, for the Emperors of Constantinople distributed as relics pieces cut off from the ends.

fulfilled by Christ, but only because He rose again, about 30 or 35 hours after His Body was laid in the tomb. In any other case someone would have had to remove the Shroud at exactly the right time and after all the other conditions were fulfilled, which seems quite impossible.

If, then, we take all the conditions which were necessary to produce the imprints, it must be granted, I think, that the data of the Shroud, with the Gospels as a key, are a means of identification

BEFORE publication of the accompanying article was undertaken, a survey of some of the sources of information as presented elsewhere was made—sufficient, it was believed, to justify publication. (Rev. Herbert Thurston, opponent of the Shroud, states in the "Catholic Encyclopaedia" that many articles have been published concerning the Shroud. Of books there are: Beecher, "The Holy Shroud;" Barnes, "The Holy Shroud;" Vignon, "The Shroud of Christ;" Hynek, "Science and the Holy Shroud.") However, publication must not be taken to imply that this magazine takes sides with regard to the question of the Shroud.—*The Editor.*

as sure as a photograph or a set of fingerprints. It was Christ who left His imprints on this cloth, with a vivid record of the drama of Calvary, and with His true likeness hidden in the stains till photography revealed it again to the world.

Though the main question is believed to be settled, the Shroud still presents some scientific difficulties. One of these is the fact that the rendering of the face is much more perfect than that of the rest of the body. It is finer, more detailed, more precise—so much so, in fact, that when the scale of values is reversed by photography, this "death-mask" stands out with the harmony and the contrasts of a living face—majestic, forceful, and still retaining an expression of deep sorrow. Why the imprints of the face should have such a superior quality, and how so startling an effect could be produced by such simple means as vapors reacting with aloes, is something which we have not yet been able to explain.

The clots of blood present another difficulty. Many of them had already dried on the surface of the body, and yet they were transferred to the Shroud. I account for this by the fact that the fibrin of coagulated blood dissolves in a humid ammoniac medium, such as surely surrounded the Body of Christ in the tomb. After the dry clots were sufficiently dissolved they were trans-

ferred to the Shroud. I have obtained similar prints of clotted blood on cloth in this way. What puzzles us, however, is the perfection of the clots which were transferred to the Shroud. They are so complete and so minutely exact that they may be called "portraits of blood." Though I carefully supervised my experiments and used small pieces of select cloth, I could obtain only imperfect prints, failing always either by excess or by defect. Here, on the contrary, all the clots, including the serum, are rendered with photographic accuracy.

One may ask, too, how the long sheet of soft linen could have been distended evenly enough to receive all those exact images of the reliquified clots. And why is it that the dry blood did not scale off from the cloth in the course of the centuries? It is still intact, even at those points where it accumulated in some quantity.

The clots which were transferred to the Shroud after being reliquified have the same color as the liquid blood which came upon the Shroud directly. This occurred, for example, where the blood flowed from the wound in the side after the Body was laid in the tomb.⁴ This blood flowed over the side and across the arched loins, falling upon the little transverse creases in the Shroud. From the feet also liquid blood stained the Shroud directly, flowing along the soles toward the heels and onto the Shroud. This flow of blood resulted from the opening of the wounds by the extraction of the great nail, which pierced both feet at once. But the color of all this blood raises a new problem. It is a sort of dull carmine, whereas very old blood becomes brown. Here, then, is another riddle, but not an objection. The more perfect and minute all the stains and particles of blood are, and the more closely we can analyze them, so much the more is it impossible to represent these things in a painting, or to reproduce them by any artificial means.

IHAVE given only a hint of the vast field which the Shroud opens to the investigation of science, archeology, and history. I could give other data on these marvelous imprints, and point out other difficulties still to be solved. There is room for further research along many lines; but though the difficulties may remain, they leave unshaken the important fact that the Shroud bears the imprints of Christ, bringing to us from the distant past the true likeness of Him who so profoundly stirred the world and influenced the course of history.

⁴This was a second flow of blood from the side, and it came from the *vena cava inferior*. The first flow, from the right auricle of the heart, came immediately after the stroke of the lance. It caused the dark stain on the front of the body, having clotted there while the dead body was left hanging on the cross.

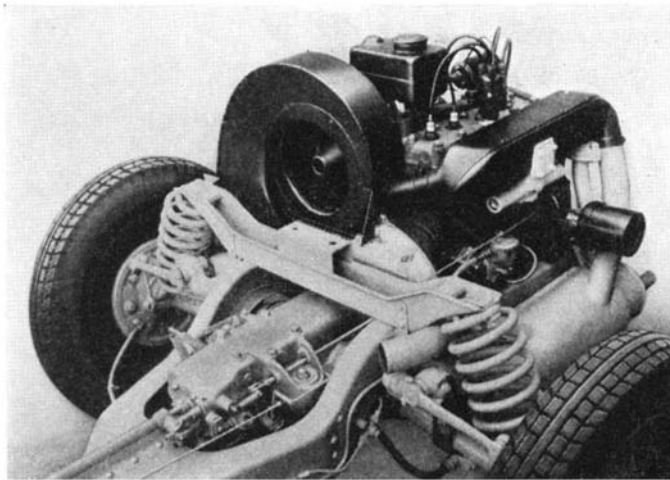
TUBULAR FRAME- REAR ENGINE

All Four Wheels Have Independent Springing . . . Engine, Transmission, and Differential In One Unit

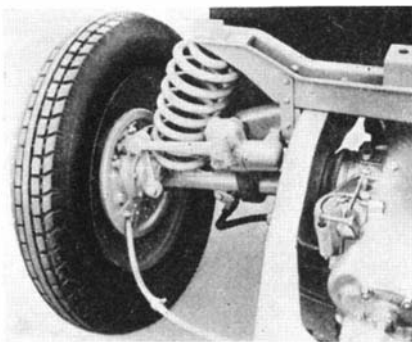
A EUROPEAN motor car now available on the American market has many features that recommend it as a decided advance in the design and construction of automobiles. It has no frame in the generally accepted sense of the word; a tubular member with a fork at rear end and three cross members serves to support the body and engine as well as supply spring anchorages for the wheels. The conventional propeller shaft has been eliminated, drive being direct from the engine through the transmission and differential to the rear wheels. Universal joints in the rear axles make possible independent springing of the rear wheels. A fume-proof and sound-proof partition separates the engine from the body interior.



The smooth curves of the partially streamlined body of the Mercedes-Benz, type 170H, are made possible by placement of the engine in the rear. Under the front hood is the fuel tank, spare tire, and baggage space. Behind the rear seat is additional space for other baggage

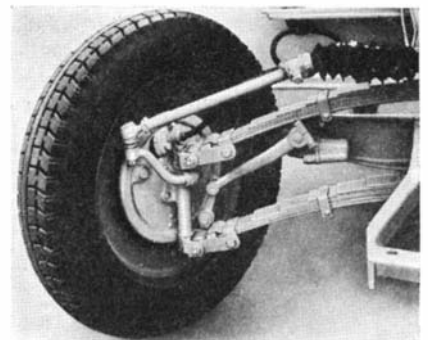


Left: Under the rear hood is the power plant with the four-speed transmission and differential in one unit. The motor is water cooled and develops 38 brake horsepower

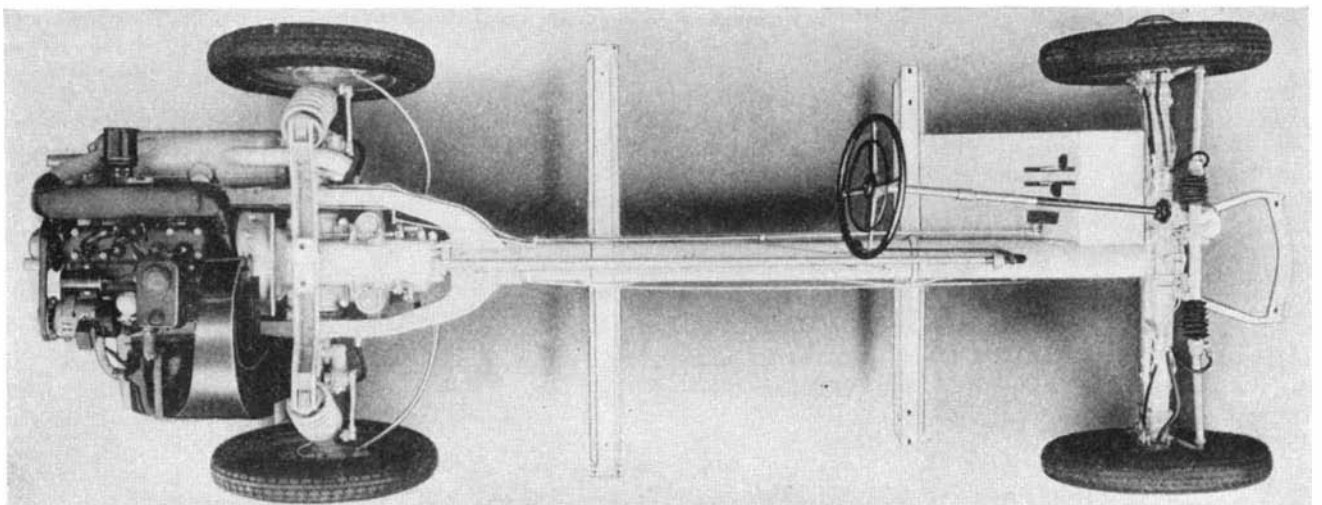


Left: Spiral springs support the independently sprung rear wheels

Right: The front wheels are supported by two sets of flexible leaf springs. Hydraulic brakes are used



Below: A top view of the tubular chassis. All parts of the engine are easily accessible when the rear hood is raised. The radiator and fan are at the right of the engine, looking toward the front end of the car



THE ANALYSIS

Progress is Being Made in the Detection of New Solar Elements by Means of the Spectroscope . . . Osmium, Iridium, Thulium Now Added to the List

By HENRY NORRIS RUSSELL, Ph.D.

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

THE analytical chemist, who seeks in his laboratory to determine the composition of a specimen of rock or mineral, and the astronomer, who attempts with his spectrograph a similar analysis of the atmosphere of the sun or of some distant star, employ very different methods. Nevertheless, their problems, their difficulties, and their successes have a curious resemblance.

Were it not for one great handicap, the astrophysicist would have the best of it. The chemist's first task is to "open up" his mineral—to get it completely into solution without losing any volatile constituent, or missing any small insoluble residue. Only when this is accomplished can he apply his systematic scheme of tests. But nature "opens up" the material of a star completely, by making the star so hot that even the most refractory substances are volatilized, and the atmosphere contains everything that there is to seek. Moreover, the chemist, having obtained his solution, must apply successive tests for the different elements—some of them simple and very precise, others laborious and less sensitive; but when once the spectrum has been photographed, tests for the presence of all elements can be made directly and in the same way. The spectroscopic test, too, is often more delicate than the chemical. Indeed, for some rare elements such as scandium, which exhibit no strikingly distinctive reactions, no satisfactory chemical methods have yet been developed for detecting the presence of small quantities in complex mixtures such as ordinary rocks, while spectroscopic analysis, in the hands of Professor Goldschmidt, has been fully successful.

The handicap, of course, is the opacity of the earth's atmosphere to all the shorter waves of ultra-violet light, which hopelessly obscures the most interesting and important region of the whole spectrum from our view. If there were elements which had no spectral lines at all except in this inaccessible region, the chemist would have a complete ad-

vantage. But—fortunately for astronomy—practically all the elements show some lines in the observable region. Spectroscopic tests are thus possible, but in many cases insensitive. Chemical tests, too, are much less sensitive for some elements than for others; so, at the last, honors are fairly even, with the chemist ahead in some cases.

At this point the writer hears an imaginary chemist remark, "But how about all the cold bodies in space—from the moon outward—for which you can make no spectroscopic tests at all?"—and is moved to reply, "Go and get a piece of the moon yourself, and you'll beat us hollow." In all fairness it may be added that the spectroscopic analysis of meteorites—though possible in several cases, where they have been caught as they flashed across the field of photographs with an objective prism—cannot compare in detail with what the chemist has done with fragments picked up after they have fallen.

The sun is the best of all objects for spectrum analysis, primarily because it is so bright. For once—and only for once—the observer has almost as much light as he wants, and can use instruments of sufficient power to reveal practically all that there is to be found. Instruments of lower resolving power—such as must be used on all but the brightest stars—fail to separate the closer pairs and groups of lines. The great spectrographs which can be used on the sun are powerful enough to reveal the natural width of the lines of the spectrum—which, by the very principles of physics, are not absolutely sharp. Tenfold greater resolving power, though it would give us much desired information about the natural widths of the fainter lines, would not help materially in separating the extremely close pairs that we know often exist. Such lines would remain blended as a result of their own slight diffuseness, however great the instrumental power.

How, then, can we know that such close pairs exist? There are dozens—

probably hundreds—of cases, in which (by pure accident) a line in the spectrum of one metal happens to have very nearly indeed the same wavelength as a quite independent line of another metal. With both metals in the arc at once, the superposed lines could not be separated by the most powerful spectroscope. But the kind aid of the chemist (who is here indispensable to the astronomer) provides us with pure samples of each metal separately, and we can measure the position of each line unaffected by the other. Now (if the line is not lop-sided), the

TABLE I

Hydrogen	Manganese	Barium
Helium	Iron	Lanthanum
Lithium	Cobalt	Cerium
Beryllium	Nickel	Praseodymium
Boron	Copper	Neodymium
Carbon	Zinc	Samarium
Nitrogen	Gallium	Europium
Oxygen	Germanium	Gadolinium
Fluorine	Rubidium	Dysprosium
Sodium	Strontium	Erbium
Magnesium	Yttrium	Thulium
Aluminum	Zirconium	Ytterbium
Silicon	Columbium	Lutecium
Phosphorus	Molybdenum	Hafnium
Sulfur	Ruthenium	Tungsten
Potassium	Rhodium	Osmium
Calcium	Palladium	Iridium
Scandium	Silver	Platinum
Titanium	Cadmium	Lead
Vanadium	Indium	
Chromium	Antimony	

The 61 elements thus far detected in the sun with the spectroscope

position of its center can be measured to within about one percent of its width; and we may thus prove that the lines of the two elements are really not coincident, even though the two, if simultaneously present, would be hopelessly blended.

The first stages of the analysis of the sun were easy enough. So many or such strong lines of iron, calcium, sodium, magnesium, and hydrogen (for example) agree perfectly with solar lines that there was never any question of their presence. But when the analysis was extended to the fainter lines and the less abundant elements, things were by no means as simple. To begin with, in the olden days there was no generally accepted and accurate scale of wavelengths, such as we now use to define the position of the lines. When Rowland made his classic study of the spectrum, 40 years ago, he met the question by a direct frontal attack—photographing the spectra of the sun and of the element under consideration side by side on the same plate. Coincidences—or failures—were then obvious; but care

OF THE SUN

had still to be taken in interpreting them.

If a few of the weaker lines of the laboratory source coincided with solar lines, but the stronger lines did not, it was obvious that the element was really absent from the spectrum, and that the observed agreements were accidental—as is indeed likely to happen now and then among 20,000 solar lines. If, however, the stronger laboratory lines agreed with weak solar lines, the absence of faint lines in the sun was not alarming.

In this way, with infinite pains, Rowland at last arrived at a list of 36 elements which he regarded as definitely present. Forty years of further research has not disproved a single one of these identifications.

Many additional elements have been added since that date. Three elements, helium, lutecium and hafnium, discovered on earth since 1896, have been detected also in the sun. Some familiar elements—nitrogen, oxygen, phosphorus, sulfur—show solar lines in the infra-red, observable on modern plates but not in Rowland's days. Others—boron, fluorine—reveal their presence by band-lines, due to compounds. Three—lithium, rubidium, and indium—show their strongest lines faintly in the spectra of sun-spots. A longer list, mostly of rare elements familiar only to chemists, has been added as the photographs

were measured with sufficient accuracy.

The latest stage of the advance has just been reported to the American Astronomical Society by Miss Charlotte Moore, the recognized authority in this field. Three new elements are added to the list of those whose lines are definitely present in the solar spectrum—raising the number to 61. These all fall into the last of the groups just mentioned. Osmium and iridium are well-known elements, with spectra enormously rich in lines. Recent accurate measures by Dr. Albertson—much more precise than any which previously were available—show that the strongest line of osmium agrees with a faint solar line, not otherwise identified. Four or five other lines which might serve as additional tests are either masked by stronger lines of other elements or blended with similar weak lines. For iridium, the situation is substantially similar. Both elements appear to be present in the sun, but evidently in very small proportions. This is reasonable, as they are among the rarest elements on earth.

Thulium is one of the rare earths, which are notoriously difficult to separate. It is only very recently that reasonably pure compounds of this element have been available for spectroscopic study. With the aid of measures by Dr. Meggers of the Bureau of Standards, and Dr. King of Mt. Wilson, Miss Moore finds that four of the strongest lines ap-

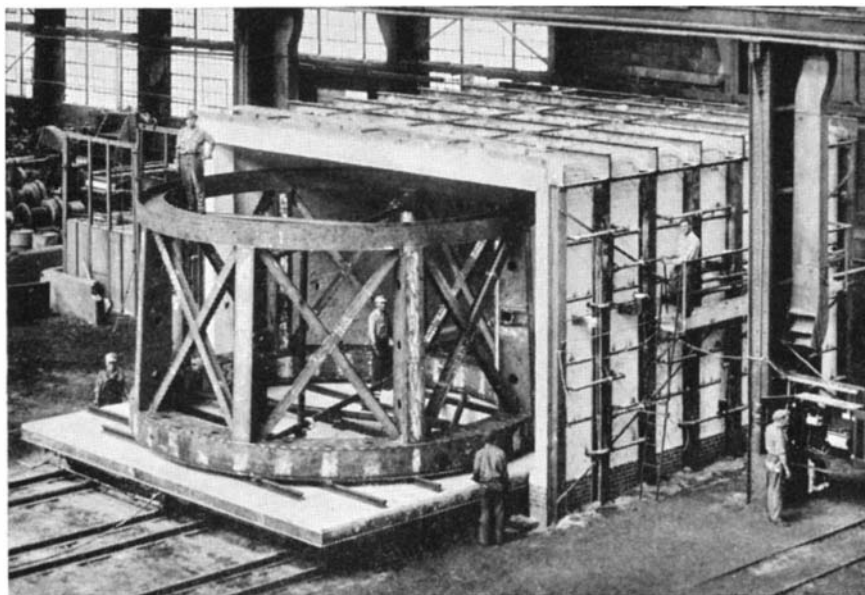
pear weakly in the sun (while seven others are masked by, or blended with, lines due to other atoms). Here the evidence is conclusive. In this case the observed lines are due to the ionized atom (as is that for all the rare earths, which are very easy to ionize).

It is remarkable how large a majority of the lines of these elements are confused with lines of other substances—but hardly typical, as osmium and iridium represent the hard cases—left over after the easy ones have been disposed of—in which the complications are abnormally great. A little more in the way of chance coincidence would have left the problem insoluble, with all the important evidence suppressed.

The list of solar identifications, Table I, is now nearly, but probably not quite, complete. Better measures are still needed for two of the rare earths—terbium and holmium—and in the very rich spectra of thorium and uranium. The most curious case of all is a familiar metal, tin. This has four good lines in the accessible part of the ultra-violet. Two of them are quite drowned out by iron lines. Another may be masked by a strong line of chromium; but the existing measures, which were made more than 20 years ago, are not precise enough to settle this. The fourth line has been recorded faintly in the arc spectrum of iron; but is it by no means easy to get iron quite free from a minute impurity of tin, and it is still uncertain whether the observed line is due to such an impurity, or to the iron itself. We must wait—not long, we hope—until accurate measures are made on the spectrum of pure tin, and also upon exceptionally pure iron, before we know whether or not there is tin in the sun.

There are still 16 elements whose lines have not been found in the solar spectrum—not counting five radio-active elements which could not possibly be present in sufficient amounts to show. For 12 of the 16, the "absence" is to be blamed upon the ozone in the upper air, which cuts off the ultra-violet light. The strong lines of all these elements lie in the inaccessible region and the observable lines are absorbed only by atoms in highly excited states—loaded with energy to an extent which, even at the sun's high temperature, would be found on the average in less than one case in 10,000 (sometimes not once in a million times). Our spectroscopic test is here inadequate. Could we get at the proper part of the spectrum, we would probably find lines of most of the "missing" atoms.

There are three metals, however—rhenium, thallium, and bismuth—whose strongest lines are accessible, and do not appear at all in the sun. These elements, if present in the solar atmosphere, must be excessively rare.—*Princeton, January 5, 1937.*



The structural steel cage for the upper end of the tube of the 200-inch telescope being run into an annealing oven at the big Philadelphia Westinghouse plant. Inside this cage, which rotates, and supported on four knife-edges, will be the prime focus unit chamber, six feet in diameter, housing the secondary mirrors and the astronomer who will "guide" the photographic plate during its exposure

ROCK-FILL DAM

Largest of its Type for the Purpose . . . Built in Six Zones . . . Compacted With Water . . . Huge Trucks Used . . . Gasoline-Operated Tampers



“COMPACT the rock,” is the watchword of workers who are speeding to completion San Gabriel Dam No. 1 in the deeply ravined San Gabriel Canyon, 30 miles northeast from Los Angeles, California. This rock and clay structure will be, when completed, the world’s largest of the type ever undertaken for flood control purposes. Built under supervision of the Los Angeles County Flood Control District at a cost of 12,500,000 dollars, the dam will contain 10,641,000 cubic yards of rock.

Sudden floods of the past have inflicted damage estimated to exceed 160,000,000 dollars to property below the dam-site. Then, too, the region contains many earthquake faults. Therefore, engineers reasoned, a structure relatively safe against both hazards must be provided. The rock-fill dam, replacing a masonry dam started earlier, is their answer.

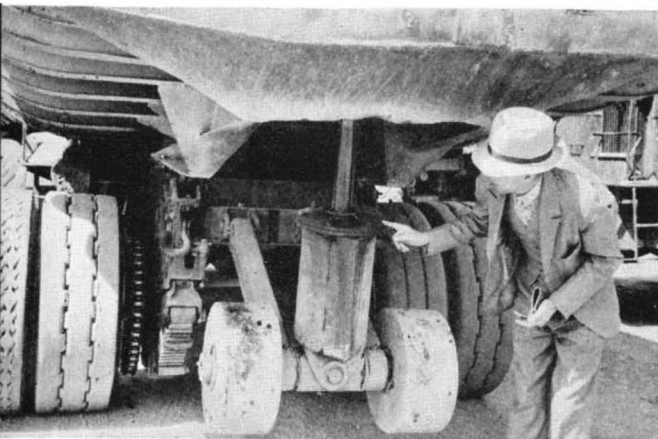
THE dam measures 1950 feet thick at the base (having a three to one slope on both upstream and downstream faces), tapers to a 40-foot width at the crest, is 1540 feet long at the crest, stands an average of 375 feet high above bed-rock, and is being built in six zones.

Zone 1 serves as a dumping ground for the finest material blasted from a nearby quarry. This includes some coarse, good rock. It is covered with clay at the water face. As the rock is put in place, it is “sluice filled”; that is, two cubic yards of water for each cubic yard of rock are applied for the purpose of compacting the rock.

Zone 2 consists largely of sandy loam, which will seal the structure against percolation. It will be protected against wave action by Zone 1, which likewise is sufficiently porous to prevent Zone 2 from drying out.

