IF YOU SMOKE: What Science Says About Smoking

SCIENTIFIC AMERICAN

June · 1936

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"... UNIVERSAL FINGER PRINTING IS BOUND TO COME"

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wrote that the incident had brought

CLUBWOMEN JOIN FINGERPRINT MOVE

406 at Convention of Jersey Federation Record Their Identity for Police.

Special to THE NEW YORK TIMES.

ATLANTIC CITY, May 9.—The New Jersey Federation of Women's Clubs in convention in Chalfonte-Haddon Hall joined the fingerprinting movement this afternoon.

Following the lead of their president, Mrs. Thomas H. Grimley of Ridgewood, 405 delegates to the convention filed past the two fingerprint machines and with the aid of four New Jersey State Troopers and Colonel H. Norman Schwarzkopf, commandant of the State Police, were "printed."

Colonel Schwarzkopf, in a brief talk, said "We feel certain that universal fingerprinting is bound to come. It is the only positive personal identity of an individual and even identical twins or the Dionne quintuplets can easily be distinguished by the method. This may save you from the fate of an unknown identity."

It was the understanding that the ...erprint machines wo... ...here throughout the ...ention.

"WE feel certain," says Colonel H. Norman Schwarzkopf, commandant of the New Jersey State Police, who figured prominently in the Lindbergh kidnapping case, "that universal finger printing is bound to come. It is the only positive personal identity of the individual . . ."

As to that, we venture no prediction. It is a fact, however, that many law-abiding citizens are now registering their finger prints in police departments all over the country as a measure of personal protection and positive identification in the future. Perhaps later such finger printing of civilians everywhere will be made compulsory by law.

Certainly finger printing is of vital importance in criminal investigation. The Bureau of Criminal Investigation of the Department of Justice, in Washington, now has the greatest collection of criminal finger prints in the entire world; and they urge that the prints of every suspect picked up anywhere—simple vagrant or red-handed murderer—be forwarded to them for checking against old records. In this manner, many dangerous, "wanted" criminals have already been identified, and the system has proved its value many times over.

HERE, then, is a new profession—old but new in that its utility has been greatly expanded of late and, further, that it shows promise of a tremendous expansion in the future. For this reason, the text-book which for years has been the standard authority among expert criminologists and police departments throughout the world:

THE FINGER PRINT INSTRUCTOR

By FREDERICK KUHNE

Has Been

REVISED AND ENLARGED

This volume, by a noted finger print expert who was for many years in the Bureau of Criminal Investigation of the New York Police Department, instructs in every phase of finger print work from the taking of the finger impression to the final job of identification. Classification of prints, filing of records, use of equipment, discovering and recording for study the prints left at the scene of a crime by criminals—in fact, every procedure in the whole study of the science is clearly and fully explained and well illustrated with numerous cuts of prints. To the text that has long been standard there have been made many revisions and the full story of the development of the science added so that the user may qualify as an expert in a court of law despite efforts of opposing lawyers to trip him up. New illustrations as well as a lengthy new section on the "Modification and Extension of the Henry System" as used by the United States Bureau of Investigation have also been added.

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NINETY-SECOND YEAR • ORSON D. MUNN, Editor

The SCIENTIFIC AMERICAN DIGEST

CONTENTS • JUNE • 1936

COVER

OF importance to research in smoking, as discussed in the article "If You Smoke" in this issue, is the cigarette puffing machine shown on our front cover and described in detail on page 355. This simple yet efficient machine, illustrated through the courtesy of Philip Morris Ltd., was designed by Doctors Michael G. Mulinos and Raymond L. Osborne of the Department of Pharmacology at the College of Physicians and Surgeons, Columbia University.

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50 Years Ago in . . .

Scientific American

(Condensed From Issues of June, 1886)

PASTEUR—"Up to April 14, Pasteur has inoculated 688 persons, presumably bitten by mad dogs, with only one death. He has also inoculated 19 Russians bitten by a mad wolf. Of these 19, three have died from hydrophobia—about 16 percent. The usual percent of deaths from the bites of mad wolves is said to be about 67. Pasteur has found that the rabies resulting from wolf bites is the same as that of dogs, and only more dangerous because the bites of wolves are more numerous and severe."

"AIR CONDITIONING"—In a case of typhoid fever "a number of tubs were placed in the room, and kept filled with ice, and the doors kept closed. The temperature of the room sank to 80° or less, an average of 12° or 15° below the temperature of the other rooms in the house; and the cooler atmosphere not only added to the comfort of the patient, but aided in keeping down the body temperature, and materially contributed to a final recovery."