Zone 3, the core section, consists of compacted quarry material screened to a size no larger than six by nine inches. This zone is rolled and tamped at frequent intervals and water applied to aid in the compaction. In place, the rolled-tamped rock of Zone 3 weighs 150 pounds per cubic foot, or about the weight of concrete. This represents the most novel feature of the dam: rolling

Upper left: As trucks unload rock on the dam, streams of water are played on the surface to help compact the material. Above: Gasoline tamping hammers, fed from a central storage tank, are used for the final tamping of parts of the dam. Left: Dumping mechanism on the rear end of one of the huge trucks used for carrying materials. Hydraulically operated, it prevents the shifting load from lifting the front wheels. Below: Looking downstream at the dam-site; quarry for rock used in dam is at upper center



FOR FLOOD CONTROL

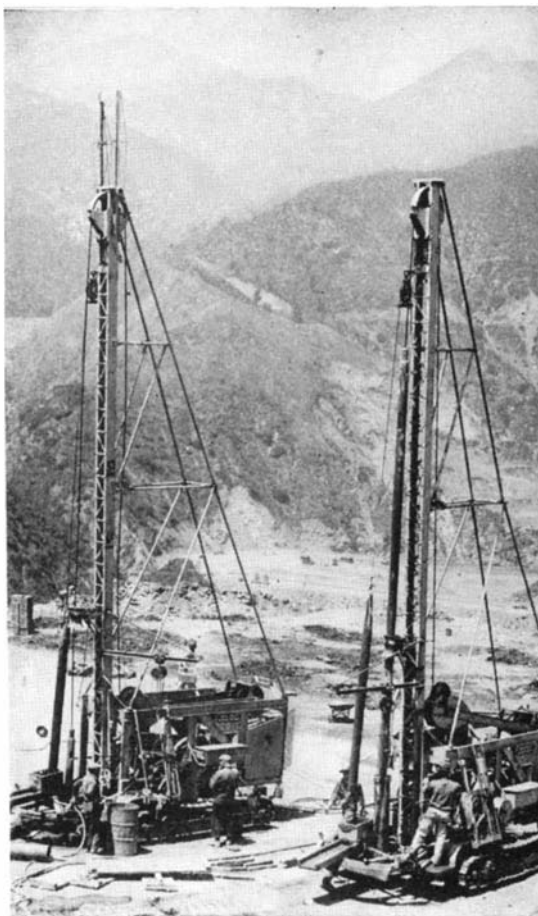
By ANDREW R. BOONE

rock to secure compactness. Dual sheepsfoot rollers are employed. They were designed especially for the job. The rollers are placed in parallel in a metal frame and hauled by tractors. Through their use the rock is compacted to about two thirds its freshly-dumped volume. After rolling and tamping—the latter accomplished by hammers powered by tiny gasoline engines fed from a central fuel supply and fired by portable electric batteries—the rock of Zone 3 shows a very high shearing strength, as well as very low permeability.

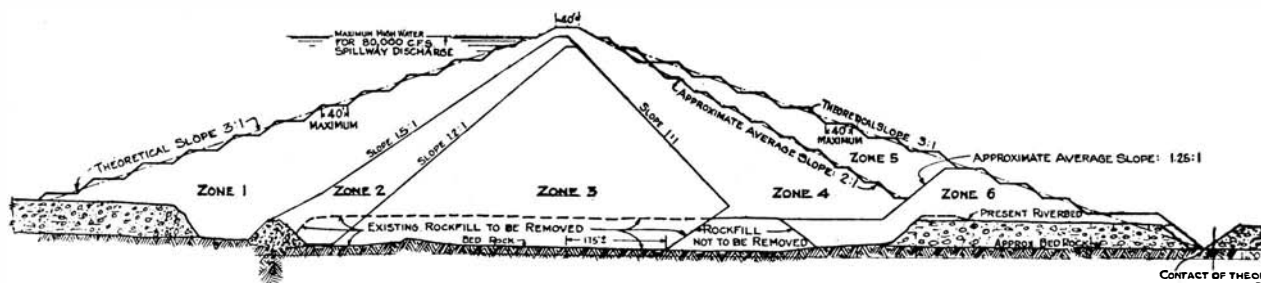
Zones 4, 5, and 6 consist of sluiced rock fill. Rock in these zones is so graded that the zones become progressively porous toward the downstream face. Zone 4 contains quarried material of all

by six blast-hole rigs capable of sinking eight-inch holes to a depth of 60 feet. Trucks, largest ever built for construction work, carry 25 cubic yards of material. So heavy are the loads that a semi-retractable dumping mechanism is provided. This consists of two steel rollers attached to the rear under-portion of the trucks by means of a hydraulic jack. Trucks are dumped by lowering the jacks slowly.

The dam will have a capacity of 60,000 acre-feet at the spillway level; 70,000 acre-feet at the crest. The spillway will cut through rock at the canyon's edge, will be capable of handling 80,000 second-feet with a residual free-board of 15 feet, equivalent to 250,000 second-feet before overflowing the dam proper.



Two of the drills that sink eight-inch holes 60 feet deep, which are then packed with dynamite in order to blast away benches of rock



Cross-section drawing of the finished dam, showing the relative masses of the six zones which will constitute the completed structure, and which are detailed in the text

Below: A view taken from the downstream side of the dam-site during an early stage of construction, giving an excellent idea of the magnitude of the project. Note 30-foot diversion tunnel at right

sizes; Zone 5, rejects from the grizzly, mostly rocks of one half cubic yard or larger; Zone 6, high strength rock of the best available quality, which forms the base for the sluiced zones.

The structure is made water-tight by a combination of Zones 2 and 3 with a concrete cutoff wall skirting the upstream side of Zone 2 which extends into bedrock to a maximum depth of 80 feet. Crevices are grouted to a maximum depth of 150 feet, thus shutting out the water from those sources. Faults of whatever nature are separately treated to a depth equalling one half the static head of water on top of bedrock at those locations, or to a maximum depth approximating 100 feet. Further, Gunite six inches thick is applied under Zone 2 along its contact line with the abutments.

NEARLY all operations at the dam-site are electrically powered. Shovels are full-revolving, Caterpillar mounted, and equipped with four-yard buckets. Benches are drilled for shooting



A Photographic Laboratory "Tool" With Which You Can

ENLARGE—PRINT—RETOUCH

ALMOST every photographic enthusiast is familiar with the usual projection enlarger of the vertical type, in which the negative is held in a carrier some distance from the bromide paper on the easel below. With a suitable illuminant and lens system, the image is projected downward on the paper.

The apparatus described below (while distinctly home constructed) differs in comparison with the vertical enlarger of the usual type, in that the negative is illuminated from below, the projection being *upward* on a focusing screen. No originality is claimed by the author, as this is indeed a home-made copy of an enlarger* that is made commercially in more perfect form. As the photographs and illustrations herewith will prove, the construction is almost identical with the factory-made product.

In addition to its virtues as an enlarger, the instrument also functions, without change, as a photographic printer for contact prints and as a retouching desk for working on negatives or examining transparencies such as "trans-lite" prints on paper or film.

To describe the construction in infinite detail would result in an article of considerable length, so actual photos of the apparatus were made during the process of construction to enable the reader to duplicate the machine quite easily.

The complete apparatus (Figure 1)

*The Graflex Enlarg-or-Printer, manufactured by the Folmer Graflex Corp., Rochester, New York.—*Editor*.

A Commercial Unit Made at Home . . . Materials Easily Obtainable . . . Uses Photoflood Bulbs for Light Source . . . High-Speed Enlarging

By **HERBERT E. HAYDEN**

Photographs by the author



Figure 1: The finished unit ready for use as an efficient enlarger

front to back. It is provided with a tilting glass table top made in the style of an ordinary contact printing frame, in which the bromide paper will be placed face down.

Half of the lower section is taken up by the lamp house (Figures 2 and 3) which measures 10 inches high and is made of two pieces of maple $\frac{1}{4}$ inch thick. Four holes, $1\frac{1}{4}$ inches in diameter and $6\frac{5}{8}$ inches from the base, are for ventilation. Later in the construction, the wooden boards are backed up inside with sheet asbestos, and painted with aluminum paint.

The top of this boxlike arrangement has a platform made of $\frac{1}{4}$ -inch thick hard asbestos sheet, over which an 18-gage steel plate is firmly affixed, using brass angles. A four by five inch opening is cut through this, centered, and forms the light aperture over which the negative holder will slide. Two pieces of one inch channel brass are secured to the sides and form a hold-down for the projection head platform which will be attached later. (Figure 6.)

An underside view of this lamphouse section is shown in Figure 3, with the

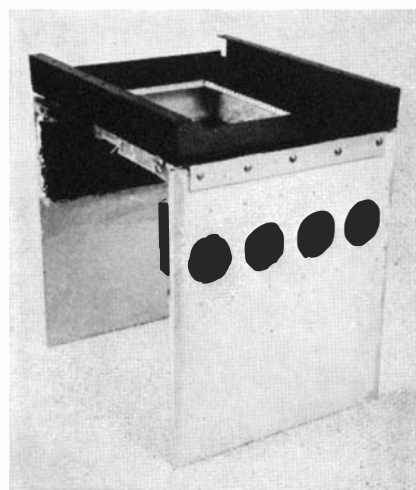


Figure 2: Lamp house under construction. Holes are for ventilation

may be considered as being made up of separate units, as follows: 1. The telescoping case, 2. The enlarging head, 3. The focusing panel top with platen, 4. The lamp house and electrical system.

The telescoping case is made in two sections, the lower section containing the lamp house, negative holder, and enlarging head proper. It measures $8\frac{1}{2}$ inches wide and 10 inches from front to back. The height is 20 inches, with a cut-out "V" section on the left side $3\frac{1}{2}$ inches from the top for convenience in changing lenses.

The top section of the case which telescopes down on the lower one, and thus decreases or increases the projection range or size of enlargement, measures $8\frac{5}{8}$ inches wide and $10\frac{1}{2}$ from

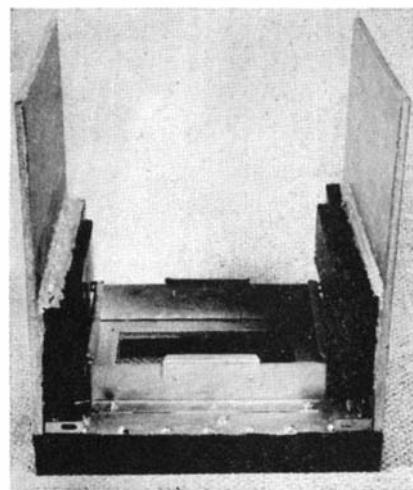


Figure 3: The lamp house inverted, showing light traps painted black

ventilating light traps, of bent up aluminum painted dead black, installed with small nails along the edge. Around the center cut-out section, and 1¼ inches from the lower surface, a frame of thin aluminum is bent up as shown to hold a standard piece of five by seven inch opal glass for diffusing purposes. This frame is purposely made large enough so that the glass is free to "jiggle" in its housing as it will expand when heated and certainly crack if it is clamped in tightly.

A second 18-gage steel plate with an opening four by five inches and matching the one just described is fitted with the bellows taken from an old camera, and with a front standard to hold removable lens boards. (Figure 4.) The L-shaped construction of this unit makes it easy to affix two ¼-inch steel rods, seven inches long, with sliding bearings for the lens standard, so that upward or downward movement is smooth and steady. This movement is made possible by means of a standard ¼ x 20 threaded nut soldered to the front of the lens standard, through which a seven-inch piece of ¼ x 20 threaded steel rod is passed and held at its upper and lower ends in suitable bearing sockets, free to rotate.

Every complete turn of this rod moves the lens up or down in a vertical line exactly 1/20 of an inch, making extremely fine focusing possible. Moreover, it is not necessary to lock the lens standard in any position as it will not budge until the rod is deliberately revolved. Motion of the lens standard is accomplished by fitting a pair of mitre

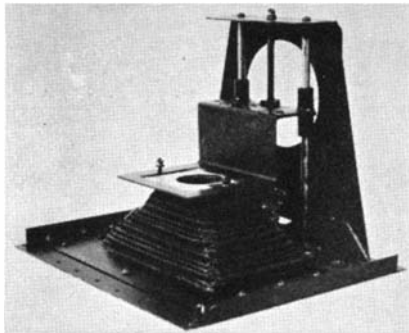


Figure 4: Projection head to be mounted on top of the lamp house

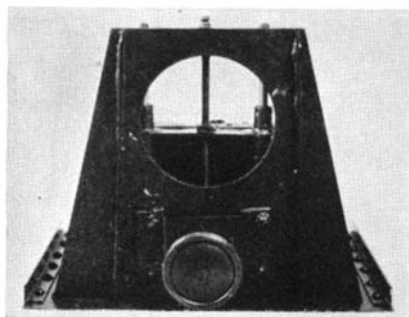


Figure 5: Control side of projection head: adjusting knob in place

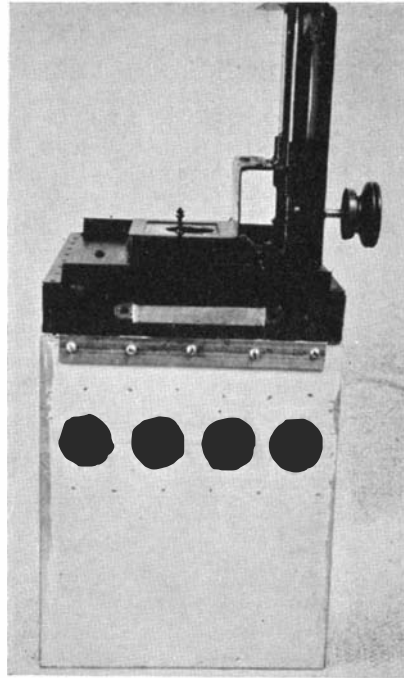


Figure 6: The lamp house and projection head completely assembled

gears, 1:1 ratio—¼-inch centers, one of which is fastened to the threaded rod at the base. The other is fitted on a 1½-inch length of ¼-inch rod, which passes through a hole in the vertical section and extends out horizontally through the case on the right hand side. When the knob that is fitted on the other end of this short shaft (Figure 5) is turned by hand, the lens board rises or falls vertically—and stays put.

Small pieces of sheet aluminum are used as lens boards, two holes at the outer edges slipping over 6/32 studs on the lens standard, and are held in place with thumb nuts. Lenses of two- and three-inch focus are used. These may be standard camera lenses, or lenses made especially for enlarging, such as the "Kino-Hypar" or the Schneider "Comonar."

The next step in construction is to build up the side pieces of the lower section. These are cut out of 18-gage black crackle-finished steel, obtainable in large sheets at most radio supply stores. These side pieces are attached to the wooden sides of the lamp housing with one-inch #4 flat-head wood screws. The large hole (Figure 7) is four inches in diameter; the slots permit insertion and removal of the opal diffusing glass. When the apparatus is in use, this hole is kept closed and light tight by the circular twist-on cover. The cover is provided with suitable handle of simple design.

The base of the instrument (Figure 8) is constructed of the steel sheet mentioned above and is provided with upright angles over which the

lower section of the enlarger is slipped and screwed fast with #6 Parker-Kalon screws. The elevated platform containing the three lamp sockets is made of 18-gage sheet aluminum, frosted finish. The two lamps installed in the exact center are Photofloods, the one slightly to the rear, a 25-watt red bulb. The small metal panel (Figure 8) is the switchboard of the outfit, the master switch turning on and off all lamps, the switch to the right turning on both Photofloods in parallel when in the "bright" position, or both lamps in series when in the "dim" position. (See Figure 10.) The switch at the left turns on the Photofloods whether the setting is at dim

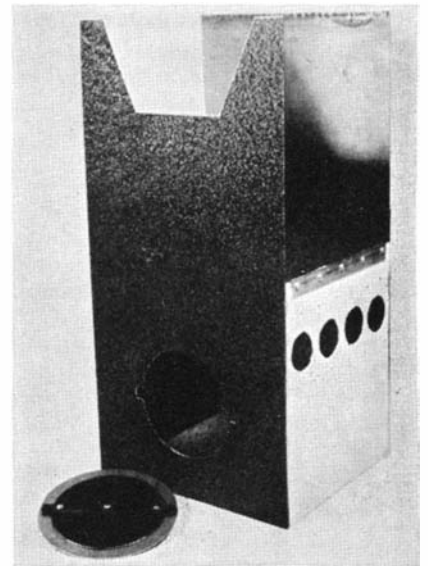


Figure 7: Lower section of the case assembled around the lamp house

or bright, and is used only for focusing and composition of the enlargement. Cross connected to this switch, however, is a second one on the top of the platen. This is so arranged that when the platen descends and holds the bromide paper against the glass, the Photofloods which make the exposure are turned on; upon release of the handle, these lights are extinguished. The red light remains "on" at all times and it is turned off only by the master switch. This safe light is used for placing the paper properly with regard to the sliding marginal masks, or for setting the negative properly when the machine is

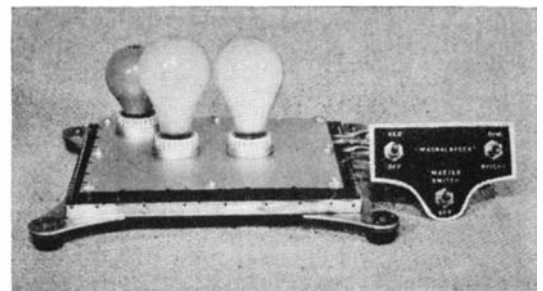


Figure 8: Base of the unit, with lamps mounted. Control switches are on panel at right

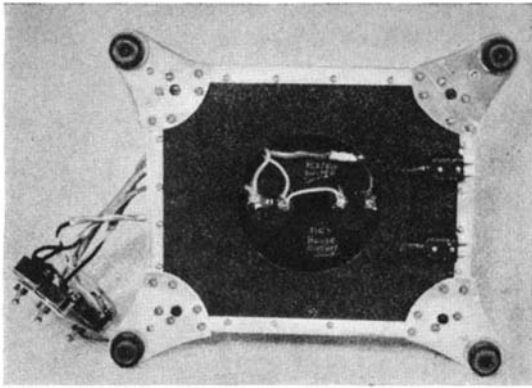


Figure 9: Bottom view of base, with split connectors at right. Hole is for ventilation

being used for regular contact printing.

The switches used are of the "toggle type"—a double-pole double-throw for the "dim-bright" connection and single-pole single-throw for the others. The one installed under the handle on the platen is a "trigger type" as used in electric hand drills and is fitted with a spring so that it must be held down manually in its "on" position, but instantly springs open when released. Commercially it is known as a "momentary control" switch and is obtainable at electric or radio supply shops.

Using two sources of light as an illuminant in an enlarger is looked upon by many authorities as rather poor design, since, it is argued, no two bulbs can be expected to give the same brilliancy; indeed, a light meter would probably prove this contention. It is

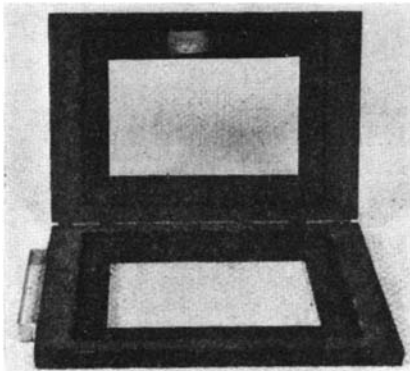


Figure 11: Negative holder with cut-out sections and flat spring fingers

also quite true, however, that opal and other diffusing glasses are not equally translucent at all points, so that a variation in this sense could be expected with a single illuminant under any conditions.

In any event, the results seem perfect enough with the two lamps, but, if desired, one Photoflood may be used, centered under the negative opening, and the dimmer provided through an external resistance, put into the circuit by a suitable switch, as it is in the commercial machine of which this is a copy.

The extra lamp will be welcome, however, if very dense negatives are encountered, or if the slower enlarging

papers are used, as well as when giant enlargements are made by projecting onto the wall.

A five-inch hole in the sheet-steel base (Figure 9) is for the purpose of ventilation. The wiring is brought out to the male side of the split connectors for further electrical connection, and to avoid trailing wires. All wires in the circuit are covered outside with a close knit wire protective covering, known in radio parlance as shielded

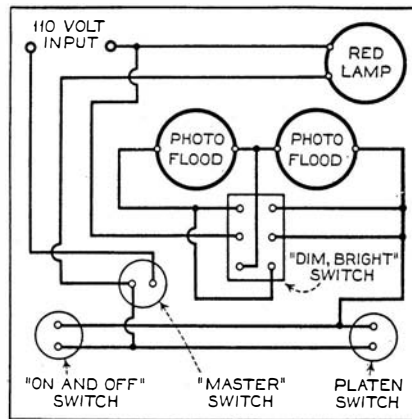


Figure 10: Wiring diagram of all the lights and switches in the unit

cable. The platen connector plugs into the line leading up the rear of the machine to the platen switch; the other connector is for plugging in the house circuit in the manner of plugging in any household electrical appliance. The extended feet of the base have soft rubber tips to keep the machine absolutely steady and prevent sliding on a polished floor.

The negative holder (Figure 11) is of the "book type," six inches wide and nine inches long. Each half is $\frac{1}{2}$ inch thick. The opening is four by five inches,

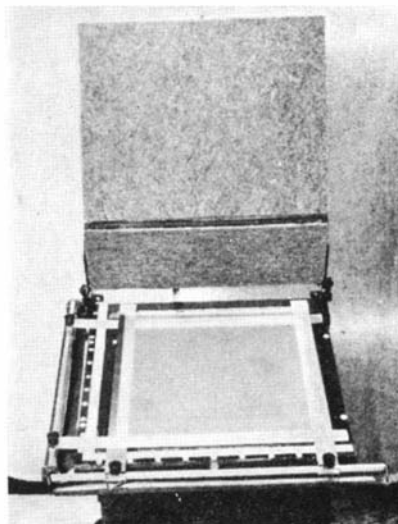


Figure 12: Top of completed unit, with focusing celluloid in position

and the recessed portion of the holder accepts two sheets of standard 5 by 7 glass including suitable masks. The upper half of the holder is provided with two spring fingers made of phosphor bronze which, when the holder is closed, keep an even pressure on the negative. Metal masks are used for certain negatives, and, if desired, a slot may be cut at each end of the holder, providing an easy pull-through path for Retina or Contax size negatives made on movie film.

The openings in both the lamp house and negative carrier are large enough to hold negatives from 35mm to five by seven inches, but the actual field from any negative to be enlarged is restricted to $2\frac{1}{4}$ by $3\frac{1}{4}$ inches or that portion of any negative up to five by seven. The holder automatically centers itself when slid into the opening provided, due to the guide rails placed on the side and at the rear.

The top section of the case is also made of crackle-finish steel sheet as shown. It is held in the desired position by a large bolt passed through the lower

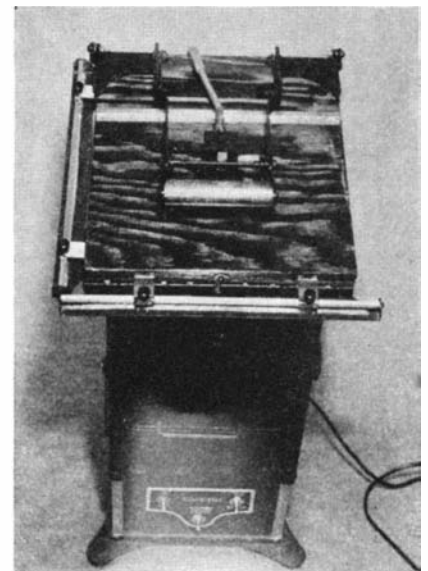


Figure 13: Platen closed. The platen switch is in box back of handle

part of the case and running in the slot in the extension piece soldered to the top section. (Figure 17.) A door in one side permits changing of lenses. (Figure 18.)

The tilting top is constructed by making a frame of suitable size to fit the top section of the case, and is supported on pivots front and back, so as to tilt from left to right. A hold-down metal strap keeps it in any wanted position by tightening the $\frac{1}{4}$ by 20 bolt which holds the strap to the case. The tilting top permits correction or distortion of perspective in the negative.

The sliding masking frame (to produce even, white margins) is made from old time radio tuning coil sliders, obtainable at most radio supply stores, and

1/4-inch square brass rods over which these sliders travel. The contact shoe of the slider (in its original sense) is used as a tension spring and rides along on a frame made of 18-gage aluminum. Soldered to these sliders are lengths of thin brass ribbon which form the masking blades. (Figure 12.) The graduated scale over which they travel is also a radio product of older days, being made up from four celluloid scales formerly used on drum type tuning dials. These are cut apart and matched so as to give divisions in inches, half inches, and sixteenths. The large numbers are also cut

turned on by the closing platen switch. At the rear, the platen is so hinged that it can be swung back and out of the way, allowing the use of an extension top which makes possible 11 by 14 inch enlargements. This is done by providing four posts, eight inches long, which screw into the frame of the 8 by ten inch platen already described, and a second bromide paper holder is thus available. (Figures 15 and 16.) In this case, the platen switch may be dispensed with, and the exposure light turned on with the toggle switch.

Focusing is accomplished by projecting the negative upward on a fine-grained sheet of celluloid, obtainable at most photographic supply houses. This is to be preferred to ground glass as it is unbreakable.

To make an enlargement, the negative is placed in the holder *face up*, using one of the masks to exclude all ex-

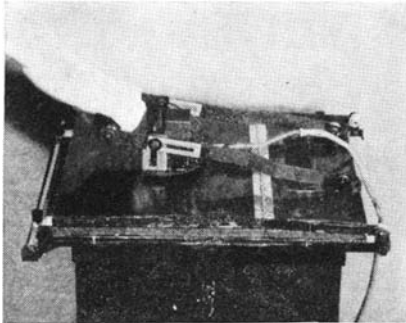


Figure 14: Operation of handle closes platen and turns on the lights

from the same drum dials, and are sunk into the wood surface.

For purposes of masking, the distances are measured using the center of the platen as zero or starting point, and the blades are pulled away from this point, thus masking off the bromide paper up to the limits of the platen.

The platen (Figures 12, 13, and 14) is constructed of half-inch wood on the style of a printing frame back, with a hinge extending all the way across. Fastened to this platen, on its under-side, is a soft 1/4-inch thick felt pad which comes directly in contact with the bromide paper, forcing the sensitive side flat against the clear glass.

The long handle of the platen has #14 piano wire springs at four points. These are of a design resembling an open safety pin. Pressure on the handle causes these springs to hold the paper tight before the two Photoflood bulbs are



Figure 17: Focusing knob and the lock knob for upper sliding case

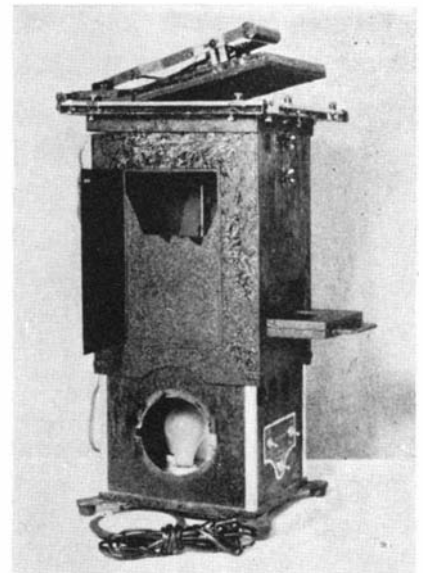


Figure 18: Completed unit, showing the two openings on the left side

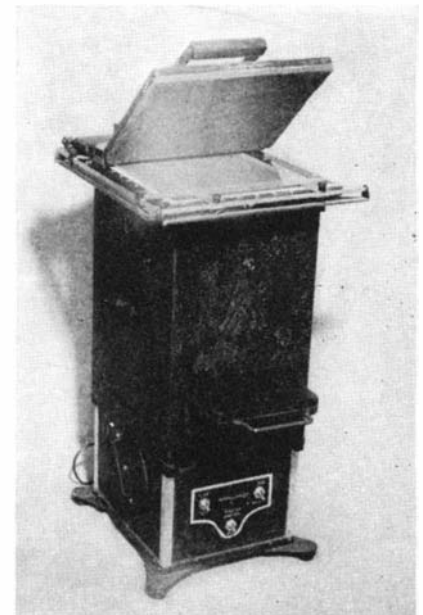


Figure 19: Front of the unit ready for use. Note the negative holder

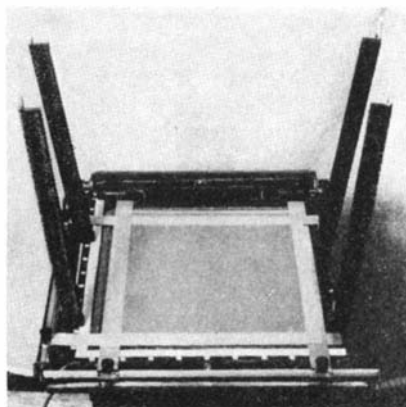


Figure 15: Extension arms fitted to provide for greater enlargement

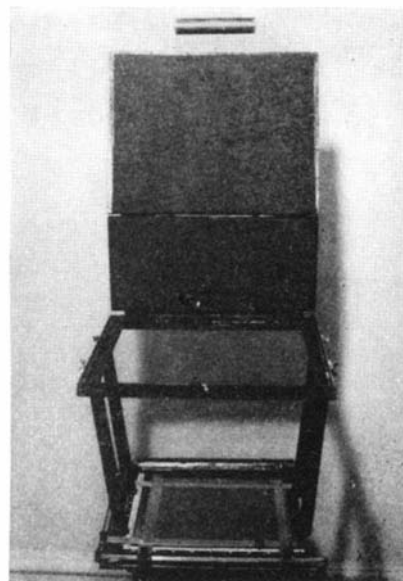


Figure 16: Frame for 11 by 14 paper fitted to the extension arms

traneous light. Focusing is then carefully done on the celluloid sheet. This sheet is then removed, the white lights turned off in the machine, a sheet of bromide paper is inserted *face down*, and the platen brought down. The speed of the machine is so great that the operation is almost like contact printing.

To use the machine for contact printing, remove the lens and board completely and lower the top section of the black case down toward the floor as far as it will go. Then proceed in the usual manner, treating the apparatus as an ordinary printing box.

As a retouching desk, use the glass surface of the platen, with the two Photofloods in series as the illuminant; or they may be replaced with two ordinary 60-watt bulbs, in this case leaving the switch on "bright."



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN

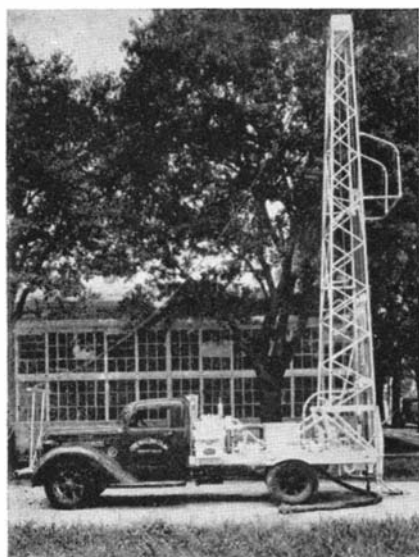
In charge, Daniel Guggenheim School of Aeronautics, New York University

D. H. KILLEFFER

Chemical Engineer

DRILLING RIGS ON TRUCK CHASSIS

AVOIDING the delays and sometimes prohibitive costs of moving in and setting up a steam drilling rig, an ingenious, efficient, and thoroughly portable motorized drilling rig consists of a standard 1½-2 ton,



New drilling rig ready for use

Diamond T truck chassis and cab, with a derrick, rotary table, draw works, and mud pump.

Twenty-four of these portable drilling units, developed and built by the W-K-M Company, Inc., of Houston, Texas, are in active service of the Core Drilling Company, an associate enterprise, operating throughout the coastal plains region of Texas and Louisiana.

The rigs are capable of drilling a hole 1000 feet deep, and through the use of auxiliary equipment, winches, and leverages, are able to traverse almost inaccessible terrain—rough country without roads and with steep hills. As a matter of record, the trucks rarely use an improved highway. Some of the trucks are equipped with separate engines, although for the most part, power for operation of drill and mud pump is taken from the truck's own power plant using a split-shaft power take-off to provide drive for both drill and mud pump. Many of these

trucks have drilled as much as 100,000 feet in addition to providing their own motive power, without any repairs whatever to the engine.

This portable drilling unit is suitable for all drilling activities, and has an extremely wide range of applications. Predominant, of course, is its use in exploratory drillings to depths of from 80 to 100 feet, a type of work essential to petroleum production, water search, and preliminary studies preparatory to beginning construction of bridges and building foundations.

In exploration of suspected oil-bearing territory, the drill truck is followed closely by a geographical prospecting crew, which does the "shooting," the results of which, recorded upon delicate seismographic instruments, indicate whether or not oil is likely to be found and, if so, at what depth.

In operation, the unit is driven to the chosen site and parked. Using the truck's engine for power, the mast or derrick is raised, the drill stem quickly adjusted and the engine's power shifted to turn the drill, while at the same time the mud pump circulates the fluid to wash the cuttings from the hole as drilling progresses. For coring

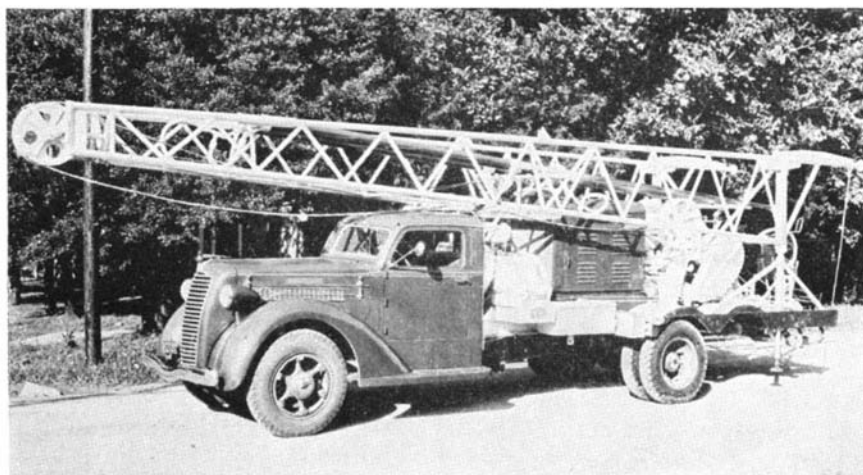
work, a larger unit and, of course, a truck of longer frame are required, as these core holes are drilled to depths of from 100 feet down to 2000 feet.

ICE BUG

MOST insects are sluggish in cold or even cool weather, but not the *Grylloblatta campodeiformis*. This rare insect, commonly called the "ice bug," is happiest when it is near freezing, prefers a temperature of 38 degrees Fahrenheit, and suffers heat prostration at 80 degrees.

SYNTHETIC SCARES

FREQUENT announcements from abroad of new synthetic products have continually caused momentary stirs in the lay mind, says *Industrial and Engineering Chemistry*, pointing out the disproportionate attention given such announcements. The statement continues: "Word, for example, that a chocolate bar which looks like soap but tastes like chocolate has been synthesized in Germany from coal-tar raw materials and actually marketed, appears at first to indicate that our foreign brethren still lead us in cleverness. However, when this and similar announcements are checked and their significance is evaluated, the impression is



The drilling rig "folded" for transportation

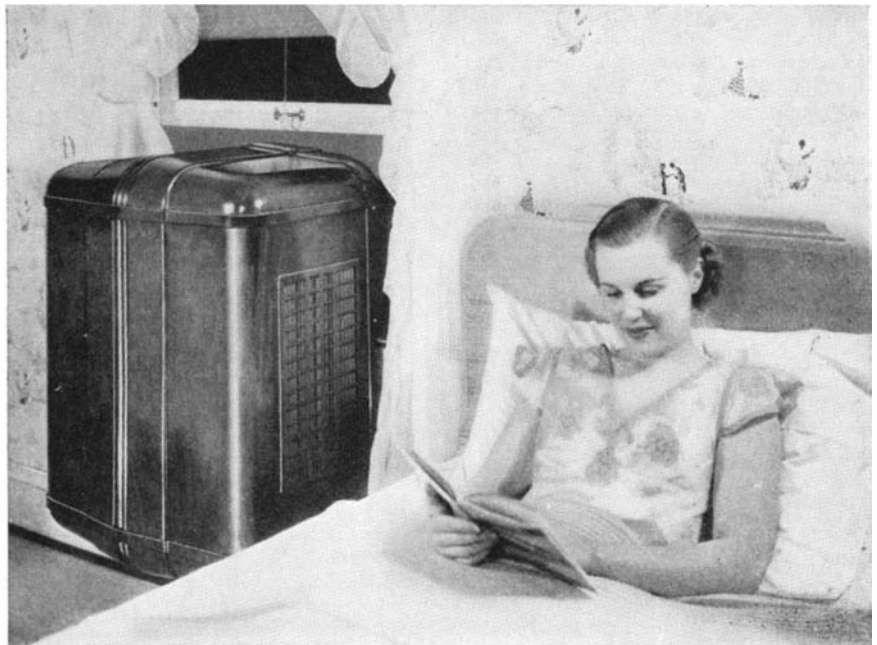
largely nullified. Similar agitation has been caused from time to time by reports of new synthetic rubber-like materials abroad, which often turn out to be more interesting than important; in this field particularly the United States, with at least two such synthetic materials in large-scale production and use, definitely leads the world. It is, however, difficult, if not impossible, under our economic system, to combat the false impression which such offhand announcements from abroad create in the public mind. Laymen generally are not in a position as chemists most frequently are to answer such announcements by the query, "What of it?" More and more the real advances of industry based on scientific discovery in the United States are becoming everyday articles of commerce which the man in the street fails to recognize as synthetic. Yet the huge tonnages of synthetic products used in this country are daily increasing and their variety is widening at a rate far greater than can be equaled in any other country of the world."—D. H. K.

WHALES

DURING his period of most rapid growth the finner whale, which is the one most hunted for oil nowadays, increases in size every day by the equivalent of a big man's weight.

PLOWING WIRES INTO THE GROUND

PLOWING telephone wire into the ground as a new and effective method of constructing storm-proof rural lines has been recently demonstrated in certain sections of New York State. Insulated and protected by a special rubber coating, the wires are buried about a foot and a half underground along the shoulders of roads. They are thus protected against snow, sleet and wind storms, lightning, fires, and other hazards which may trouble overhead lines.



New room-size air conditioner that plugs into a light circuit

By the new method the telephone lines of 17-gage copper wire coated with tough rubber are planted by a special wire sub-soil plow mounted on a two-wheel chassis, drawn by a tractor or a truck. From reels attached to the plow, the wire is fed directly to the bottom of the trench dug by the plow. The trench, being narrow, fills up easily and without marring the highway or the subscribers' grounds.

Under favorable conditions as much as four miles of line can be buried in a day. Over irregular terrain the progress is much slower. A crew of linemen and other telephone plant men is needed to operate the plow and do special splicing and construction work.

For many years the Bell System has steadily improved the service by placing its telephone circuits underground. But in nearly all cases, these placements have been made in cables which carry a number of

circuits. In fact, more than 80 percent of the wire mileage of the New York Telephone Company in this state is thus buried in cables, while all but about 1 percent of the remainder is in cables overhead. Consequently the new method of burying an actual pair or two of wires along rural routes, where only one or two circuits may run for a considerable distance of poles, tends still further to cut down the remaining bit of open wire left along the voice highways.—*Telephone News Bulletin.*

NEW AIR CONDITIONER BECOMES PLUG-IN APPLIANCE

INTRODUCTION of a new window-mounted room cooler by Westinghouse that embodies ease and quickness of installation and inexpensive operation costs was reported by S. F. Myers, Manager of Air Conditioning Sales. Myers continued with the explanation that the new Westinghouse cooler could actually be installed in less than 25 minutes, thereby eliminating one of the principal objections to the purchase of room coolers.

This new summer air conditioner for bedrooms, dining rooms, medium size offices, hotel and living rooms, has been so perfected that preliminary construction work to install it has been completely eliminated. Installation is very simple; it is only necessary to open the window of the room about half way, rest the unit on the sill, place the cabinet in position, plug the cord into the nearest wall socket, and the cooler is ready for operation. The cooling and dehumidification which takes place during operation of the unit is equivalent to the heat absorption obtained by the melting of approximately one-half ton of ice every day.

All of the air passes through an air filter before passing over the cooling coils, and with a portion of the "stale room air" always being expelled from the room into the atmosphere outside the window, cool, fresh, dehumidified air is always assured.

Other features of the new Westinghouse cooler are: an hermetically-sealed unit;



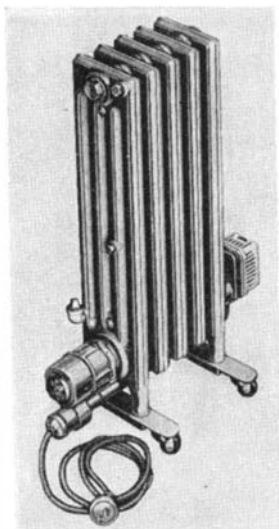
Courtesy Telephone News Bulletin

Sub-soil plow, drawn by a tractor, buries telephone wires

built-in "watchman" to guard motor against overheating; a compressor and motor cooled by refrigerant lines around the shell; a powerful oil pump that insures adequate and continuous lubrication; air filters to insure clean air; ventilating damper that permits exhaustion of foul air from the room; and a means of insulation that deadens noise, making for a more quiet operation. It is remarkably silent.

HEAT ON WHEELS

FOR all those odd little corners lacking heat but where warmth is still very necessary, a new portable electric steam radiator has been placed on the market. As our illustration shows, it resembles the ordinary



Heat where you want it

radiator, used commonly in the home, with the addition of an attachment cord and electrical heating element. It is on casters and is light in weight for moving up and down stairs. It is recommended for such difficult-to-heat spots as booths for police, ticket sellers, cashiers; for sun porches; and for camps.

The heater comes filled with the right amount of water containing a non-freezing fluid. It has a thermostat dial marked for a temperature range of from 55 to 80 degrees, while, for special purposes a temperature range for as low as 35 degrees can be furnished. After it is plugged in, its operation is automatic. The current quickly converts the water into steam, heating the room by both radiant and convected heat. In addition to the thermostat control of heating, there is an automatic current shut-off which prevents trouble should high steam pressure be developed in the radiator.

This radiator, which is made by the Burden Industrial Appliance Corporation, is simple to operate, uses current only about 75 percent of the time, and, for the amount of heat furnished, uses relatively little power. It is built for use solely on alternating current systems.

STEAMOTIVE—PACKAGED POWER

THE design and testing of a new type of steam-generating unit of good efficiency, relatively light in weight and requiring minimum of space, was described jointly by the General Electric, Babcock &

Wilcox, and Bailey Meter companies at a recent meeting of the American Society of Mechanical Engineers.

The new type of steam-generating equipment has been named the Steamotive. In it, steam is generated at high pressure and temperature; fully automatic control in response to changes in demand has been incorporated. The units are intended for capacities of from 2000 to 10,000 horsepower.

Two such units have already been built. The first, now in service in the Lynn, Massachusetts, works of the General Electric Company, is used to test marine and other small turbines. It has an output of 21,000 pounds of steam per hour at a pressure of 1500 pounds.

Another, a completely co-ordinated power-generating plant incorporating the Steamotive and turbine-generator, with a capacity of 10,000 pounds per hour and furnishing steam to a turbine at 1200 pounds per square inch and 950 degrees, Fahrenheit, is being installed in a small, isolated plant of a large industrial concern to supply electric power and low-pressure steam for building heating. Both are oil-fired.

Two oil-fired Steamotive units, each with a capacity of 40,000 pounds per hour, are now being constructed for the Union Pacific Railroad for driving two 2500-horsepower electric locomotives, it was announced at the meeting. These units will furnish steam to the turbines at 1500 pounds per square inch and 950 degrees, Fahrenheit.

Indicating the compactness of the Steamotive unit, the one for Lynn was shipped complete from Schenectady on a railroad flatcar.

Objectives sought in the design of the new equipment were pointed out as high steam pressure and temperature, minimum weight and size per unit of steam produced, wide range of capacity with ability of the unit to respond quickly to wide variations in load conditions, adaptability to a wide range of fuels, completely co-ordinated

auxiliaries, completely co-ordinated automatic control, and units of simple design and constructed in sizes small enough to be portable.

In the operation of the Steamotive unit, the flame and gases pass from the burner through the completely water-cooled furnace, thence into the superheater, flowing around the separator, through the economizer and air heater, and up the stack. The air for combustion leaves the blower at relatively high pressure, passing through lanes intersecting the stack, and down around the air-heater tubes to the oil burner. There is no induced draft fan, the blower forcing the air through the burner and furnace under pressure.

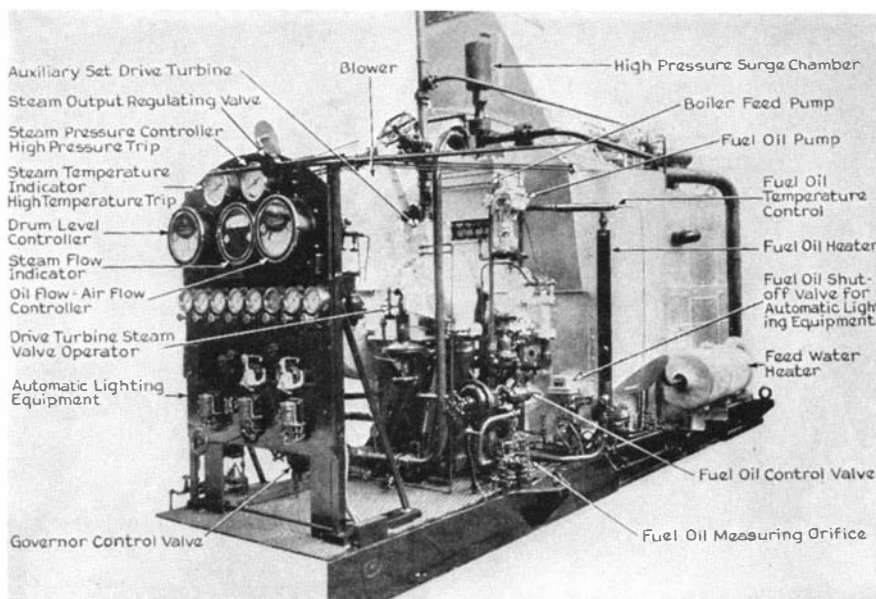
The feed-water enters the economizer inlet header, and, after leaving the outlet header, is divided into several circuits, all of which form the floor, sides, and roof of the furnace, as well as the sets of loops forming the boiler screen. All the steam is generated in these furnace and boiler circuits, and enters the separator with a surplus of water in each circuit. From the separator, the dry steam goes through the superheater, and directly to the main turbine. The water from the separator is called the spillover, and it passes through a heat exchanger to the hot well, where it mixes with the condensate, and is re-fed to the boiler by the feed pump.

Due to the compact arrangement of the Steamotive unit, it constitutes what is practically a packaged power plant.

HIGHWAY LIGHTING

DURING 1936 more miles of highway were illuminated than during the preceding five years. The tempo of research work on this important phase of highway safety was stepped up and there continues to be a great interest shown in the future of highway illumination.

The longest sodium highway-lighting installation in the world is on a section of the New York State Route 7, known as the



A power-plant in a package—Steamotive

Duanesburg Road. It utilizes 390 10,000-lumen sodium highway-lighting units for illuminating 17½ miles of highway.

The world's longest bridge, the San Francisco-Oakland Bay Bridge, is appropriately lighted with the golden light of more than a thousand 10,000-lumen sodium luminaires.

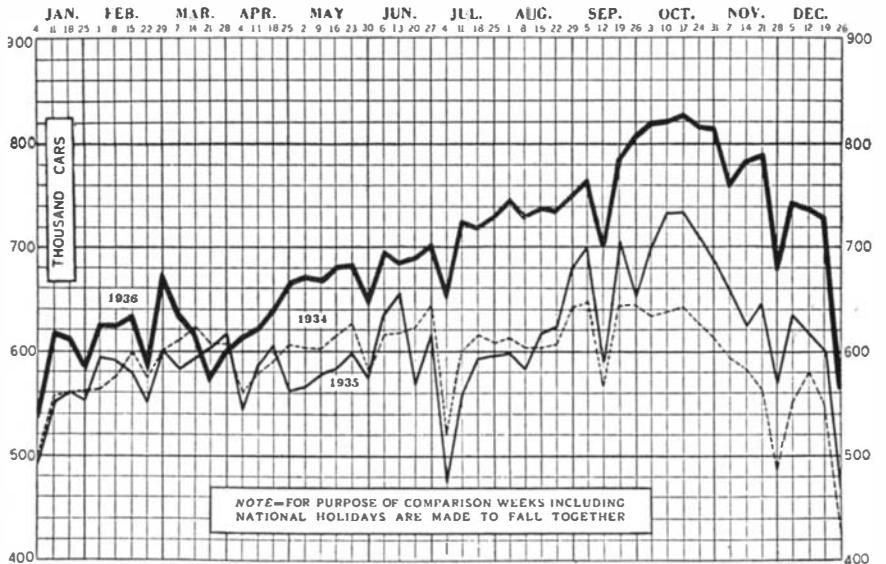
DIESELS

A NEW annual production record for Diesel-electric locomotives was reported in 1936. During the year 50 such locomotives were placed in service or were under construction.

STEAM-POWERED, STREAMLINED

FOR several months the New Haven Railroad has operated a new streamlined, steam-powered, two-car train between Bridgeport and Hartford along the Naugatuck Valley. The train consists of two cars with an over-all length of 163 feet, and seats 152 passengers. Both ends of the train have been streamlined, and while the entire power unit is located in one end of the train, controls are located in each end, allowing it to be moved in either direction without time-consuming and expensive turn-around movements. The sides of the coaches reach almost to the ground, presenting a smooth and uninterrupted surface.

Air-conditioning equipment is an auxiliary unit of the train capable of producing the equivalent of fourteen tons of ice per



day. Adequate heating is supplied in cold weather by means of shielded thin tubes which take up very little space but give rapid radiation.

The power plant of this train is unusual in that it is steam-operated and occupies a space only as wide as the car and seven feet long. It consists of three main units—the boiler with its auxiliaries; the condensers with their fans; and the power truck. The total power plant weighs only 8500 pounds. The boiler is heated by an oil-burning device somewhat similar to that in use in home furnaces and is fully automatic.

When the steam pressure drops, the boiler

BIGGEST WELDED SHIP

THE new tanker to be built for The Atlantic Refining Company in the Chester shipyard of the Sun Shipbuilding Company, will be the world's largest welded ship. With a dead weight tonnage of 18,500 tons, the new oil carrier will also be the largest commercial vessel under construction in American shipyards.

The new tanker will have a length of 521 feet between perpendiculars, a beam of 70 feet and a cargo capacity of 156,000 bulk barrels of gasoline. Turbo-electric engines, developing 5000 horsepower, will give the vessel a speed of over 13 knots, enabling it to make the trip between Philadelphia and Texas gulf ports in the unusually fast time of six days. It will carry a crew of 8 officers and 26 men.

Preliminary construction work has already been started and the vessel is scheduled for delivery to the refining company by the end of the year.

PIPE LINES NO PIPE DREAM

PAUSE a moment and think of the different commercial transportation systems in modern America; the railroads, motor vehicles, airplanes, lake, and river transport, and the electric trolley lines. Is that all?

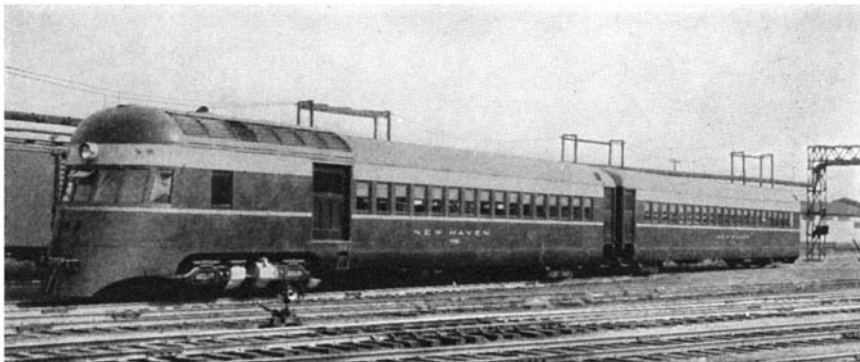
No! Another one is the pipe-line.

People who think of pipe-lines as a form of transportation are distinctly in the minority and of these few only a tiny fraction realize that they are the second ranking form of commercial transport following right on the heels of the railroads in the total loads carried, as expressed in ton-miles.

Ranked in North America on the ton-mile category, the transportation systems are tabulated by *Science Service* like this:

Railroads	500,000	million
Pipe-lines	400,000	"
Motor Vehicles.....	34,000	"
Electric R. R.....	11,000	"
Inland Waterways.....	11,000	"
Airplanes	33	"

Pipe-lines by their very nature seldom come into the consciousness of the average citizen. You turn on the water faucet in the

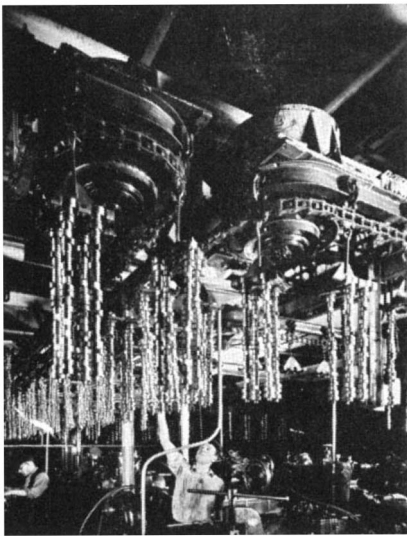


Two views of the New Haven's steam-powered streamliner



automatically starts and stops when the desired pressure has been reached. While the unit is of the high-pressure type, it is entirely safe and has passed all of the tests applied by the Interstate Commerce Commission. After steam has been generated in the boiler to approximately 1200 pounds, it is taken to the power truck, which consists of two high-pressure and two low-pressure cylinders located directly on the truck. The steam first enters the high-pressure cylinders and then passes to the low-pressure cylinders, thus doing double duty before it is returned to the condensers located on the top of the train, where it is condensed into water ready to start the cycle from water to steam and steam to water again.

Safety features on the train are many, including a train signal device which reproduces in the cab the signals along the track. The throttle is also automatic in that if the pressure of the operator's hand is released the train immediately stops.



Icicles in a factory? Not at all; the unusual pattern effect is created by Ford V-8 crankshafts hanging from chain conveyors as they move toward the motor assembly lines

kitchen without realizing that back of that flow of water are miles of water pipes; 211,000 miles of them, in fact, on the North American continent. And behind the gas stove in the kitchen are a collective 312,000 miles of pipe in Canada, the United States, and Mexico.

Moreover, there are 425,000 miles of sewerage pipe-line system and 100,000 miles in petroleum transmission lines. Natural gas transmission lines add a final 65,000 miles of pipe to the total.

Transmission of fluids is one of the oldest technical arts, points out the *Bulletin of the Ontario Research Foundation*. Pipes and aqueducts were, of course, common to the old Romans. But even earlier the Chinese piped natural gas through bamboo poles laid with large ones and small ones alternating so that their ends fitted into one another. The joints were sealed with wax. (End of Transportation Section)

COLONEL LINDBERGH'S LATEST PLANE

IT is rather sad to think that Colonel Lindbergh now lives in England, and that his latest airplane, the Miles Mohawk, was built

by a British firm, Phillips and Powis. But of course it serves us right! In the design of his new craft, the famous pilot supervised every stage of the engineering, and the result is a machine in which the efficiency and convenience of the pilot have been studied in every detail—even to the external color scheme, which is orange and black because these colors show up boldly in all conditions of weather, in blinding sun or in mist.

It makes us feel a little better to know that at least the power plant is of American make. The engine is a supercharged, 200-horsepower Menasco, an in-line, air-cooled engine, with its cylinders inverted so that the pilot's vision is not hindered in the least.

The external lines of the Miles Mohawk are not of conspicuous novelty, though they are clean and neat. The landing gear is streamlined to the limit, but is *not* retractable. At least when Colonel Lindbergh and his wife adventure afar they will never be bothered by a landing gear refusing to come down or go up. The low, cantilever wing is familiar and so is the split flap, widely employed by designers in the United States. The top speed of 200 miles per hour is up to the very best standards, particularly with a gross weight of 2700 pounds, a figure which is fully justified when the equipment carried is taken into account.

But the greatest interest lies in the arrangement of the cockpit and equipment.

The two seats are located in tandem, on

the front and rear spars respectively, and are covered in by an exceptionally neat transparent roof; transparent side panels can be slid up and down at will. The enclosure has concave sides, permitting the pilot to look outside without exposing more than a fraction of his face. Behind the rear seat is a roomy luggage compartment with a recess for suitcases which is accessible from the cockpit as well as through an external door. Further aft is stowage for a tent, a collapsible dinghy, and other articles likely to be useful on long journeys to out-of-the-way regions. Radio, flying, and navigation equipment is equally complete, and seaplane floats may be readily substituted for land wheels.

May the Colonel and Anne Morrow make many interesting flights and give us another fascinating book.—A. K.

THE MENASCO BUCCANEER

IF our readers will examine the photograph of the Menasco six-cylinder "Buccaneer" engine, they will see how this inverted engine fits into the narrow nose of Lindbergh's new plane and gives the unimpeded vision ahead which a pilot so much desires.

The public sees nothing but radial air-cooled engines on the large transports. We can assure our readers, however, that in-line air-cooled engines for aircraft of moder-

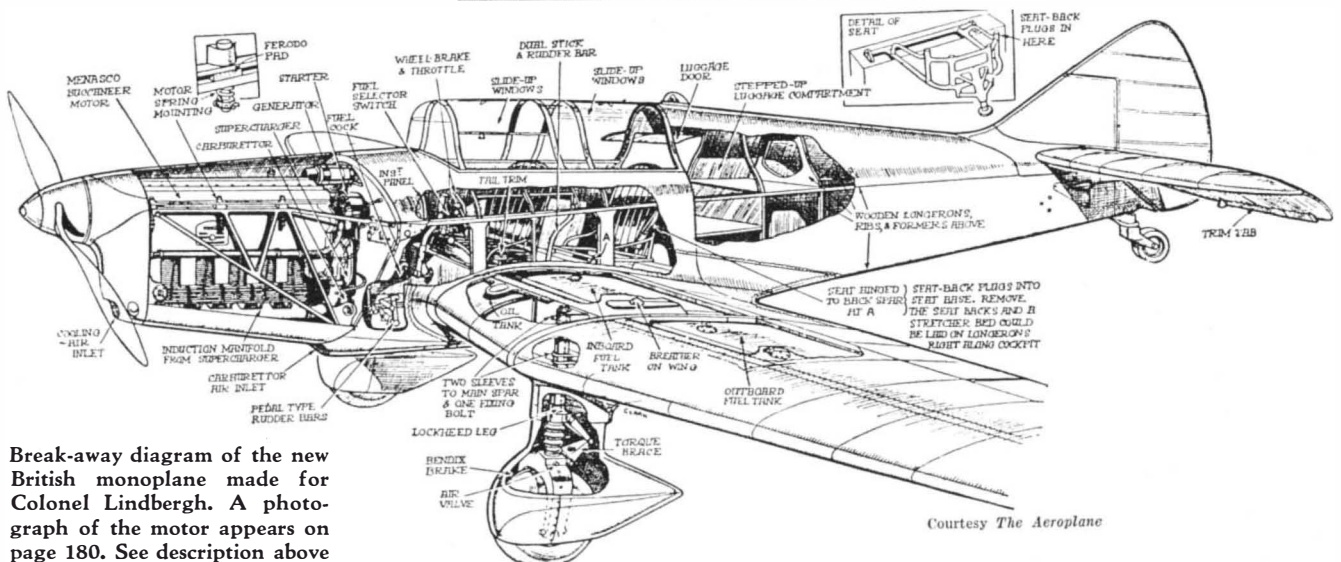
Right: Front of the Miles Mohawk plane built for Colonel Lindbergh. The highly streamlined landing gear is not retractable



Courtesy British Society of Aircraft Constructors



Left: Side view of Colonel Lindbergh's new plane, showing the neatly enclosed cockpit with transparent roof and concave sides, giving good visibility



Courtesy The Aeroplane

Break-away diagram of the new British monoplane made for Colonel Lindbergh. A photograph of the motor appears on page 180. See description above



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But to that smaller group of men who are the executives, and coming executives, in American business this message will be of utmost importance.

The next five years, even though they be years of prosperity, will prove a more severe test of personal and executive competence than any similar period in the past. Men who want to win financial independence must meet a new set of requirements. There will be none of the indiscriminate,

get-rich-quick prosperity of the last boom. A higher order of business knowledge, executive training, and understanding of the new rules of industry will be the price of better-than-average income.

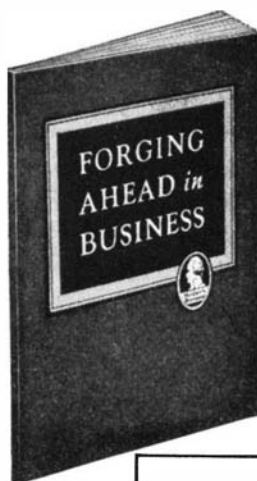
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HEART DISEASE:

Do you know that heart disease has shown an alarming increase in recent years? Do you know how to escape it—how to live if you have it?

COSMETIC CARE OF THE SKIN:

Are you familiar with the cause of sudden outbreaks of pimples and blackheads—skin pigmentation or superfluous hair and what corrective measures should be taken?



SLEEP:



Do you know how to sleep? Do you understand the principles of restful slumber and how to achieve it without counting sheep—reviewing the day's activities or other similar methods.

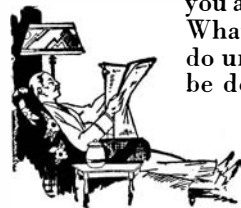
GALLSTONES:

Do you know what gallstones are—what causes them to form—what the chief symptom is—if immediate relief is possible—if the stones may be dissolved and what happens if they are removed?



SELF CONTROL:

Can you keep your mental poise? Are you a calm and collected individual every minute of the day? Do you believe you are immune to hysteria? What is hysteria? What causes it? What does it make a person do under extreme conditions, and what should be done about it?



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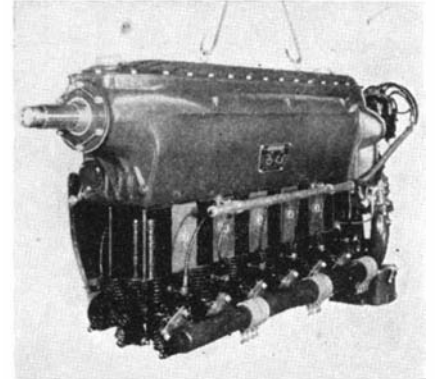
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ate power are worthy of serious consideration. The Buccaneer, after six years of development work by the Menasco company, develops 200 horsepower at 4500 feet altitude, thanks to its moderate supercharging, and has made a splendid record for itself both in private flying and in aircraft racing.

Besides the unimpeded vision, the following advantages are claimed for the inverted



Inverted Menasco Buccaneer

in-line type: low frontal area which is a help in streamlining; noise and exhaust carried away below the cockpit; high propeller thrust line; high degree of accessibility. These engines are as well designed and constructed in every detail as their more powerful brethren of the radial type, and have as many and as efficient accessories.

The Buccaneer weighs 415 pounds. As compared with the radials, this is heavy. But as compared with the six-cylinder automobile engines which people are endeavouring to use in aircraft, and which weigh close to 500 pounds while developing only a little over 80 horsepower, they are very light.—A. K.

A PILOT'S MOST DANGEROUS TIME

In a recent address before the National Association of State Aviation Officials, James E. Hoskins of the Actuarial Society of America gave some interesting information on the most hazardous stages in a pilot's career.

It appears that the most dangerous time in a pilot's career is not while he is taking instruction in the early part of his solo flying, but during a certain period after he has received an advanced license or a military rating. "At first he knows he is green and plays safe; eventually he gains skill, but there is an intermediate time when his self-confidence exceeds his ability," said Mr. Hoskins.

Pilots who have been involved in an accident, or who have been disciplined for violation of air regulations, have a greater chance of a fatal crash than those who have not. They might be expected to be more careful. Perhaps the pilot who has had an accident or who has been disciplined shows a lack of physical or mental aptitude?

According to Mr. Hoskins, no great difference has been observed between the safety records of younger pilots and those of more mature years. This is contrary to widely accepted opinion.

What type of flying is the safest? Mr. Hoskins is quite sure that the flying which is most closely supervised, either by govern-

ment inspectors, by responsible airline operators, or by corporations owning planes for their own use, is far safer than private flying undertaken for pleasure. This will not encourage us to accept a friend's invitation to "come and fly with me some time."

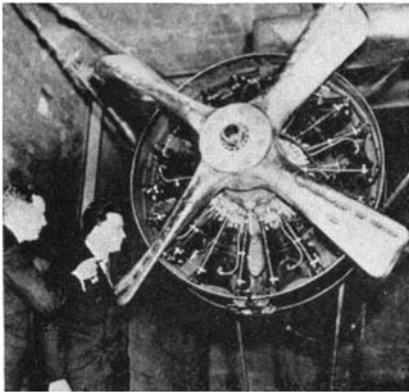
—A. K.

MOTORS TESTED IN SOUND-PROOF CELL

AN automobile engine, unmuffled, makes quite a little noise. But it is merely whispering as compared with the overpowering roar of the Wright Cyclone G developing some 1220 horsepower at 2200 revolutions per minute. The Wright Aeronautical Corporation's engineers have the arduous task of testing such engines on a 24-hour a day schedule. Now while the town of Paterson, New Jersey, is extremely proud of its mighty aircraft engine factory, and owes no little of its welfare to the large orders received by Wright's, its citizens did suffer from the noise, and did not scruple to make violent and continuous complaints.

So the aircraft motor engineers turned into "acousticians" and built completely sound-proof test cells as part of their new testing equipment.

The sound proofing was based on a combination of three principles. In the first place the walls of the cells were made of a porous substance which absorbs much of the sound. Secondly, the exhaust vent into the open air consists of a deep honeycomb which breaks up the sound waves before they emerge into the atmosphere. Lastly,

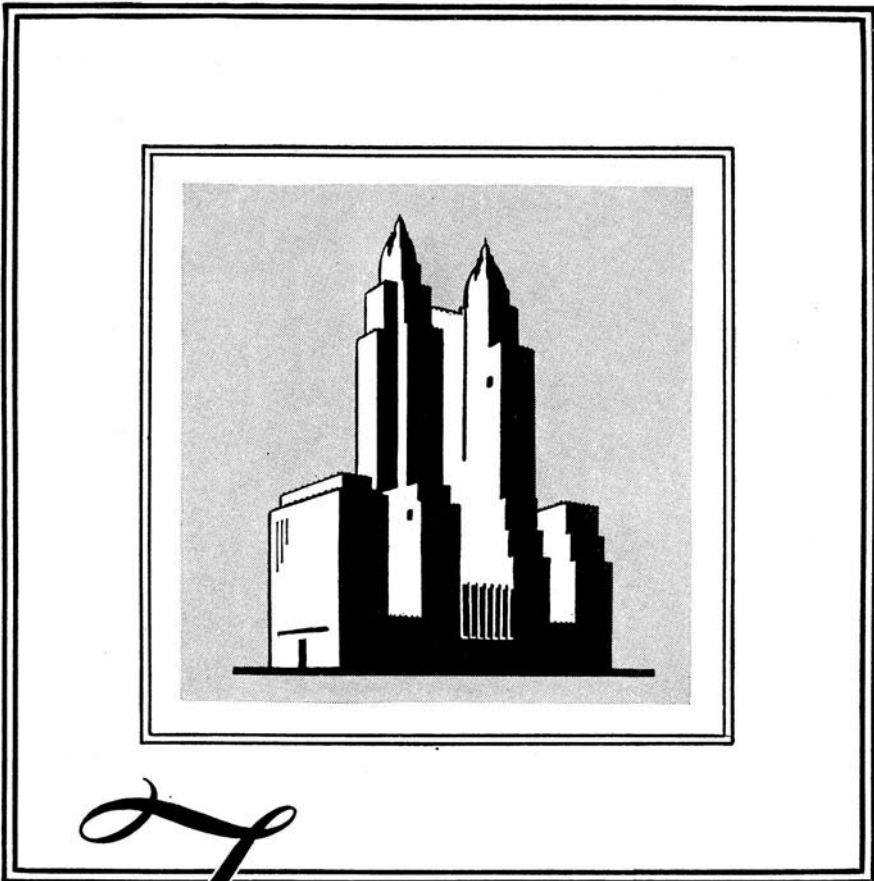


Airplane motor ready for test

the suspension of the engine itself is an important factor. The engine under test is mounted on the end of a large steel cylinder about 10 feet long, which is suspended 10 feet above the floor in a three point cradle of cable loops anchored to the walls and the floor. Vibration at the anchorage points of the cables is absorbed by rubber washers which separate the bearing surfaces from the structure of the building. These methods have proved entirely efficacious and the complaints of Paterson inhabitants have ceased.—A. K.

FEEDING BIRDS FROM THE AIR

THE peacetime applications of flying never cease to increase in scope and number, as a good offset to the dangerous functions of the airplane in war. Thus we hear that Commissioner Harry M. Armstrong of the New Jersey Fish and Game Commission has saved the lives of thousands of ducks in the lower bays of New Jersey



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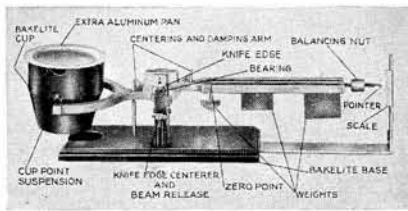
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and New York, by spreading grain from the sky, at a time when ice prevented approach to the starving birds by any other means. The procedure was simple. A plane loaded with 500 pounds of grain, packed in one-pound bags, flew over the desolate area. Thumb holes were punched in the paper bags just before they were tossed over-board, and the grain from each bag scattered over a 25-foot circle on hitting the ground.—A. K.

HAVE AVIATION SHOWS ANY UTILITY?

AT a recent luncheon gathering of well informed aviation men we heard the question of the utility of aviation shows discussed rather heatedly. It is a terrible bore to manufacturers' representatives to answer questions all day, mainly from small boys who walk away with great quantities of expensive pamphlets, photographs, and so on. At an automobile show cars are sold right there and then, on the floor of the show. But very few people buy an airplane without having had a demonstration flight, so that measured in dollars and cents the results of an aircraft show are apt to be disappointing. But aviation shows serve to educate the public in a way which no other activity does, and their indirect results are valuable to industry and public alike.—A. K.

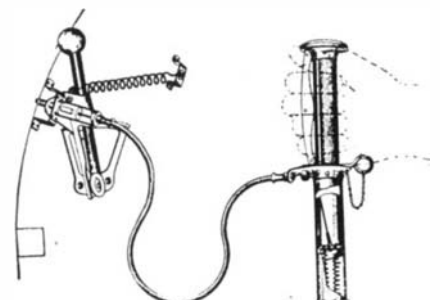
MODEL AIRPLANE FLIES FOUR MILES

IT is interesting to note that Lieutenant Hewgley and Sergeant Lewellyn of the Army's 12th Air Base Squadron have flown a gasoline-powered model airplane a distance of four miles—the world's record. Flying a powered model is a most interesting sport, and the builders of these craft have acquired uncanny skill, so that the powered models take off, maneuver, and land almost as if they were manually controlled.—A. K.

SAFETY DEVICE FOR HIGH ALTITUDE FLYING

IN a recent issue we described the British airplane which holds the world's altitude record. The French have also given much care to the equipment of high altitude machines, and in the Potez 50 a safety device is provided which is not available in the aircraft of other countries.

This is an attachment to the control column, which is a safeguard against loss of consciousness by the pilot should his oxygen supply fail him or some other mishap occur at high altitude. It is illustrated



If an airplane pilot becomes unconscious, the throttle will automatically close when his grip relaxes

in the sketch, which we owe to the courtesy of *Aircraft Engineering*. A grip lever is mounted on the control column and is normally held against the column by the pilot's hand. If the pilot relaxes his grip the handle is pulled down by a spring, which at the same time actuates a Bowden cable. The cable disengages a peg or locking pin and the throttle lever is moved back by the closing spring, so that the gas supply is shut off. Further, the plane itself is so rigged as to be slightly nose heavy. When the pilot no longer holds the control column, the ship noses down into a glide to earth.

The supposition is that the pilot recovers consciousness long before he approaches the ground, and has plenty of time to resume control before landing.—A. K.

THE NEXT FIVE YEARS IN AVIATION

THREE great engineering societies recently combined their efforts in organizing a symposium entitled "The Next Five Years in Aviation." The American Society of Mechanical Engineers, the Institute of Aeronautical Sciences, and the Society of Automobile Engineers are to be complimented on the results of this meeting, which produced not a purely imaginative effort of the H. G. Wells type, but a serious technical projection of the advances of the next few years.

All important air-cooled engines will develop well over 1000 horsepower in the near future. The specific weight will be less than one pound per horsepower. The fuel consumption of the gasoline aircraft engine will, in the next five years, be reduced to 0.35 pounds per horsepower-hour as compared with the 0.5 pounds of to-day. This great advance in economy will be due, to a large extent, to the introduction of improved fuels, of a very high octane rating, which will allow compression ratios to be increased even further than to-day.

At this meeting the aircraft Diesel apparently did not have a single friend. If the above economies are attainable with gasoline, we can readily see that the aircraft Diesel will have harder sledding—fire prevention will be the main argument of the Diesel proponents.

Our readers have often written in to ask why the Junkers Diesel is so generally used and so highly regarded in Germany, and why it did not get a footing in the United States. A well informed and distinguished German aviation constructor gave an explanation during the meeting. The only reason the Germans are using the Diesels in their transport planes is because the gasoline fuel situation is so difficult. If Germany had an unlimited supply of gasoline, they would themselves abandon the use of Diesels for airplane work!

Igor Sikorsky spoke with his usual vigor and authority about aircraft weighing 100,000 to 200,000 pounds which will be under construction in the next five years. Cruising speeds will be increased to 200 miles an hour for flying boats, and 250 miles an hour for land planes.

The writer of these notes had the privilege of making predictions from the same platform. He really made no predictions but raised what Mr. Sikorsky thought to be an interesting point. As planes increase in size, they lose in maneuverability—just like

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the giant ocean liners which need a small army of tug boats to bring them into dock. Now if airplanes get bigger and better, and consequently less maneuverable, how will they ever bring themselves into the landing glide, and how will they ever flatten out again? Will they have to be provided with airports fifty miles in length, perchance? There are methods, as a matter of fact, of maintaining maneuverability while increasing size, but real difficulties remain to be solved.

The Sperry Gyro Pilot is now universally employed on the airlines. When the Gyro Pilot has conquered the transport field, will it be reduced from its present cost of several thousand dollars to a price of, say, ten dollars so as to be available for every private airplane? At present the use of the Gyro Pilot on a small private plane would be absolutely prohibitive from the point of view of expense and of the care required in maintenance. But the electric starter for automobiles was once also regarded as a tremendous luxury—now no car would sell minus an electric starter.

Space will not permit us to give the views of other distinguished speakers. It is to be hoped that these learned societies will in time make the full views of these engineers available in detailed reports.—A. K.

DETERMINISM AND MAN

SCIENTIFIC writers who have turned to the philosophical interpretation of science are invariably concerned with the relation between man and the physical and

biological science he creates. These writers fall, roughly speaking, into three schools.

The first maintains that the methods that man has evolved for the study of the physical universe can be applied, without fundamental modification, to the study of mankind, and of man as an individual; that the determinism of physical science must apply equally to characteristics of the individual, and that from this can be deduced the behaviour of the mass. The universe, including man, is a complex machine. These are *mechanists*.

The second school sets man and his mind apart from the rest of the universe, asserts that although he is amenable to physical laws, these do not determine the whole of his actions, and that otherwise he is "free" to act as he wills, in accordance with or against his moral conscience. There is a great variety of such *philosophical idealists*, ranging from the solipsist who maintains that the universe is created out of the elements of his (the particular solipsist's) consciousness, to those who believe that man, in the exercise of his will, is working out the law of a Superior Intelligence that exists outside man.

The third class asserts that man is a product of material nature, consciousness being a complex quality of the brain; that physical science has been produced by man in his struggle with the material world; that the scientific laws he finds operative to inanimate matter are not necessarily valid as they stand for the more complex problem arising when man, the active agent, is in-

(Please turn to page 196)

THE AMATEUR TELESCOPE MAKER

Conducted by ALBERT G. INGALLS

HOW heavy a hold the telescope making hobby has taken on people is indicated by frequent reminders. We learn that courses in telescope making are now being given at New York University, also at the Pennsylvania State College, and we go so far as to predict that graduation credit for this work will eventually be given at many universities, presumably in the departments of physics. Writing from Eindhoven, Holland, T. L. Rinia advises us that "telescope making is now rapidly becoming popular in Holland."

Amateur telescope makers in any community will testify to the interest their telescopes have aroused locally, some of the owners deciding they have become too popular by half, since the townspeople had learned where to get a free peep at the moon at all hours. One man threatens to "leave town or else commit suicide," in order to escape this kind of popularity, but others have enjoyed the nightly visitors. J. Milo Webster of Wyomissing, Pa., has kept a visitor's book at his observatory (see pictures in "A.T.M.," pages 455, 456) and says the book was entirely filled up, last summer, with 4000 visitors' names! In Rochester, N. Y.—the optical city—they had a hobby show, with stamp collectors, painters, cactus growers, micro-biologists, engine model builders, fancy quilt makers, and telescope makers among those represented. The Rochester Astronomical Society, with a membership of 100, won the silver cup as First Prize. In that city, too, the university is apparently in contact with the telescope making hobby, as the Rochester Astronomical Society has the co-operation of the university Department of Optics.

New astronomical and telescope making societies seem to spring up daily. Photographs of two of the older clubs are shown in Figure 1. In half-tone reproduction the reader can't clearly make out features, but we have been all over the original photographs with a 2" lens and, as we used to say in the army, each club group is a "fine body of men."

WHEN we first published "Amateur Telescope Making," 11 years ago, we had no idea the hobby would take such a determined hold on our readers, but today, in addition to that book, now in its fourth edition and "going strong," we now have

the new book "Amateur Telescope Making—Advanced," the sequel to "A.T.M." and 150 pages larger. This most recent book harks way back to a thought we had while lying abed about 11:23 A.M. one Sunday morning in 1925, even before the thin first edition of "A.T.M." was conceived—namely, to bring together, *in one place*—that is, between the same two covers—reprints of some of the things we had already been chasing up in different public libraries, at considerable inconvenience. Other items in "A.T.M.A." have been written by amateurs who took up the hobby as beginners soon after "A.T.M." first appeared. Together they show how the amateur, starting at scratch and in ignorance, has performed the feat of virtually lifting himself aloft by his own bootstraps—a process of levitation which still continues, for standards improve every year.

In dividing "A.T.M.A." into two parts, one on practical "optics" making, the second on the "more practical aspects of observing," we have had in the background of our mind the possibility that, some day, if the hobby continues marching on as it has, each of these parts could be enlarged and built into a separate book. Readers' reactions to that thought are solicited. Would there be enough market for the second book (on observing) to make it economical?—say, a sale of 3000 copies—for these books must pay their way in the world.

However, avast with thoughts of making new books for the present: what we now want most, after just a year of spare time work at home, in preparing "A.T.M.A." (all this hobby work being done on time sneaked in between regular work on the magazine) is to do a long stretch in an overstuffed chair, with time to yawn frequently. Ho, ho, hum—haven't been to the movies in a year and Mae West is on tonight. By the way, please turn in proof errors, found in reading "A.T.M.A." We save these with care, against a later edition.

In case you prefer the drawing in Figure 2, to the one on page 521 of "A.T.M.A.," you may cut it out and substitute it. When invited to make the drawing for that humorous page to provide a break between Part I and Part II, R. W. Porter sent us two drawings—perhaps we selected the wrong one. Every amateur should learn this song, a

parody on the Gilbert and Sullivan light opera "Pinafore," with its catchy music.

Speaking of songs reminds us of poetry. The Enid Crawford Pierce who wrote the verses about dinosaurs, on page 196, is Mrs. John M. Pierce of Springfield, Vermont. Some think the philosophy is a bit gloomy but the verses reached us one day when we felt just that way. So we accepted them. We are born, we grow up, worry about income taxes, make telescopes, make other telescopes, and die. "What's the use—only an egg yesterday and a feather duster tomorrow." But tomorrow, unless it rains again, we may feel different.

HERE is an interesting note by R. W. Porter. See Figure 3: "If a template, used either as a grinding or polishing tool, is moved across a spherical concave disk, it will *automatically* produce a paraboloidal surface of revolution. The tool (template) moves parallel to itself from about *A* to *B*, the disk slowly revolving beneath it."

CONSIDERABLE interest has been shown in small items regarding the theory of polish, published here from time to time, the question being whether polishing is sub-microscopic scratching or some kind of molecular flow. The following is from a recent article by Dr. Wilbur B. Rayton of the Bausch and Lomb Optical Co., in *The Review of Scientific Instruments*, Vol. 7, No. 9.

"In the process of grinding, the particles of emery plough out channels by 'springing' out a series of small chips. Apparently the emery particle serves as a point of compression building up pressure until the glass is locally strained beyond the elastic limit, whereupon a chip flies out and immediately the process begins again at a point a little farther along. The chips are removed by a process quite similar to the process by which flakes of flint are sprung out of the surface in the fashioning of arrow heads.

"The polishing process is not so well understood. The ground surface consists of minute hills and valleys. Does the polishing process remove material from the hills until all of them are reduced to the level of the bottom of the valleys or does the material removed from the hills partially fill up the valleys?

"For a long time it was known that pol-



Figure 1: Amateur Telescope Makers of San Francisco and, right, Indianapolis Amateur Astronomical Association



Figure 2: The unforgettable, catchy song of the amateur astronomer

ished surfaces on calcite crystals used in X-ray spectrometers were much less satisfactory than natural fracture surfaces. Professor Richtmyer eventually discovered that if after a calcite surface was ground, but not polished or only lightly polished, it was etched with weak acid its behavior became equal to a natural fracture surface and, in speculating on the cause of this effect, suggested that it might be explained by assuming that the grinding process left embedded in the surface great numbers of small crystals which, although broken away from the original crystal, were lodged in pits on the surface but with their crystal axes running in all directions. Such loose crystals would be subject to attack on all sides by the acid and would therefore be dissolved, leaving a surface which might be rough but which would be completely regular insofar as crystal axis was concerned and that it would reflect X rays as a single crystal. Apparently polishing the calcite serves to make the surface appear to be continuous, the outstanding characteristic of a polished surface, but does not remove the debris left in the pits in the process of grinding. Whether there is any reason to extend this reasoning to the grinding and polishing of glass is not immediately apparent. Glass is amorphous and calcite is a crystal but in spite of this there is the thought that a polished surface on a piece of glass may be a sort of a false front that makes an actually

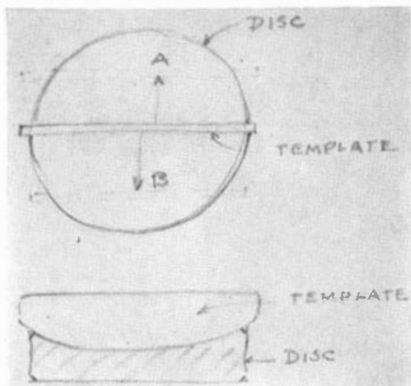


Figure 3: Professor, please tell us its secret, in monosyllables

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chaotic condition present the appearance of order."

WE have been looking over an accumulation of unpublished descriptions of telescopes, with photographs, and out of about 100 only nine could be found which haven't a slender "bottleneck" ("A.T.M.," fourth edition, page 130) between the tube and declination axis bearings. It seems almost hopeless to harp on that point—folks evidently will build 'em wobbly. Here on these pages are four other descriptions we ran across, with interesting features. Figure 4 shows not only a swiveling eyepiece for a Cassegrainian, but a finder which swivels around with it, remaining always parallel to the optical axis. Thus the user can choose a comfortable position for both eyepieces. G. L. Ardery, 205½ West Third St., Yankton, S. Dakota, made the telescope.

Figure 5 shows one of the inverted engine block polar axes described in "A.T.M.," fourth edition, page 142. B. L. Bradley, 235 North High St., Salem, Oregon, is the maker. He also writes: "Here is a suggestion for those who may have trouble in

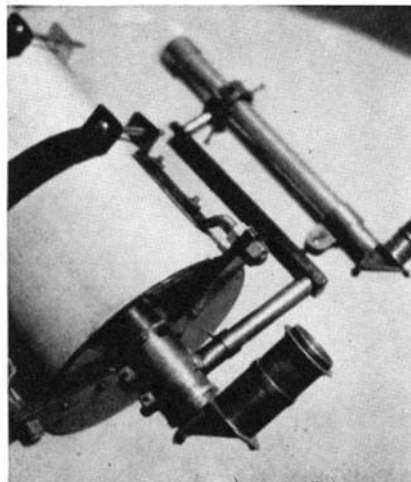


Figure 4: Ardery's conception

squaring the mechanical parts of their telescope. (I had lots for a while.) I finally ran across the idea of using my 5" scope with cross-hairs to square up the mechanical parts of the 8" telescope. I carefully marked the center point of the dec. axle, both ends. Then I lined up on the center point with my 5" portable scope, putting the center point of the axle just on the cross-hair. It takes two people to do this, else you may walk the equivalent of several hundred holes of golf before the center points coincide. Continue to revolve the dec. axle around the polar axle, and adjust the set screws in the T-pipe fitting until the center points coincide on the cross-hairs. I used a similar procedure on the tube with reference to the dec. axle."

Figure 6 is a sea-going telescope. H. Leroy Benfer of the Radio Department, S.S. *Santa Clara*, left it with us. (Incidentally, we think no more graceful steamers sail the seven seas than the *Santa Clara* and others of the Grace Line's *Santa* class. They go through the Panama Canal and down the west coast of South America, also to California. Beautiful lines, these new vessels have, and we make our bow to the naval architect who laid them down.) Mr. Benfer says he gets quite a little use of his telescope—though not often on the high seas.



Figure 5: Bradley's ex-Lizzie

A photo of the moon he sent shows good sharp resolution of detail. Many other photographs of the moon have been sent to us, but when reproduced in half-tone they would all look exactly alike; the half-tone would knock out any excellence they might possess. This is why they are not published.

After the sea-going telescope comes a land-going one, with pedestal permanently bolted to the rear of a car (Figure 7). C. C. Miller, president of the Amateur Telescope Makers of Kansas City, concocted this mounting. He says the tube is detachable and is taken inside except when in actual use. A trout rod and line show dimly, leaning against the mounting.

AT present several are either making 20" Pyrex mirrors or flirting with the idea. How about getting up a "Twenty-Inch Club" among these aspirants? Doubtless they could help one another to a considerable extent, a 20" being quite a job to tackle all alone. Let's hear from all of them.

HERE is a note from T. E. Morgan, of the *Sacramento Shopping News*, 2836 Fifth Avenue, Sacramento, Calif.: "Those amateur telescope makers who have had their mirrors silvered by just anyone should inquire about the methods to be employed before entrusting them to some workman



Figure 6: Benfer's amphibian

ignorant of an optical surface. Not having the slightest idea of an optical surface, much less matters of a few millionths of an inch, they do it about as follows: Using no chemicals to clean the mirror, they smear rouge—probably poor rouge at best—on a cotton pad and rub the mirror in all manner of strokes and probably in spots. If they think it needs more polishing they may even use a motor driven buffer. ‘Oh well,’ they think, ‘it’s just another mirror and we’ll put a film on it with no spots, and polish it well.’ The remainder of the method is to use the silver with heat and more rubbing of the rouge pad. It nearly happened to me.”

DURING the World War there was a dearth of practical optical workers, and persons who had even elementary knowledge of optical work were at a premium. In case this nation got into war again (and let’s hope it won’t) it would turn to the thousands of amateur telescope makers for help. Not, however, that every man who can tell rouge from pitch will be made a field marshal. Just a thought.

ABOUT the slip ring idea (“A.T.M.,” p. 146): Frequently amateurs invent this independently. Actually it is very old. “I don’t know how old the idea is,” is what Prof. H. D. Curtis, mechanically-minded astronomer and designer tells us when asked, “but I feel pretty sure that Saegmuller used it on his mountings way back before 1900. In the ‘Handbuch der Astronomische Instrumentkunde’ the earliest mention seems to be in mountings made by Fritsch about 1893.”

IT is regrettably necessary to end on a very sad note. New York papers of January first contained the following bare item: “Kildarton, Armagh, Ireland, Dec. 31 (U.P.)—Canon W. F. A. Ellison, rector astronomer of the Armagh Observatory since 1908, died today.”

This is the total of our present knowledge of the matter, though we hope soon to learn more. Rev. Ellison was about 72 years of



Figure 7: Miller’s motorscope

age, and a year or two ago was made a canon of the Church of Ireland. Thousands of American amateur telescope makers will add their regrets to those of Ellison’s pupils elsewhere in the world at the loss of this great preceptor who has given so much enjoyment and satisfaction to all of us.

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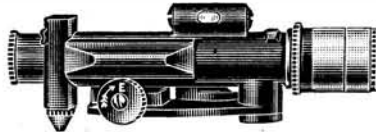
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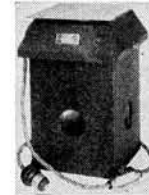
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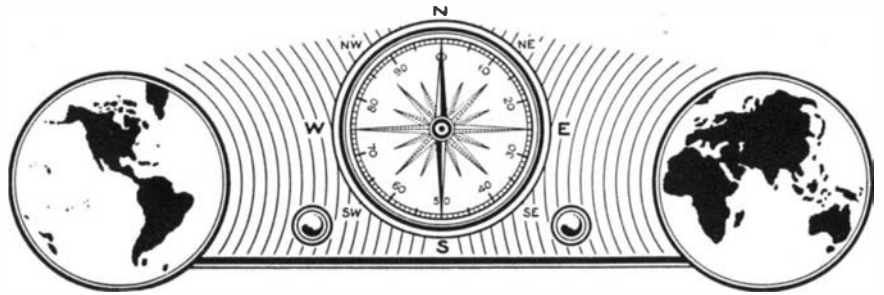
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WORLD-WIDE RADIO

Conducted by M. L. MUHLEMAN
Editor, *All-Wave Radio*

GERMAN REGIONAL BROADCASTS

THE German short-wave station, with studios in Berlin, began a special series of regional broadcasts directed each month to a different part of the United States or Canada. These broadcasts pay special attention to local interests and tastes. Berlin started with this type of transmission in October by directing a special broadcast to Texas on the occasion of the centenary of the Lone Star State. This was followed in January by a broadcast addressed to New Yorkers, and in February to the Pacific Coast. The March broadcast will be for the benefit of New Englanders.

NEW HONG KONG STATION

A NEW short-wave broadcast transmitter has been installed and is now operating in Hong Kong, China. The power of this station is 2.5 kilowatts and replaces a small experimental transmitter of only 0.5 kilowatt.

Four frequencies have been assigned to the new transmitter. The selection of these will be governed by seasonal conditions, and the particular frequency in use will be indicated by the call, as follows:

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Both European and Chinese programs are broadcast and the transmissions commence daily at 11:30 P.M. Eastern Standard Time, except Saturday, when the time is 9 P.M.

UNUSUAL BROADCASTS

BRITISH listeners were thrilled when some time ago they heard a message of cheer broadcast to the 30 men and women of a film unit who were "storm-stayed" on the Island of Foula in the Shetlands. The message was: "If the marooned party is listening to the broadcast, we take this opportunity of sending them a word of greeting along with the hope that the sea will soon subside."

Messages of this character are not often broadcast. In the early days of the Spanish conflict an appeal was broadcast to British nationals in Spain, urging them to take advantage of the facilities offered for leaving the country. In a less serious vein was the appeal to the patrons of a great sporting event in the north of England who had hired

cushions and gone home with them. About 4000 cushions were missing and in response to the broadcast message about 600 were returned. Another message which caused some amusement was sent by Sir Harry Lauder at the end of one of his programs. He informed his wife of the time of his departure from London, and of his arrival in Dunoon. As he said: "That will save me the price of a wire, ye ken."

FIJI CHANGES WAVELENGTH

THE wavelength of short-wave station VP2, at Suva, Fiji, has been changed from 22.94 meters to 31.45 meters. This station broadcasts daily, except Sundays, from 5:30 to 7 A.M., Eastern Standard Time.

The Suva station, although it has been operating for only a year, already has a large audience. It is heard clearly in this country, and quite recently one of its programs was rebroadcast over the NBC network.

BBC CHECKING STATION

THE frequency-measuring equipment employed by the British Broadcasting Corporation at their receiving and checking station at Tatsfield is correct to one tenth of a cycle if a megacycle is the frequency to be measured; in other words, it is correct to a ten-millionth part.

Hundreds of measurements are made daily, and if any station is not keeping to



Courtesy BBC

The four short-wave relaying receivers used at the BBC receiving and checking station at Tatsfield

its frequency, representations can be made founded on practically absolute accuracy. In addition to checking long, medium, and short-wave stations, Tatsfield is also the receiving station of the BBC through which programs are relayed from overseas, passed through to Broadcasting House in London, and then distributed as required. A view of the Receiving Room is shown in the accompanying photo.

Tatsfield is the third receiving and checking station of the BBC. Previously similar stations were installed at Keston and Biggin Hill. Each of these stations was erected in pleasant pastoral country in Kent.

EARS FOR PROPAGANDA

THERE are now about 6,700,000 radio receiving sets in the United States capable of picking up European and other overseas programs, according to Bond Geddes, executive vice-president of the Radio Manufacturers Association in Washington.

This means that about one fourth of the radio families in the country, the number of which is estimated to be 24,269,000, are now able to listen to foreign as well as domestic radio programs.

GUIDE TO SHORT-WAVE RECEPTION

TO simplify the somewhat different operations of the short-wave feature of the modern all-wave radio receiver, as well as to explain in popular language just how the short waves differ from the more familiar broadcast wavelengths, the Electrical Division, Bureau of Foreign and Domestic Commerce, has made available a fifteen-page booklet titled "A Guide to Reception of Short-Wave Broadcasting Stations." The material was prepared by Lawrence C. F. Horle, a prominent radio engineer, working in co-operation with the Engineering Division of the Radio Manufacturers Association.

Since there are available throughout the country competent radio service experts, the booklet makes no attempt to instruct the listener in the intricacies of the servicing of receivers. And since the design and production of the modern all-wave receiver requires the highest type of scientific and

engineering skill, no attempt is made to provide constructional details whatsoever except such suggestions as will assist the user in providing himself with a suitable receiving antenna for obtaining the best results with his set.

Sections of the booklet are devoted to installation of the set, to the characteristics of short waves, difference in time between countries, a list of the principal short-wave broadcasting stations of the world, a list of the international assignments of call letters, and instructions for tuning receivers. A time-zone map of the world and a chart of the world showing great-circle distances and azimuths from Washington, D. C., are also given, both by courtesy of the Navy Department's Hydrographic Office.

The booklet is now being sold through the offices of the Bureau of Foreign and Domestic Commerce in Washington at 25 cents a copy.

TWO-WAY RADIO IN AMBULANCE

SNAPPED during a first-aid drill with their new two-way radio-equipped ambulance, police of Evanston, Illinois, are shown in the accompanying photo demonstrating how to deal with an accident at a skating pond. The ambulance, equipped with a transmitter as well as a receiver, constitutes one unit of an 11-car ultra-short-wave police radio system recently installed by General Electric engineers. It permits the police to carry on a duplex conversation with headquarters even while driving at high speeds.

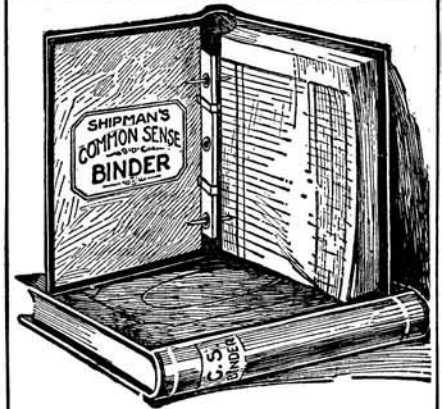
This ability to maintain inter-communication at all times with the ambulance makes it possible to save valuable time in relaying word ahead to the hospital regarding needs of an accident victim. Among examples of vital messages that can be transmitted are requests that the operating room be made ready for immediate use on arrival and that special surgical or medical assistance be summoned—all of which is usually impossible to do, without two-way radio, until the ambulance reaches the hospital.

The transmitter in the ambulance has a power of 15 watts. The "buggy whip" visible beside the right front fender of the ambulance is in reality the radio antenna.



Two-way radio ambulance of the Evanston, Illinois, police department

THE COMMON SENSE WAY

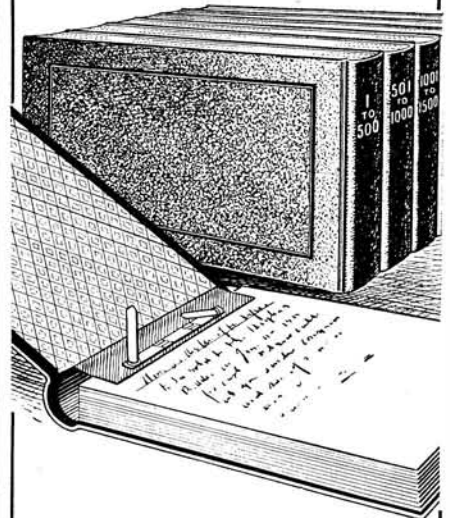


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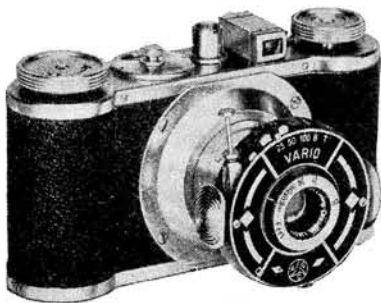
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TRAILING THE SHADOW

THE term "shadowless" lighting was recently declared to be a misnomer. The view was held that no photograph is possible without shadow and every photograph owes its existence to shadow, even though that shadow be minimized down to the point where it just outlines the subject. Be that as it may, and putting aside the very reasonable assumption that those who use the term to describe so-called "high-key" lighting do not mean the term literally but do so merely from lack of a better name to identify this beautiful method, it is the thesis of the present article that a shadow is a lovely thing. And the longer it is, the better we like it.

By the use of a spotlight we can, of course, obtain very fine shadow effects indoors just as the "shadowless" workers get their results by liberally "flooding" the subject with



"At Ease"

ing the proper time of day, and being on the alert for any "come-and-go" pictures.

"Across the Square" was shot from the stairway leading to the elevated railway. (The patient readers of this department must by now be aware of our partiality for angle pictures.) The wide expanse of cobble roadway leading to the piers seemed a perfect "canvas" for long shadows. As we waited for the right ones to appear, many shadows came and passed, each in its turn rejected until what you see came upon the scene to be quickly snapped and permanently recorded before it got away forever. It must be confessed, however, that we did miss one picture that might have been better than this one—a boy running across the square, his animated shadow enlivening the scene.



"Across the Square"

thoroughly diffused lights, but many workers prefer to let the sun do the work. So they go outdoors in early morning or late afternoon, when Old Sol is low in the sky. This may appear to some like following the line of least resistance, turning away from the hard work of an indoor set-up under artificial light to a chance "set-up" provided by nature. But who is to say which is the harder, and who is to say which is the better? In the one case we imagine an idea and try to crystallize it into a picture; in the other we let nature do the work. But is this actually true? It takes imagination to perceive nature's set-ups, just as it takes imagination to work up an idea and to build it. Besides, if the result is an attractive photograph, affording pleasure to all who see it, who cares how it came to be made? We, for one, do not.

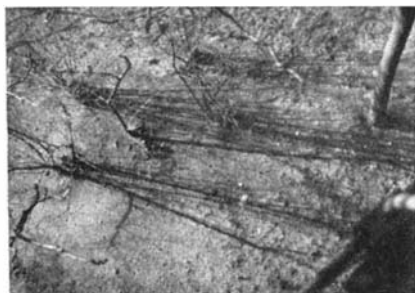
The four illustrations here shown will give some idea of the possibilities open to the camera shooter in search of shadow pictures outdoors. All were taken in the late afternoon at the Battery in New York City on a single occasion, which shows what a variety of material may be obtained in one locality in one visit if we will take some trouble in sizing up the situation, select-

In Battery Park we came upon "At Ease" and were immediately attracted by the curve of park benches and the shadows they cast, with the "human interest" reading a newspaper at the farther end. It remained only for a pedestrian to come along and fill in the space at the left, which in a few minutes he obligingly did. The slight motion which you will notice in this walking figure is due to the 1/10th second exposure we were obliged to give because of the lateness of the day and the necessity of stopping the lens down for depth.

Climbing again to the platform of the "El" we were able to spot a few good subjects, two of which are "Late Afternoon Stroll" and "Winter Brush." The first was stopped down considerably in order to get both the foreground (the tree branches)



"Late Afternoon Stroll"



“Winter Brush”

and the strollers in sharp focus. We particularly direct your attention to the length of the shadows cast by the subjects, a little more than three and one-half times the height of the latter. Nor would we want you to overlook the pleasing pattern of the walk. “Winter Brush” is one of those things it is always a pleasure to photograph—texture. Maybe the subject isn’t much to rave about, but just study that texture and just look at those shadows!

“ZEISS PHOTOGRAPHY”

IN these days of annuals and picture collections it was inevitable that the makers of Zeiss lenses and cameras should eventually put out a book containing outstanding examples of work done with Ikon cameras. It is announced that such a book, to contain more than 100 pictures, will be out during the current year under the name “Zeiss Photography.” The sponsors promise that “no expense will be spared to make each picture in the book an absolutely faithful reproduction of the original print.” The book is so planned that on the page facing each picture there will appear “a critical appreciation and information concerning the camera, lens, and process used in making the original print.”

In its announcement, Carl Zeiss, Inc., invites all users of Zeiss Ikon cameras to submit prints for reproduction in the book, and continues: “It is preferable that finished prints be submitted, but test prints or the original negatives will be suitable for consideration, and shortly after receipt of prints or negatives we will communicate with the entrant as to acceptance. There is no restriction as to subject matter, consideration of pictures being based on technical quality and merit in the particular branch of photography with which the picture is concerned. The maker of each print reproduced will be sent a copy of the book when published. “Zeiss Photography” will be copyrighted so that each photographer represented will be protected against unauthorized use of his picture.”

DEVELOPING WITH HYPO

WE know it sounds fantastic, but here’s the proof. The paper used is Seltona, one of the daylight papers, which, as its name implies, is printed in daylight. A collodion self-toning paper, it will yield, depending on whether it is bathed in water or a salt solution before fixing, a variety of tones ranging from reddish brown or sepia to dark brown, purple, or blue.

It sounds almost too good to be true, but no darkroom is needed because the printing is done by exposure to daylight, the progress of printing being observed from time to time until the full image is visible

from shadows to highlight details. At this point the print is removed from the frame and slipped into a hypo bath consisting of two ounces of hypo dissolved in a pint of water, where it is allowed to remain 10 minutes. The print is then washed for an hour and the result is a normal sepia print. To obtain tones from dark brown to blue all that is necessary is to immerse the print in a bath of common salt; the stronger the salt bath the colder the tone, a normal salt bath consisting of two ounces of common salt in 20 ounces of water. The print is kept moving in this solution for five minutes, then washed in clean water for a few moments and finally transferred to the fixing solution, which is followed by an hour’s bath in clean water. The paper comes in various surfaces and in sizes ranging from 3¼ by 4¼ inches to 8 by 10 inches, in single and double weight.

DECKLE-EDGE TRIMMER

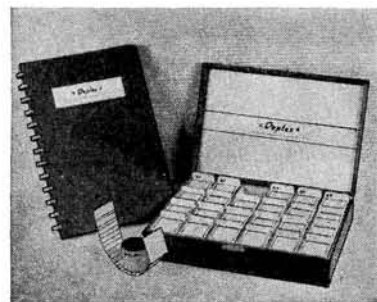
IF you have been wondering how the professionals get those nice deckle edges on greeting cards, here is the answer. They use a steel trimmer, one of the best of which is the Chandler 10-inch All-steel Deckle Trimmer. It is simple to use, no more difficult, in fact, than an ordinary trimming board, and is ideal for deckle-edging snapshots, Christmas and greeting cards, and other types of photographs. Uniformity of trim is assured by the all-steel blade and base, both of which are machine-cut and in perfect alignment at all times. The working plate is provided with a finely graduated ruler.

UNDERGROUND FOR PICTURES

ONE bright spot among many in the life of conducting a photographic department is the opportunity of gossiping with its readers about its adventures in picture-taking and of sharing with them its experiences in what we all agree to be the most attractive hobby of all. Take, for example, this department’s recent descent, in the course of a newspaper assignment, to the depths of manholes, those tight places under the street levels where men splice electric and telephone wires and repair cables and gas mains. Some of the pictures were of necessity taken within four feet of the subject because a solid wall of earth prevented



“Underground”



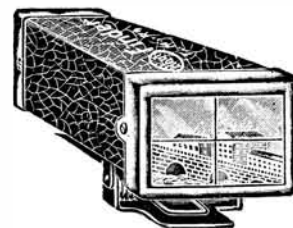
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getting any farther back, and it is to the great credit of the candid 35-mm camera that pictures were possible at almost the full opening of one of the fast lenses characteristic of these cameras. Yielding to an inspiration, this department lay on its back at the bottom of the hole, a clean piece of canvas being considerably provided for the purpose by the subject, and shot the latter's head silhouetted in the manhole opening against the sky. The accompanying illustration is the result.

NEW RETINA

INCORPORATING several improvements over the earlier model, which was introduced in 1935, the new Kodak Retina, one of the finest outfits in the low price miniature field, is now available with a new



Retina—latest model

type of F:3.5 lens. The Kodak Anastigmat Ektar, as it is called, is said to be ground with the greatest precision according to a newly computed formula and to be notable for its critical definition even at its full F:3.5 opening. It is of 50-mm (2-inch) focal length and, according to its makers, "generous enlargements which are amazingly sharp and rich in detail may be made from the negatives produced by this new lens." The lens takes the screw-in mount Retina filters, N-1, N-2 and N-3, Kodak Retina Portrait Attachments A and B, and Kodachrome and other filters in the No. 17 slip-over mount.

Its outward appearance enhanced by a covering of tooled leather and a trim of satin-finish chromium, the new Retina includes the following features: 36-picture film capacity, except in the case of Kodachrome, which offers 18 pictures on the regular 1 by 1½-inch size film; Compur-Rapid shutter with nine speeds from 1 second to 1/500 second, as well as bulb and time and plunger release; enclosed direct-view optical finder; depth-of-focus scale; large knurled knobs for rapid film winding and rewinding (automatic stop accurately centers each exposure); exposure counter and film release; duplicate focus and diaphragm scales for horizontal and vertical pictures; hinged back with improved safety latch; tripod socket; die-cast metal case to assure rigidity. Dimensions, closed, 4¾ by 3 by 1¼ inches; weight, 15½ ounces.

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Monsters & Madonnas, by William Mortensen. This is a book of methods for the artist-photographer, who glories in producing a finished print that contains more than was recorded on the original negative. The book includes a number of beautiful photographs ranging from portraits through nudes to the grotesque. \$4.15.

Practical Amateur Photography, by William S. Davis. Deals with the whole subject from the origin and growth of photography to the latest types and uses of cameras. 264 pages, illustrated. \$2.40.

Press Photography, by James C. Kinkaid. Amateur photographers may in some instances do well to ape the procedure of the press photographer. This book tells the whole story of the interesting work done by these men and contains many fine examples of their work. \$3.20.

Infra-Red Photography, by S. O. Rawlings. A treatise on the use of photographic plates and films sensitive to infra-red. Exposure and processing are fully covered; formulas are given for sensitizing. \$1.65.

The American Annual of Photography—1937—Volume Fifty-One. The cream of the year's photography, a series of articles on various phases of photography, and a miscellany of formulas and hints for the amateur photographer. \$1.65.

Elementary Photography, by Neblette, Brehm, and Priest. You can learn much of the fundamentals of photography from this little book even though you have little or no knowledge of physics and chemistry. \$1.15.

Photographic Enlarging, by Franklin I. Jordan. A complete treatise on enlarging, discussing not only the necessary equipment but all of the dark-room processing dodges which may be employed. \$3.70.

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ting properties of certain salts. An exposure of a second or a few seconds will cause the sheet to remain bright for hours or minutes depending upon the intensity and nature of the light source, which is learned by experience. The color of the light is green and for this reason Glims is especially recommended for use in processing panchromatic emulsions; but Glims has other uses also, such as illuminating a dark room timer, for labeling bottles of chemicals so that they may be found in the dark, for locating the darkroom light switch, and so on. Glims are obtainable in standard sizes, including 4 by 5, 5 by 7, and 8 by 10 inches. Other sizes can be made on special order.

FROM A MOVING TRAIN

WE do not ask you to admire the accompanying picture nor would we be offering it here if it were not to indicate how simple a matter it is to shoot a subject from a moving vehicle, in this case an elevated railway train. A 35-mm camera was used and an exposure of 1/100 second at



Taken from a moving train

F:6.3 was made on superpan film as the train was rounding a bend which afforded the view here shown. You have to be ready, of course, by making the camera adjustments in advance and getting the camera poised for a quick shot. Owing to the unusual angle of view afforded or because one might not be coming by that way again, this is a method worth trying on worth-while subjects that you see from your train window and perhaps may never see again.

POLARIZATION FILTERS

THE introduction of polarized glass filters into the field of photography, announced in this department quite a while back, to take undesired reflection and glare out of picture-taking, has recently been extended to accommodate quite a variety of lenses, including the miniature camera types. These new filters are known as the Marks Polarization Filters and are available, unmounted, in the following sizes: 19 mm, 25 mm, 31 mm, 39 mm and 51 mm, other sizes required being made up on order. The filter material is said to be "the only polarizing plate consisting of a single crystalline sheet with effective polarization throughout the entire visible spectrum" and because of its high transparency requires only two times increased exposure or a single diaphragm stop. The filter may be used with or without color filters. The filter is mounted in a regular filter mount. In use, the photographer looks through the filter, revolving it slowly until the glare is either partially or totally eliminated, when it is placed over the camera lens at exactly the same angle. When using reflex cameras, the filter is

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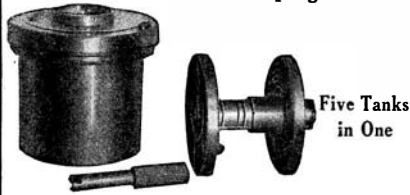
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placed over the lens and revolved, the elimination of glare being watched in the ground glass. The filters may be used with movie or still cameras and with any film.

TWO DEVELOPING TRAYS

ONE cautious worker uses two developing trays of D76 solution in processing film packs. The 15-minute period which he allows for full development at 70 degrees, Fahrenheit, is occasionally found too short for one or two of the films. These latter he drops into the second tray to identify them as those which seem to be "coming up" more slowly than the rest and therefore requiring longer development.

This same worker, incidentally, seems loath to use the larger lens openings although his camera is equipped with an F:3.5 lens. He prefers to give longer exposures, even to 1/2 second and a second, rather than open up the lens diaphragm and court the danger of a shallow focal depth. This is laudable indeed and a practice that many would do well to follow—provided, of course, that the subject-matter will permit it and a tripod is handy to make the longer exposures possible.

TREES IN WINTER

THE beauty of trees in winter ought not to be overlooked by the worker in search of the unusual. Shorn of the leaves that have taken a winter holiday, the branches are displayed to their full advantage, offering a variety of lines and shapes ranging from the thick trunk to the thinnest needle ends at the farther points. Etched sharply against an evenly lighted sky, they give the impression of fine needlework or cobwebs, the latter in all but design. The variety of lines and curves and forms gives sweep and movement such as is not easily found in trees when in full bloom.

Usually it is necessary to get fairly near the tree and to study its photographic possibilities by viewing the branches against the sky; often, also, the lower part of the tree will offer interesting pictures in the texture of the bark or the extraordinary arrangement of the thicker branches. Squirrels and birds lend a helping hand in many



Sun directly illuminating . . .



Against the brighter sky . . .

circumstances. Both pictures here shown were taken of the same tree, within a few minutes of each other, one with the light of the sun directly illuminating the subject, the other taken against the brighter part of the sky, giving a clean-cut silhouette. In all cases, when shooting during the full sunlight hours, a yellow filter will have to be used for a subject etched against the sky, although when the sun has begun to weaken this can be dispensed with.

THERMOMETER THAT SIGNALS

A THERMOMETER distinguished by the fact that it warns of danger ahead when the temperature falls too low or rises too high has been brought out under the name Photo-Thermometer. The signaling is done with color, the 50 degree point, the lowest temperature for effective fixing and safe washing, being green; the 65 degree point, the normal temperature for developing film, blue; and the 78 degree point, the melting point of gelatine, being appropriately red.

VERTICAL OR HORIZONTAL

WHETHER to give your composition a vertical or horizontal "frame" does not always depend on the position of your main subject. Ordinarily, you would say that in a portrait of the "head-and-shoulder" or standing type the arrangement would be vertical, whereas in the case of most landscapes it would be horizontal. However, it is necessary not only to see that the subject is properly placed within the frame but that the mood of the occasion, or the photographer's interpretation of the mood, is also given full consideration.

Let us take, for specific discussion, the accompanying illustrations, "The Day's News." See how much more intimate is the horizontally arranged picture than is the vertical one. The pretzel seller's withdrawal from all that is going on about him, although people are constantly walking back and forth on the sidewalk before him, is here indicated much more strongly. The

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"The Day's News"



inclusion of so much wall space also helps along the atmosphere of retirement, since it emphasizes the man's aloofness in a world of distractions. Also, the strongly prominent diagonal line of the jutting part of the wall offers support to the standing figure and, with the strongly lighted pretzel basket and box support, completes an attractive triangular composition. Contributing further to the general theme of quiet and exclusiveness in the midst of action is the contrast between the restless, relatively brightly lighted pattern of the wall and the greatly subdued lighting of the subject. It is this department's contention that in the vertical picture proper emphasis is overlooked.

TANK AGITATOR

A NEW device for agitating the developing solution contained in a tank used for processing miniature type film is announced by the Central Camera Company. While it is said to work "effortlessly," permitting one to "continue work with one hand while the other agitates the tank when necessary," it must be noted that the device works by hand. Known as the Trojan Agitator, its distributors describe it as follows: "The agitator is made of one piece stainless steel with a round rocker bottom and a grip-tight rubber top. Being of stainless steel it cannot rust or corrode. Operation is as follows: Place tank on the agitator and with a slight motion of the hand, the tank will rock up and back in a circular motion, distributing the developing solution thoroughly over the film."

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THE SCIENTIFIC AMERICAN DIGEST

(Continued from page 183)

Involved, the wider problem of "man performing the social activity science," for example; but that this, being on a different level of complexity and abstraction, will exhibit laws of a specific nature which have themselves to be the subject of study. This class composes materialists who are not mechanists.—Professor H. Levy in Nature (London).

SAVING SHAVERS' TEMPER

DULLING of razor blades has been found to be caused by corrosion rather than by use. Recently a new method of preventing the corrosion of razor blades and hence saving the temper of the shaver has been devised which consists in adding to the shaving cream a material to prevent corrosion. The useful life of the blade is reported to be materially prolonged by the addition of potassium chromate or other corrosion inhibitors to the shaving cream.—D. H. K.

"A TALE . . . SIGNIFYING NOTHING"

(Macbeth's Soliloquy)

I. In a younger and a plastic world Peopled by monsters, horrible and grim, Weird mixtures, part reptilian, partly birds, Cold-blooded, sinister, Swimming, crawling, Plodding, heavily winging, Lived finny Dimetrodons, horny Triceratops, Relentless Mosasaurs, unbelievable Pterodactyls, And some of these—a dreadful, bestial race— Were creatures which are called the Dinosaurs. Unwieldy, tall as a mast, Scaly, loathsomely thick, With snaky neck and tiny brain, A nightmare in rank flesh! They ate, drank, propagated, slept; They ate, drank, propagated, slept— And millions of years passed.

II.

Then on one steamy, unimportant day A group of Dinosaurs, a family, Moving in sluggish pace to satisfy One of the basic hungers of all life, Came to a stream to drink, Guzzled their fill and then, Lingering a while upon the river bank, Re-entered the forest, unwitting as ever. But on the impressionable sand At the meandering river's edge, they left Huge three-toed tracks! That very night the freshest came And the brown waters overspread the banks, Depositing their thick alluvial mud, Filling the three-toed tracks up to the brim; And in due time the waters receded, Leaving the mud behind.

III.

Age succeeded Age, And flood succeeded flood; Layer after layer of river mud

Formed rocks as the ages passed. Dinosaurs vanished away, But still the tracks were there— Buried, but still there!

IV.

And after more uncounted rounds of years Mankind came into being, And into lumpy bodies, in some mysterious fashion, Souls were injected. What was the source, and what the quality Of those first souls? Awful imagining! Could they have felt the dreadful pangs Of suffocation in their beastly tenements, Trapped and helpless, an agony of despair? Well, that we cannot know!

V.

Meanwhile, by changes in the river bed, By sun and wind, earth heavings, erosion, The tracks left by that lethargic Family of Dinosaurs are uncovered, Exposed to view!

VI.

Ages on ages more have slowly passed, And Mankind has developed to this day— Our brains a great deal larger in proportion Than were the brains of those great Dinosaurs. We eat, we drink, we propagate, we sleep, We eat, we drink, we propagate, we sleep. It's true we do a little more—that is, We write, and paint, and play stringed instruments, Design machinery, and raise huge piles of stone, And build fine bridges for the floods to crumple, And really think quite highly of ourselves! But tell me, please, what do we leave behind As lasting as the tracks of Dinosaurs? —Enid Crawford Pierce

TOWARD AN AROUSED PUBLIC OPINION

SO far as the lay public is concerned, the greatest factor in the control of cancer and tuberculosis has been the publicity these diseases have received. Press, magazines, placards, radio, all have made familiar the early symptoms, emphasized the consequences of neglect and the necessity of reputable medical care, and, as for tuberculosis, laid stress on the public health menace. Any adult who can hear or read has been repeatedly told, in brief but telling slogans, that "any lump in a woman's breast may be cancer"; "don't spit—spitting spreads disease"; "beware of the chronic cough—it may be tuberculosis"; "consult your doctor at once if you have so and so." The people are, to use the advertising man's phrase, cancer- and tuberculosis-conscious.

The dissemination of similar knowledge concerning syphilis has, however, been left almost entirely in the hands of the advertising quack. Legitimate organized medicine and public health officials have done little or nothing to inform the public of syphilis, its prevalence, what it is, what its symptoms may be, how it infiltrates all levels of society, how it attacks innocent women and children, how and where it may be treated, what may be the consequences of neglect. Most laymen know none of these things.

If the people have this information, more of them when infected will consult their doctors, and, of greater public health importance still, more of them will come

early and will stay under treatment. An aroused and organized public opinion will aid in the elimination of the quack, charlatan, and cultist. Drug-store treatment may be at least partially controlled by co-operation between public health officials and the pharmaceutical profession.—*Dr. Joseph Earle Moore in the Journal of the American Medical Association.*

ICE BY WIRE

SALES of electric refrigerators in 1936 reached a new high mark of 2,037,746. This figure represents an increase of 30 percent over those sold in 1935. Last year's sales bring the total number of electric refrigerators in use in the United States to 9,287,746.

INDUSTRY USES PRECIOUS METALS

EXPENSIVE metals having unique properties frequently pay for their added cost by saving operating expenses in chemical plants. Recently the substitution of the rare metal tantalum, once familiar in the filaments of electric lamps, for a cheaper metal increased the cost of a piece of chemical plant equipment 150-fold. Yet output was doubled in the tantalum unit and the product was of superior quality, so that this precious metal paid for its enormous cost in the short space of eleven months. The special value of tantalum is that it is not corroded by many chemicals, nor do surface films of "rust" form on it to waste heat. Silver has been found similarly useful in heaters and coolers used in the food and beverage industries in addition to numerous specialized chemical applications. Not only are operations in plants made more economical by the use of these metals, but the high scrap value of equipment made from them offsets first cost.—*D. H. K.*

WHERE MAP STUDENTS HAD THEIR WAY

AS everybody knows, it is fascinating fun to pore over maps and globes, and a great many shortened trade routes have thus been worked out, to the world's everlasting benefit. Likewise, however, some other shortened routes have been worked out to the world's everlasting chagrin. Give a man a map, let him hatch an idea for a shortened trade route, and the idea so fills his field of vision that it sometimes excludes everything else, including such minor trifles as practical economics. If you get out a map—or far better a globe which does not distort—you will see how much shorter it is from Canada's great wheat belt to Great Britain by way of Hudson Bay and Hudson Strait than by the more southern route. So appealing was this idea that human nature worked out in Canada just the same as it does in U.S.A., and a government railroad was built to Hudson Bay. Now, after some years of operation, we find in *Railway Age* the following brief account of the actual results:

"Fort Churchill, Canada's farthest north railway grain terminal, and the Hudson Bay Railway are receiving a rough ride. Both

the Conservative and the Liberal parties at Ottawa a few years ago engaged in a competition of voting for the western vote and the result was that both of these parties became committed to building a railway outlet for grain in Hudson Bay. The Hudson Bay Railway was built at a cost of at least 60,000,000 dollars and the terminal facilities, first began at Port Nelson and then moved farther north to Churchill, cost at least 10,000,000 dollars more. In the six years of operation up to this fall a total of a little over 16,000,000 bushels of wheat has been moved out of Churchill by vessels to Europe.

"Figuring the total cost of the grain route for western growers at not less than 70,000,000 dollars, the cost per bushel of wheat actually moved up-to-date is four dollars, and this in spite of a highly efficient management and exceedingly generous marine insurance rates on boats which have to traverse Hudson Strait which is regarded as highly hazardous."

Hudson Strait as a navigation route combines, or rather, compounds, icebergs with a very high, rapidly moving tide. Neither of these "minor inconveniences" showed on the map. New York State once built a barge canal to carry America's grain to the seacoast and here, too, various "minor matters" did not show on the map. Now a canal is being strongly urged for Florida. On the map it looks fine, and it is said to look fine to some local communities.

Human nature appears to be fairly similar, the world over.

BETTER SOAP

ADDITION of small amounts of salt, sodium sulfate, or sodium phosphate to soap, the alkalinity of which has already been adjusted to give the best results, improves its washing effectiveness. Five percent of added disodium phosphate has been found to increase brightness of the washed samples of goods more than 27 percent, as compared with soap alone.—*D. H. K.*

ON NOT BEING SCIENTIFIC

IT may sometimes be unscientific to be too "scientific" about the food given to infants. We recall an article in the *Journal of the American Medical Association* ("What Infants on the Self-Selected Diet Experiment Eat," 1930, pages 137-146) which described experiments in which babies were daily surrounded with a wide variety of foods, some of them not usually regarded as suitable for infants, and allowed to grab at will. In many cases the infants chose and ate immense amounts of some one food—enough, according to some solicitous grandmothers, to kill them—and exactly *nothing* happened. The experiments possibly tended to bolster the theory that infants, like other animals, instinctively know what is good for them—what their bodies crave—and eat it if they can get it.

The following paragraphs are from an article in the same journal, 1936, pages 765-768, by Dr. Clifford Sweet, of Oakland, California, and we reprint them because we like their common sense as applied to normal children:

"The young mother must be taught that the formula prescribed for her infant is made sufficient to allow him all the food

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he wants and that it should be offered at prescribed intervals. When additional foods are prescribed they should be given in small amounts, and, if they are resisted, a taste for them should be taught gradually. Human nature has always yielded more readily to seduction than to violence.

"Few mothers realize that the components of a balanced diet need not all be eaten every day. They must be assured that a commonly taken and necessary food should be omitted without opposition for days whenever the child tires of it; the child's body has abundant stored-up supplies to draw on during the holiday, and when he needs the food he will take it gladly.

"Children who are allowed to omit a food at will do not develop a lasting dislike for it as they do when it is forced on them against their will.

"Malnutrition has been over-emphasized until it has become a menace to the peace of mind of mothers.

"Not every child needs a quart of milk daily and he should be given credit for the milk he takes with other food as well as that drunk.

"Temporary loss of appetite may mean nothing except that the child is not hungry, while a more prolonged absence usually is the first symptom of illness and the most dependable symptom of the need for a careful physical examination.

"The strict interdiction of all foods from his diet which the child says 'I do not like' for a few days or weeks often changes at least the greater number of them to the highly desirable list for which he will then ask."

diameter of 15 feet. Designed to operate at 100 pounds steam pressure, this 65,000 gallon unit is of all-welded construction with the exception of the cast-steel door rings and door head, which are attached with rivets.

It has a vertical rising door operated by screws with motor power. A standard gage 90-pound railroad track is installed in the vulcanizer so that tanks can be moved in and out on specially constructed steel cars.

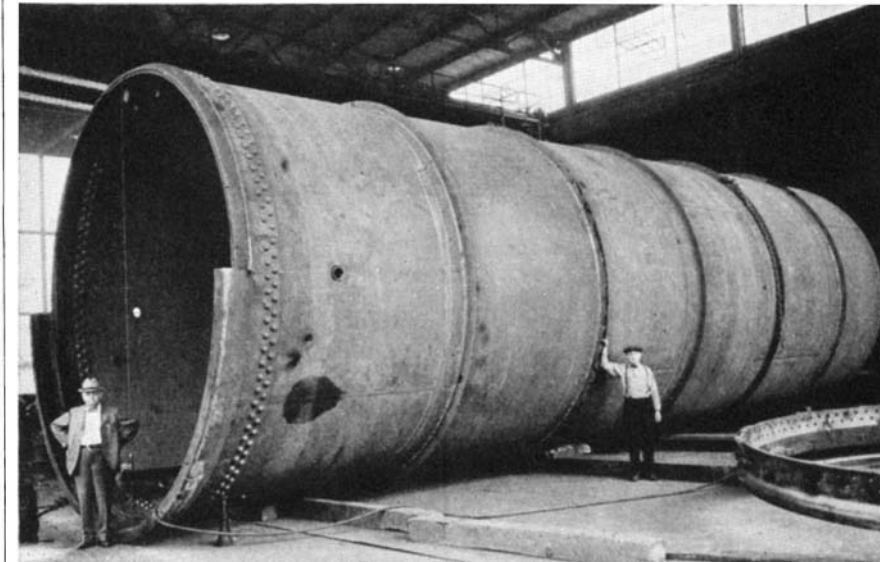
The primary advantage of this mammoth vulcanizer is that it will now be possible to complete large rubber lined tanks in considerably less time than was previously required.

BERYLLIUM-COPPER ALLOYS

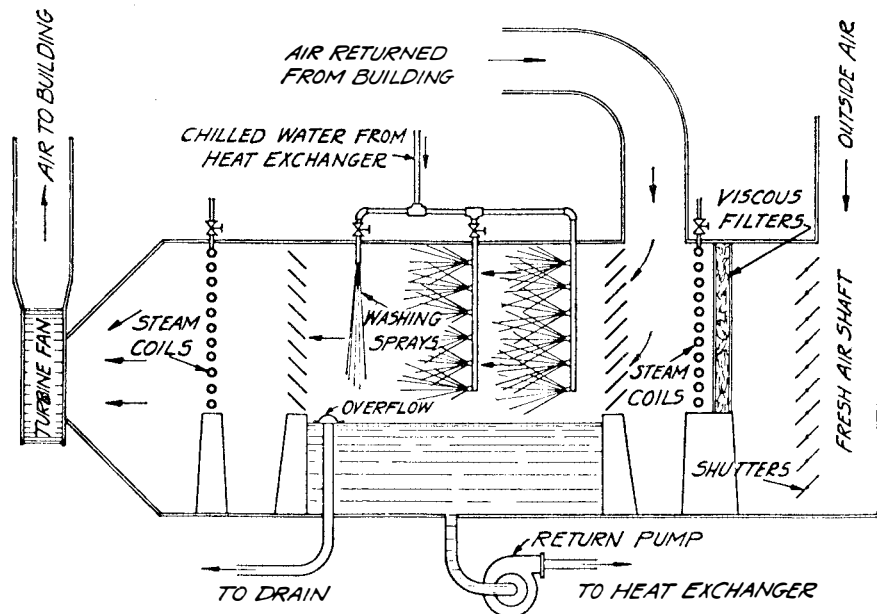
BERYLLIUM, the rare element contained in the gem stones, emerald and beryl, is now produced in commercial quantities and used for imparting valuable properties to copper alloys. These alloys, containing only about 2 percent of this rare metal, have rapidly developed to great commercial usefulness. In summarizing developments in this field, Horace F. Silliman recently made the following statements.

"In many cases beryllium-copper has been substituted for other copper alloys and for steel, even though it is relatively more expensive than the older alloys. The wrought alloy goes into the manufacture of springs and other articles having spring parts. Springs made from this alloy have the corrosion resistance of copper plus high resistance to fatigue, high resilience, and low hysteresis loss. In addition to coiled springs and flat springs, the list of spring-like parts includes diaphragms, fuse clips, current-carrying contact springs, spring washers, switch blades, and many other articles. The alloys are particularly adapted for instrument parts because they are non-magnetic.

"The comparatively high hardness and shock resistance of beryllium-copper permits it to be used for non-sparking hand tools such as hammers, chisels, wrenches, wrecking bars, drift pins, scrapers, and the like, and for pistons in vibrators and firing pins in firearms. The good wear resistance is advantageous in precision bearings, bushings, ball cages, adjustable-pitch propeller



Shell of the huge vulcanizer for making rubber-lined tanks



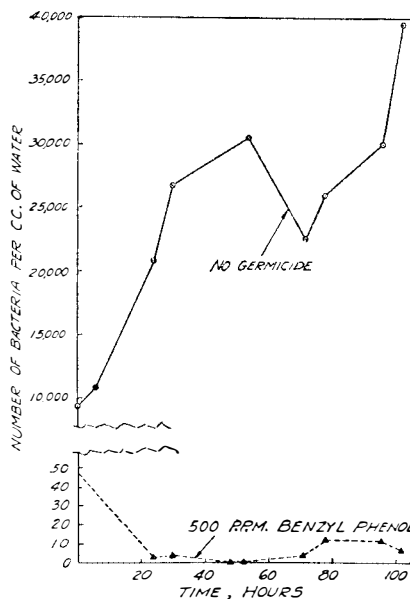
Bacteria in re-circulated conditioned air systems such as this can be controlled

hub cones, gears, and sliding contacts. Other commercial uses at present are platers' bars and cores, retractable landing-gear parts, surgical instrument handles, woven wire cloth, bolts and nuts, molds for plastics, and valve parts.

"In about four years these remarkable alloys of one of the oldest and one of the newest of the metals used by man have assumed considerable commercial importance."—D. H. K.

PREVENTING INFECTION WITH CONDITIONED AIR

MODERN air-conditioning systems which re-use the air of the conditioned space and allow it to accumulate bacteria appears as a new menace to health, but fortunately one easily controlled. Addition of germicidal agents which kill germs but do not increase corrosion of equipment effectively reduce the number of bacteria in the water used to wash air. Organic disinfectants of the benzyl phenol type have been found particularly effective.—D. H. K.



Upper chart: Rise in bacteria in re-circulated conditioned air. Lower: When germicidal agent is used

ELECTRICITY

THE people of the United States now use over four times as much electric power per capita as the average for the rest of the world.

DENTAL CAVITIES AND DIET

IN spite of the facts that there are more dental clinics, that many more people brush their teeth, and that more dental treatment is practiced today than ever in the world before, dental disease seems to be as prevalent as it has ever been, especially among civilized peoples. The experimental work of Mrs. Mellanby has shown that there is an intimate relationship between the diet and the structure of the teeth in both animals and man, and that there is similarly a close relationship between structure and liability to caries in man. It remained to be proved that the incidence and progress of

the disease could be influenced by alterations or additions to the diet.

The final report [The Influence of Diet on Caries in Children's Teeth (Final Report). By the Committee for the Investigation of Dental Disease (assisted by Alan Deverall and Mabel Reynolds)] of the Committee for the Investigation of Dental Disease describes the influence of diet upon caries in children's teeth and shows that the teeth, like other organs of the body, are strongly influenced by nutritional factors brought to bear upon them, whether through their blood supply or the saliva. The dental decay that developed in the children receiving an addition of Vitamin D to their diet was definitely less than in the control children not receiving extra vitamin, and its influence in inhibiting the initiation and spread of caries was especially impressive when the addition was made during the period of development and before full eruption of the teeth.

The investigations were made in three

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similar institutions. Three experiments were carried out. In the first, the three institutions had daily additions to the diet of treacle (28-42 gm.), olive oil (14-21 c.c.) and cod-liver oil (14-21 c.c.); 50-100 units of vitamin D per c.c.) respectively. In the second, carried out in one institution only, one group of children received the olive oil and the other Vitamin D in olive oil (625 units per c.c.: 14-21 c.c.). In the third, the children were younger (2-5 years old) instead of 5-14 years old, and the additions were treacle, vitamin D in olive oil, and cod-liver oil in daily doses of 7 gm. or 7 c.c., in three different institutions. Although about 1600 children were under observation for varying lengths of time, the number who received the special additions for the full period of three years was much less.

Summing up the results of these extensive experiments, it may be concluded that a relatively high intake of vitamin D can do much to diminish the incidence of caries if the vitamin is given during the period of development of the teeth: that a beneficial effect may be obtained if it is given at a fairly late stage of development; and that even when it is given after the eruption of the teeth, the onset and spread of caries are delayed.—*Nature* (London).

Oo-o-oo!

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110 ciphers—is Dr. Karl T. Compton's estimate of the total number of the smallest things in the universe (the electrons) which could be packed side by side into the largest volume so far measured (the limits of the present known universe).

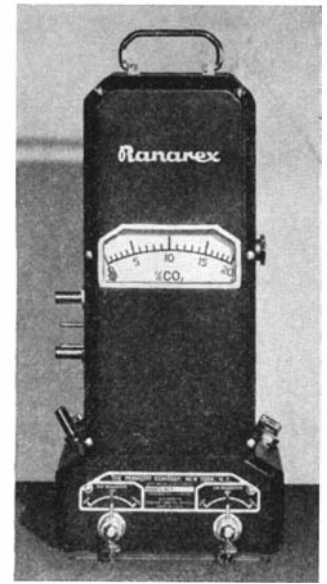
CO₂ DETECTOR

A PORTABLE line of instruments for determining the CO₂ content of flue gases of boilers and furnaces, and also for determining the air-fuel ratio in the exhaust gases of internal combustion engines, in order to permit adjustment of the air-fuel ratio for maximum efficiency and best performance, has been announced by the Permutit Company. This instrument determines the CO₂ content of air-fuel ratio by a mechanical principle based on the fact that the specific weight of exhaust or flue gases varies with changes in air-fuel ratio or CO₂ content. This principle has been well proved by Ranarex CO₂ recorders long in use in both stationary and marine steam power plants.

In order to obtain a substantial force as a means of measuring the specific weight of the exhaust or flue gas, a rotating motion is imparted to the gas by means of a motor-driven fan revolving in a chamber. This fan blows the gas against the blades of an impulse wheel, thus producing a torque on the shaft of the impulse wheel in proportion to the air-fuel ratio, or CO₂ content. Changes in fan speed, temperature, humidity, and at-

mospheric pressure are automatically compensated for by a comparing torque produced on another impulse wheel by air to which a rotating motion is imparted in a second chamber by a second fan driven by the same motor. The two impulse wheel shafts are coupled together by means of a balancing linkage, actuating the indicator, the scale being calibrated in terms of air-fuel ratio or CO₂.

The instrument may also be furnished with scales reading in terms of specific



Portable CO₂ indicator

gravity for use in gas plants or natural gas fields. For use with internal combustion engines a vacuum or combined vacuum and pressure gage is built into the instrument to permit measurement of the pressure in the intake manifold. The Ranarex gas analyzer, by reason of its mechanical principle and rugged construction, is a practical instrument for hard service. It is readily portable and can be furnished to operate either on lighting circuits or on standard six-volt automobile batteries.

QUALITY OF CIGARETTE SMOKE

A PPLYING a method of mechanical smoking of cigarettes, research workers in one of the large tobacco companies have learned important facts about the quality of smoke and why certain smokes are harsh and others smooth. In summarizing their results in a recent issue of *Industrial and Engineering Chemistry*, they say: "The most marked difference in the smoke of various types is found in its relative acidity, and this is related to the quantity of sugars in the tobacco. These may be the natural reducing sugars of the leaf, or added glucose, invert sugar or sucrose. Although sugars contribute somewhat to the quantity of smoke acids and increase slightly the proportion of formic acid, their principal function is reducing base formation. The alkaline tobaccos are definitely rich in aroma, which contributes to smoke quality when the excessive formation of bases is restrained. The added sugar seems to reduce ammonia proportionately more than nicotine. The paper in which a cigarette is wrapped yields some acid on combustion. However, the pro-

portion of paper to tobacco is small and relatively constant (about 4 percent).

"The association of the composition of cigarette smoke with taste sensations leads to some generalizations concerning palatability and chemical constituents. When smoke is alkaline or in too high concentration, the bases act as irritants, causing a choking sensation and frequently stimulating the cough reflex. Yet, without a sufficient amount of bases, smoke is flat and lacking in character. Nicotine and ammonia are not interchangeable in the base fraction. As the proportion of nicotine increases from the lower extreme, the smoke (weak and somewhat irritating) becomes smoother and more satisfying; as the other extreme is approached, it becomes heady and deficient in flavor and sensibly more acid. These changes may be masked, however, by added flavor or, as in the case of the Turkish cigarette, by the natural aromatics of the tobacco plant. The acid type of smoke is described as harsh or sharp. Tongue bite and throat irritation are more noticeable. Formic and acetic acids comprise the greater portion of smoke acids and, through their local irritant action, seem to be responsible for the effects noted."—D. H. K.

EARTHQUAKE FIRE-VALVE

APPROXIMATELY 5 percent of the damage done to San Francisco at the time of the earthquake was due to the earthquake itself, the remaining 95 percent having been caused by the fire which resulted mainly from the breakage of gas pipes and gas mains.

Much work has been done by architects and engineers to prevent a recurrence of such a disaster. In regions subject to earthquakes, building codes and building methods have been radically revised to prevent, as far as possible, the danger to lives and property caused by falling walls. This is extremely important because fire insurance policies usually state that an earthquake may technically render the policy instantly void. Until walls can be so built that earthquakes will not topple them, the property owner is faced with the problem of preventing fire on his premises. And this is often impossible because an earthquake may smash all sprinkler and water lines.

A company on the West Coast—the Water Works Supply Company, Inc.—has, therefore worked out a simple and most ingenious valve, to be placed in the gas feeder line, which operates to cut off the gas im-

mediately there is an earthquake or a serious shaking of the building. The Fire-Kwake valve consists essentially of a non-corrosive metal ball which normally rests upon the top of a small pin, so that when shaken, it falls to one side and seats itself tightly into a circular hole. Seated therein it effectively bars further flow of gas. The ball is attached by a small chain to a screw plug immediately above its pin rest. To reset, it is only necessary to remove the screw plug, lift the ball, and drop it upon the pin. In addition to the automatic earthquake shut-off feature, the valve is provided with a thermostatic control, comprising a thermostatic valve at the bottom of the pin support, and, in the intervening space, a fusible metal link. Should the area surrounding the valve become heated to the danger point this control also automatically drops the ball to cut off the gas.

FISH-FLOUR

A HEALTH decline among Japanese students, due to their adoption of the American custom of eating a snack of bread-and-jam, has inspired Japanese research to develop a fish-flour (without the accompanying disagreeable smell and taste) for those who still feel that they wish to eat bread similar to that of the Occident.

PREVENTING CYANIDE POISONING

CONTROL of the sale of lethal poisons which are used in industry has been found to reduce but not prevent deaths from them. The Japanese Department of Home Affairs is sponsoring a movement to add a disagreeable odor and distinctive coloring to potassium cyanide in the hope of reducing accidental and suicidal deaths caused by it.—D. H. K.

HIGHWAYS WILL BE SAFER: DRIVER REMAINS A PROBLEM

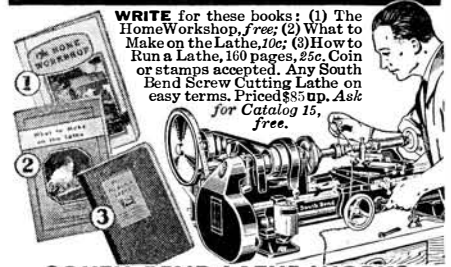
THE main highways of the future are pictured by Thomas H. MacDonald, Chief of the United States Bureau of Public Roads, as broad, unobstructed surfaces over which traffic can flow smoothly with safety and comfort. In discussing the work the state and federal governments are doing to make the main highways safe under modern traffic conditions, he said:

"There will be provided for motor vehicle operators of the future roadways that can be used with safety by the reasonably careful driver.

"The roads of the future will have traffic lanes wide enough for ample clearance. That means that at the speeds we now foresee we will want a 22-foot road for two-lane traffic. It will have shoulders wide enough for stopping, with no deep side ditches. Its surface will be consistently smooth and non-skid. It will be so designed as to alignment, profile, and cross section that at no place will the traveler suddenly encounter the unexpected or come into traffic so slow that if impatient he will be tempted to take a chance.

"Where the traffic is so heavy that two

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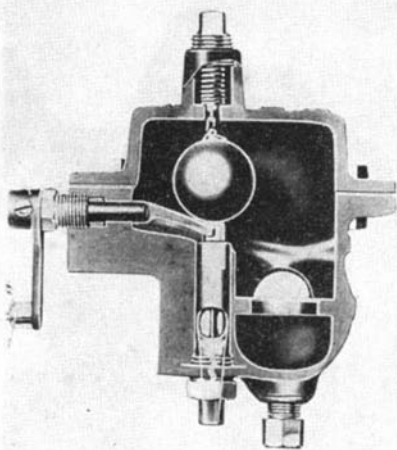
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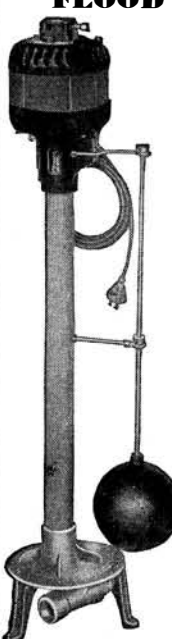
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lanes will not carry it, there will be four-lane roads. But they will consist of two lanes on each side of a center parkway; there will be no chance to meet opposing traffic as there is in the present road with four contiguous lanes. Most engineers endorse the principle of separated-lane roads wherever more than two lanes must be provided to carry the traffic.

"More highways will be lighted, no doubt, but the amount of lighting will depend on the funds made available for highways and on whether we find that we can spend the money in any other way that is as effective in preventing accidents. Greater dividends in lives saved per thousand dollars of expenditure would result from construction of foot-paths along heavily traveled routes and from separation of grades at intersections of main traffic arteries than from a general lighting program.

"However, lighting will have a place in the future program. Old methods of lighting are inefficient and of doubtful value, but marked improvements are being made. We must experiment to produce a thoroughly efficient system of lighting. We must also light experimental sections of highway and accumulate accident records as a guide in determining where the expense of lighting is justified. I think it is clear that lighting for all roads is not possible now. Installation is not expensive, but operation would cost more than all the other items of highway maintenance put together. And, as it is, most highway departments do not have enough maintenance money to keep the highways in as good shape as they would like.

"We will have pedestrian walkways at a safe distance from the highway surface; also, on heavily traveled roads we will have surfaced areas where busses may pull out of the stream of traffic to receive and discharge passengers; and turn-outs for R.F.D. carriers to use in serving the boxes of their patrons. The danger spots which cannot be eliminated by reason of great expense will be plainly indicated by signs that will advise the motorist what speed is safe.

"The highway engineer's part in promoting highway safety is to design highways that are safe for reasonably careful drivers; that is, highways as safe as they can be built with the funds available. They will be highways on which you can pass an overtaken vehicle with safety, highways that will not confront a driver with hazardous conditions without ample notice or warning. When this has been accomplished, the highway will occupy its proper place in supporting the safety triangle of the road, the vehicle, and the driver. But finally, safety will always rest with the driver."

SOME PULL!

DEVELOPMENT at the Massachusetts Institute of Technology of a compact magnet capable of producing the highest permanent magnetic field ever attained has opened the door to a new and significant field of exploration in the world of matter. The new magnet was designed by Dr. Francis Bitter of the Department of Mining and Metallurgy, and the magnetic field produced in its first test was 150,000 times more intense than the earth's field, the effect of which is commonly observed in its influence on the compass needle.

Scientists have long known that strong

magnetic fields change or distort matter, thus altering its properties in a great variety of ways. For such fundamental research magnetic fields of great intensity are necessary and the quest for methods of producing them has been carried on actively for many years. Until recently, however, the types of apparatus available



The newly developed high-field-strength magnet is inside the jacket on which Dr. Bitter is leaning

only partially met the demands, either because the intensity of the desired fields lasted for only a fraction of a second, or because, as in the case of the iron-core magnet, the field covered too small a volume for practical applications.

Technology's new magnet was designed to produce fields of at least 100,000 gauss, the unit of measurement for magnetic fields, and in its preliminary test in which no attempt was made to develop its full capacity, a field of 75,000 gauss was produced and maintained for a considerable period of time. The enormous amount of power required to produce this field was made available to Dr. Bitter through the co-operation of the Edison Electric Illuminating Company of Boston, which placed at his disposal laboratory space in one of its large substations. With controlled direct current up to 12,000 amperes at 250 volts to draw upon, the first test was successfully carried out with a maximum current of 8000 amperes producing a field of 75,000 gauss. The intensity of the earth's field is slightly less than half a gauss.

The copper coil of this unique magnet, which is only eight inches long, six inches in diameter, with an inside diameter of one inch, is enclosed in a bronze shell. A water cooling system is employed to dissipate the enormous heat generated when an amount of power sufficient to supply a small town, or more energy than is needed to operate 50 automobiles of 80 horsepower each, is poured into this amazingly small piece of apparatus. Without water cooling the magnet would melt and be rendered worthless within one second.

Because of the very heavy power load and the strength of the magnetic field, precautions were taken to protect the research

staff and the electrical machinery. The two huge bus bars carrying the current to the magnet each consisted of six strips of copper six inches wide and a quarter of an inch thick bolted together.

COLDS

ONE of the latest estimates states that the common cold costs the United States a half billion dollars each year.

FARM WOODS INCREASE

ONE result of the depression has been to increase the areas usually classified as farm woodlands. This has occurred chiefly in the industrial states where lack of employment in cities caused migration to cheap lands where a living could be eked out from the forest and small areas of tillable ground, says the New York State College of Forestry at Syracuse University.

According to the United States census, during the five-year period between 1930 and 1935 woodland on farms increased 23.7 percent or approximately 35,529,000 acres. This brings the total farm woodland area in the United States to 185,000,474 acres.

These figures indicate the importance of farm woodlands as a source of timber. The Forest Service estimates that approximately one third of the total cut of timber is produced from farm woodlands. A larger acreage is devoted to farm forests than any other land crop. The increase in the forest area on farms was far in excess of the increases of the total farm area which was only 7 percent as against 23.7 percent for woodlands. This increase in farm forests also is partially accounted for through the abandonment of cotton and corn fields in the South and to a small extent in other sections.

FATTY OILS AS MOTOR FUELS

In Belgium, contests for prizes offered by the Royal Automobile Club have shown that automobiles and particularly trucks can be operated on cotton-seed oil and palm oil. A five-ton truck using cotton-seed oil is reported to consume about 27 liters of the oil as fuel per 100 kilometers, equivalent to 8.71 miles per gallon, or 11.5 gallons per hundred miles.—*D. H. K.*

PROTECTIVE COATING FOR METALS

MOST people are familiar with the microscopic coating that has been used for years on certain silver articles, such as candlesticks, to prevent tarnish. This principle has been expanded in the development of a new transparent protective coating for all bright metal surfaces. The new coating, called Cellufoil, announced by the Evans-Walton Company, when applied as a liquid, hardens quickly and becomes a tough, adhesive top layer. It is said to preserve indefinitely the natural bright luster of any of the usual plating metals such as chrome or nickel.

Cellufoil has a nitro-cellulose base and can be applied by either brushing or spraying. It is being marketed in 4, 16, and 32

ounce, and one gallon containers through accessory chain stores and repair shops. Its price is reasonably low.

The chief virtue of Cellufoil is that it is not affected by weather conditions or normal temperature changes. It does not start to break down under a temperature of 270 degrees, Fahrenheit. Because of this weathering ability it is being recommended for all the metal parts of automobiles and for the brass and copper of boats, in which latter service it protects against the harmful and corrosive action of salt water and air.

REMOVABLE PRINTING INK

TO make easier the recovery and re-use of the wood pulp of newspapers and other printed matter, German chemists are reported to be developing an ink which does not contain lamp black and which consequently will be more easily removed from the paper.—*D. H. K.*

MORE DUST

NEARLY a billion particles of dust—or 900 million, if we must be exact—pass through the lungs of city dwellers each minute. Of these microscopic particles 90 million are left behind in the lungs, according to Dr. Helmut Landsberg of Pennsylvania State College.

PRIMITIVE PARADOX

PAPUAN natives are becoming sport-conscious and are discarding their old "skull-crusher" clubs for golf clubs, according to J. T. Jennings, member of the Australian Parliament who has recently been on a trip to New Guinea and Papua.

"Some of the magnificent specimens amongst these people," said Mr. Jennings, "could, with proper coaching and training, become athletes equal to the world's best, worthy to compete in the Olympic Games."

The Papuans are the most air-minded people living. On the gold-fields in the interior, 50 natives can be seen riding in one airplane. They know no other kind of transportation. The Papuans have never seen a train or a taxicab but they know all about flying.—*Australian Press Bureau.*

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AUTOMATIC transmissions for motor vehicles finally passed out of the speculative and experimental state with advices from Chicago that 101 automatic transmissions in regular bus service there have accumulated a total of some 1,300,000 miles of operation with the total building up at the rate of some 20,000 miles per day.

The transmissions, of the Banker "Mono-Drive" type, are installed in 101 new rear-engine, double-deck motor-coaches produced by General Motors Truck Company and operated by the Chicago Motor Coach Company. A feature of the transmission is that it eliminates both the gearshift lever and the clutch pedal. Thus the operator has only two foot controls: accelerator and brake. A

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Early in 1936, however, the Carnegie Institution of Washington made the startling experimental discovery that such a force of attraction (now known as "super-gravitation"), actually exists!

Now that supergravitation has been discovered experimentally, the savants of Franklin Institute announce that they have found an "explanation" for it in Einstein's equations. Such wisdom after the fact would be more convincing if it had been published, like the author's prediction, prior to the experimental discovery thereof.

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THE IDENTITY THEORY

By Blamey Stevens

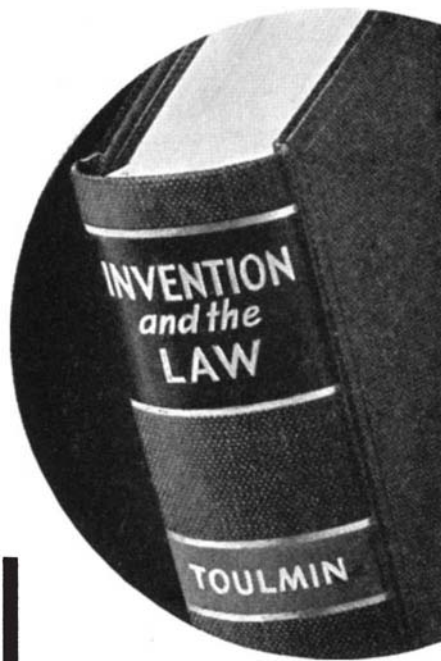
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LEGAL HIGH-LIGHTS

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

By **ORSON D. MUNN, Litt.B., LL.B., Sc.D.**

New York Bar
Editor, Scientific American

TRADE MARKS—SECOND HAND

A MANUFACTURER or dealer may recondition used articles of merchandise of another manufacturer but in reselling the reconditioned merchandise he can not employ the trade mark of the original manufacturer.

This question recently came before a United States District Court in a case involving a well-known brand of spark plugs. In that case the spark plug manufacturer was the plaintiff and he sued the defendant, charging among other things that the defendant was infringing his trade mark by selling reconditioned spark plugs bearing plaintiff's trade mark. The spark plugs were originally manufactured and sold by the plaintiff and after they had been used for some time were discarded by the user and purchased by the defendant who reconditioned the spark plugs and then resold them without removing plaintiff's trade mark. The defendant, however, had taken the precaution of stamping the word "Used" on the spark plugs, and the boxes in which the spark plugs were resold by the defendant contained a printed statement indicating that they had been reconditioned by the defendant.

In spite of these precautions the court held that the defendant had infringed the plaintiff's trade mark by selling the reconditioned spark plugs with the trade mark thereon and ordered that the defendant should be restrained from thereafter selling the reconditioned plugs without first removing the trade mark therefrom. In reaching this conclusion the court found that the reconditioned spark plugs did not represent the high quality of plaintiff's product and in this connection the court stated:

"The plug here involved has undergone such changes since its manufacture and sale by the plaintiff that it no longer can be said truly to represent the quality usually associated with and belonging to plaintiff's product when first made and sold by plaintiff, the product by which it made its reputation with the public. The plaintiff, therefore, is entitled to prevent its resale to the public under his trade mark."

EXPANDING SYMBOLS

THE decision in the spark plug case, referred to under the heading "Trade Marks—Second Hand," is but one of several recent judicial pronouncements recognizing the growing importance of trade marks in modern commerce.

Business men have long recognized the fact that they can not adopt or copy the trade marks of their competitors without

subjecting themselves to liability in suits for trade mark infringement or unfair competition. Many do not recognize the fact, however, that where merchandise has been sold with a trade mark affixed thereto, the purchaser of the merchandise can not so use or abuse the merchandise with the trade mark affixed thereto as to destroy or injure the good will symbolized by the trade mark.

Thus, in the spark plug case referred to, the purchaser of the spark plugs could not recondition them after they had been used and then resell them with the trade mark of the original manufacturer, and in the case referred to in this column last month under the heading "Price Fixing," the United States Supreme Court held that under the Illinois Fair Trade Statute a retailer could not resell merchandise bearing the manufacturer's trade mark at prices lower than those fixed by the manufacturer.

The fundamental reason underlying these decisions is to be found in the fact that a trade mark symbolizes the good will of the proprietor, and as such is a form of property. When the proprietor sells merchandise with his trade mark affixed thereto, he parts with ownership of the merchandise, but does not part with the trade mark affixed to the merchandise.

The Supreme Court, in the Illinois Fair Trade Statute decision referred to above, summed this up in the following statement:

"The ownership of the good will, we repeat, remains unchanged notwithstanding the commodity has been parted with."

When the full implications of this statement are realized by business men and legislators, rapid strides can be made towards eliminating many of the annoying unfair trade practices which exist today.

REPAIR BUT BEWARE

CAN the purchaser of a patented article repair or rebuild the article without subjecting himself to liability for patent infringement?

This question is by no means free from difficulty. However, the law may be briefly summed up as follows: The purchaser of a patented article may make all reasonable repairs to maintain the article in good condition during its normal life. He can not, however, substantially rebuild or reconstruct the article so that in effect a new article is substituted for the original one.

It is obvious that difficulty arises from time to time in distinguishing between reasonable repair, on the one hand, and substantial reconstruction, on the other hand. In the spark plug case referred to under the heading "Trade Marks—Second Hand," the plaintiff, who was a prominent manufacturer of spark plugs, was the owner

of a patent under which the spark plugs in question were manufactured. The defendant purchased used spark plugs whose efficiency had been impaired but whose usefulness had not been completely exhausted, and then reconditioned the used plugs and resold them. The plaintiff charged that the reconditioning constituted infringement of its patent. The court neatly summed up the question involved in the following statement:

"Whether the acts of the defendant here complained of amount to an infringement of any patent of the plaintiff depends upon the question of whether such acts constitute a reconstruction of the spark plug involved or merely a repair of such spark plugs."

The conclusion was then reached by the court that since the reconditioning took place during the normal life of the spark plugs and since no additions were made to the spark plugs, defendant's acts merely amounted to a reasonable repair and did not constitute patent infringement. In reaching this conclusion the court stated:

"In view, however, of the facts already stated as hereinbefore found, I can not avoid the conclusion that the defendant has merely exercised the right which, in my opinion, he had to make what are in substance and effect repairs to these spark plugs and, therefore, that he has not thereby infringed any patent of the plaintiff."

A typical case of reconstruction amounting to patent infringement is found in another case decided by the Federal Courts in which the owner of a patent for an incubator sued the purchaser of one of the patented incubators for enlarging the incubator so as to increase its capacity. In that case the court found that the alteration of the incubator so as to increase its capacity amounted to reconstruction and so changed the original nature of the device as to constitute patent infringement.

IN UNION THERE IS — ?

REFRAIN, if you wish, from selling your merchandise to any customer or to any group of customers for any reason whatsoever, but in so doing be sure that you do not combine with others in your refusal to sell.

The Federal Trade Commission recently proceeded against a group of prominent magazine publishers, alleging that they had combined together in a refusal to sell their magazines to retail magazine dealers who handled second-hand or back-number magazines. It was alleged by the Commission that the concerted refusal to sell to the dealers was for the purpose of inducing the dealers to stop selling second-hand magazines. An order to cease and desist the alleged concerted and combined actions of the publishers was issued by the Federal Trade Commission against the publishers.

From this order an appeal was taken to the Circuit Court of Appeals for the Second Circuit, and the Court affirmed the order of the Commission, holding that the combined action of the publishers amounted to an unfair method of competition. In its decision the Court stated:

"Though any one publisher acting alone may sell or not sell his magazines as he may choose * * *, two or more may not combine in such refusal if the result is to harm the public or any person against whom the concerted action is taken."

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and finally comes into harbor with some practical appendices. It is long on common sense, short on abstruse calculations of "metastatic heights," "centers of effort" and all other reefs on which many a landlubber snags his bottom and founders. (Our nautical language was learned on an upstate frog farm.)—\$3.95 postpaid.—*A. G. I.*

OUR NATURAL RESOURCES AND THEIR CONSERVATION

Edited by *A. E. Parkins and J. R. Whitaker*

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American School of Photography	193	Laboratory Materials Company	200
American Telescope Company	187	Manhattan Electrical Bargain House	187
Bannerman, Francis, Sons	197	Medo Photo Supply Company	192
Bass Camera Company	193	Metal Cast Products Company	196
Bassett, J. H. & Co.	201	Metallic Letter Company	196
Bean, L. L., Inc.	196	Mimosa American Corporation	194
Box 800	182	Monographic Press	202
Brooks, Burleigh	195	N. Y. Institute of Photography	195
Burke & James, Inc.	193	North American Institute	203
Central Camera Company	193	N. W. Amateur Telescope Supply Co.	185
Chalfin, M.	185	O'Brien, C. A. and Hyman Berman	198
Chicago Gear Works	201	Optical Research Laboratories	185
Chicago Wheel & Mfg. Company	201	Parks Air College	196
Clausing, Leroy M. E.	185	Pierce, John M.	185
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Columbia Pharmaceutical & Chem. Lab.	183	Plot Genie	200
Consumers Union of U. S. Inc.	2nd Cover	Popular Mechanics Press	196
Corn Exchange Bank Trust Company	196	Precision Optical Supply Company	185 and 187
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Cutting & Sons	185	RCA Institutes, Inc.	188
Electrical Testing Laboratories	183	Ross, Harry	187
Elman's	200	Scott, Charles A.	199
Evans, Victor J., & Co.	199	Shipman's Sons, Asa L.	189
Evinrude Motors	197	Sinclair, James	196
Folmer Graflex Corporation	195	Souther, E. E. Iron Company	201
Fotshop, Inc.	194	South Bend Lathe Works	201
General Electric Company	Third Cover	Standard Engine Company	196
Gilson Slide Rule Company	197	Stevens, Blamey	203
Goetz, C. P. (American Optical Co.)	192	Tech Editorial Service	182 and 183
Hamilton, Alexander, Institute	179	Tinsley Laboratories	185
Hygeia (American Medical Assn.)	180	University Society	188
International Typewriter Exchange	201	Van Nostrand, D. Co., Inc.	Fourth Cover
Johns Company	197	Veeder-Root, Inc.	201
		Waldorf-Astoria Hotel	181
		Willoughbys	190 and 191
		Wollensak Optical Company	200
		Wright, L. G., Inc.	200
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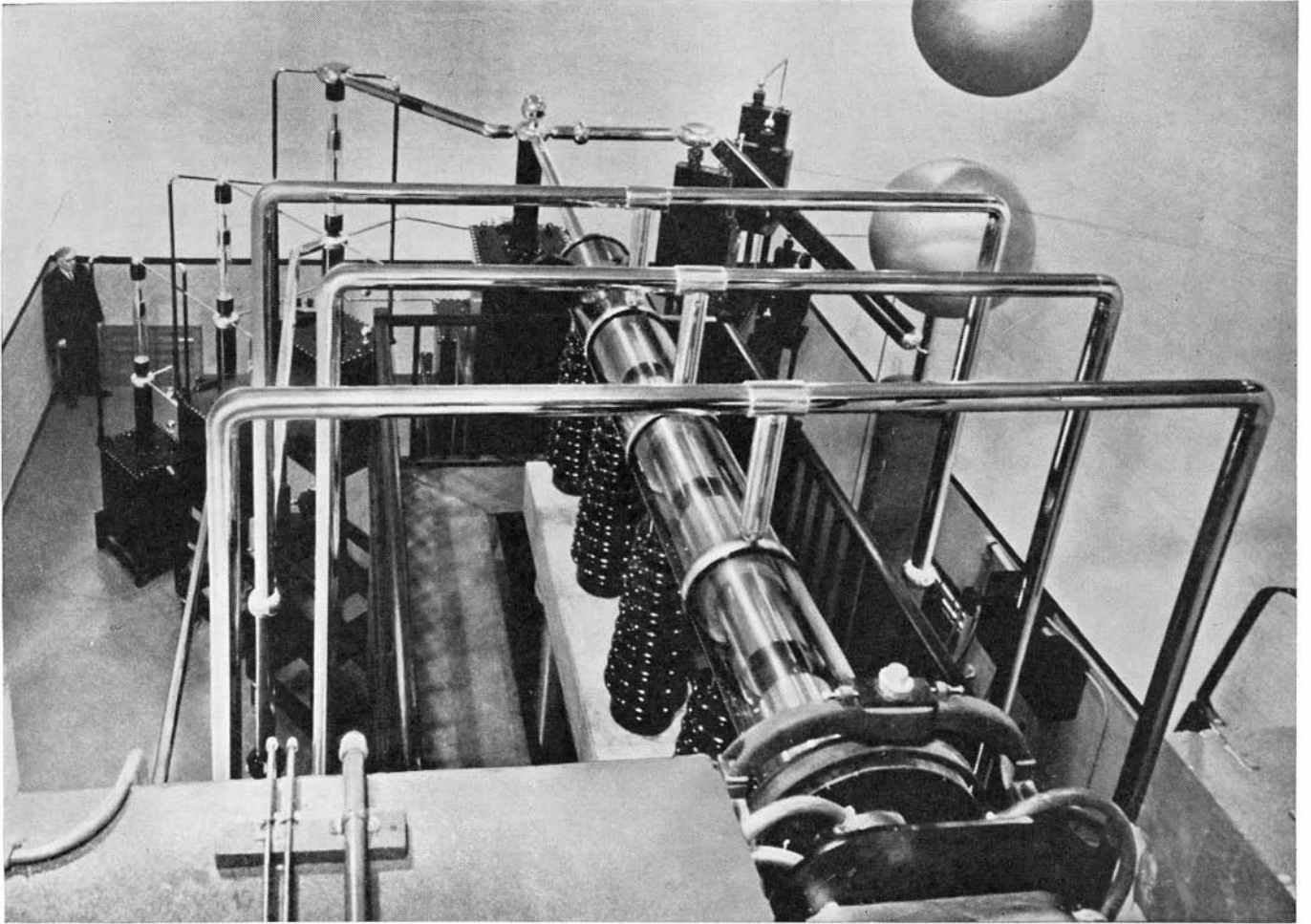
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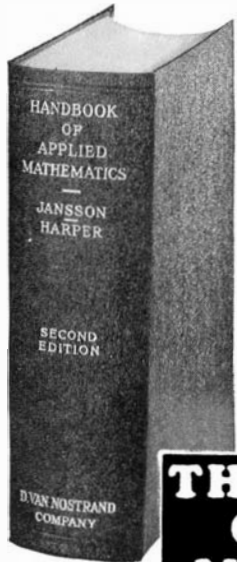
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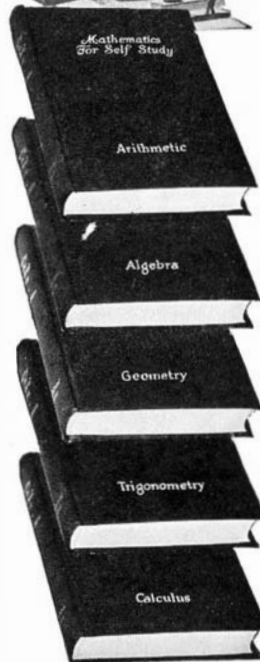
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