ALUMINUM—"A cubic foot of aluminum weighs 166 pounds, while the same bulk of tin will weigh 445 pounds. The uses of aluminum are indeed unlimited, even when it is produced at $2 a pound, as may be easily conceived from its many valuable properties."

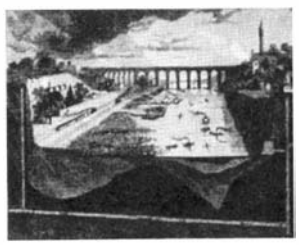
SPHINX—"For some months past, excavations have been carried on at Ghizeh, near Cairo, with the view of freeing the famous Egyptian Sphinx from the masses of sand which have gradually buried the monument. M. Maspero, the Director of the Boulak Museum, has superintended the operations, which have proved remarkably successful, and in a recent letter he states: 'The result is beyond all my hopes. The face, raised fifteen meters above the surface, is becoming expressive, in spite of the loss of the nose. The expression is serene and calm. The breast has been a good deal injured, but the paws are almost intact. We have nearly reached the limits of the diggings of Mariette and Caviglia. The work now going on is in beds of sand, which have not been disturbed since the first centuries of our era.' Later he writes: 'The stones of the right paw are covered with Greek votive inscriptions, while the left have none—an indication that the piety of the faithful was called into play more on the south side.' "

ELECTRIC LIGHT—"With a view to put at rest the question whether local electric lighting companies are profitable investments, we have recently addressed a circular letter to the general managers of a number of such companies. We have received answers from all parts of the country, and the general tenor of the replies is that many of their local companies are earning better dividends than are yielded by the majority of other new enterprises."

BALLOON—"A new dirigible balloon, says the *Deutsche Heeres-Zeitung*, is 150 meters in length and 15 meters in diameter, with a capacity of 18,000 cubic meters, about ten times as great as that of the Renard and Krebs balloon. The propelling machinery consists of two steam engines of 50 horsepower each. The cost is estimated at 100,000 marks ($50,000)."

WOOD WOOL—"Wood wool was first introduced into France as a packing material. It weighs about 40 or 50 percent less than the materials generally used for such a purpose. Its beautiful appearance, its fineness, and its extreme cleanness at once brought it into favor with shippers. It was afterward found that the material was well adapted for the manufacture of mattresses, for bedding for cattle, for the filtration of liquids, and for stuffing horse collars, etc."

AQUEDUCT—"Perhaps the most interesting and novel feature of the great aqueduct now being built by the city of New York to increase its water supply is that portion of the tunnel extending beneath the Harlem River. The contrast between the old and the new methods of crossing this river has been happily brought out by our artist. High Bridge, over which the present supply comes, shows in the background; the foreground being occupied by the section through the bed and banks of the river, far below the surface of which the new aqueduct is to pass."



NEWSPAPERS—"The wonderful growth of American newspapers is shown by a comparison between the directories published in 1776 and in the present year. The one contains in its sixteen small pages a list of 37 newspapers which were published in this country one hundred and ten years ago. The other is almost as large as an unabridged dictionary, and in its two thousand pages contains the names of 14,160 newspapers and periodicals of all classes."

LIFEBOATS—"During the last meeting of the Institute of Naval Architects, the question of using steam lifeboats was made the subject of a very interesting and useful discussion. Messrs. Benjamin and Taylor have designed a very ingenious steam lifeboat, and they read a paper describing it, and exhibited a model. The boat in question is, of course, intended to be unsinkable, and, as we understand the description, she is also to be uncapsizable."

MACHINERY—"Those who entertain the opinion that the possibilities of labor saving machinery are nearly exhausted are greatly mistaken. In the hands of the modern scientific inventor, matter becomes almost miraculously endowed with life and intelligence, and with great accuracy performs those functions which the most skilled manual labor executes but slowly and imperfectly."

COMETS—"The new comet just announced by Professor Brooks makes the ninth that he has discovered during the past five years. It is the third comet discovered this year, and, with the last one announced in 1885, makes four comets in succession detected by this one observer."

GUNPOWDER—"The advances made within the past two or three years in the manufacture of gunpowder for heavy ordnance have been very great . . . due to the development of more perfect mechanical devices for the necessary processes."

AND NOW FOR THE FUTURE

¶Unraveling the Mystery of Machine Tool Design, by Philip H. Smith

¶Polar Molecules: What They Are, What They Do, and Why, by Sidney J. French

¶Misinterpreted Animal Observations, by S. F. Aaron

¶Cutting Metals Underwater With the Electric Arc, by R. G. Skerrett

¶Ingenious Machinery Used on the Colorado River Aqueduct, by Andrew R. Boone

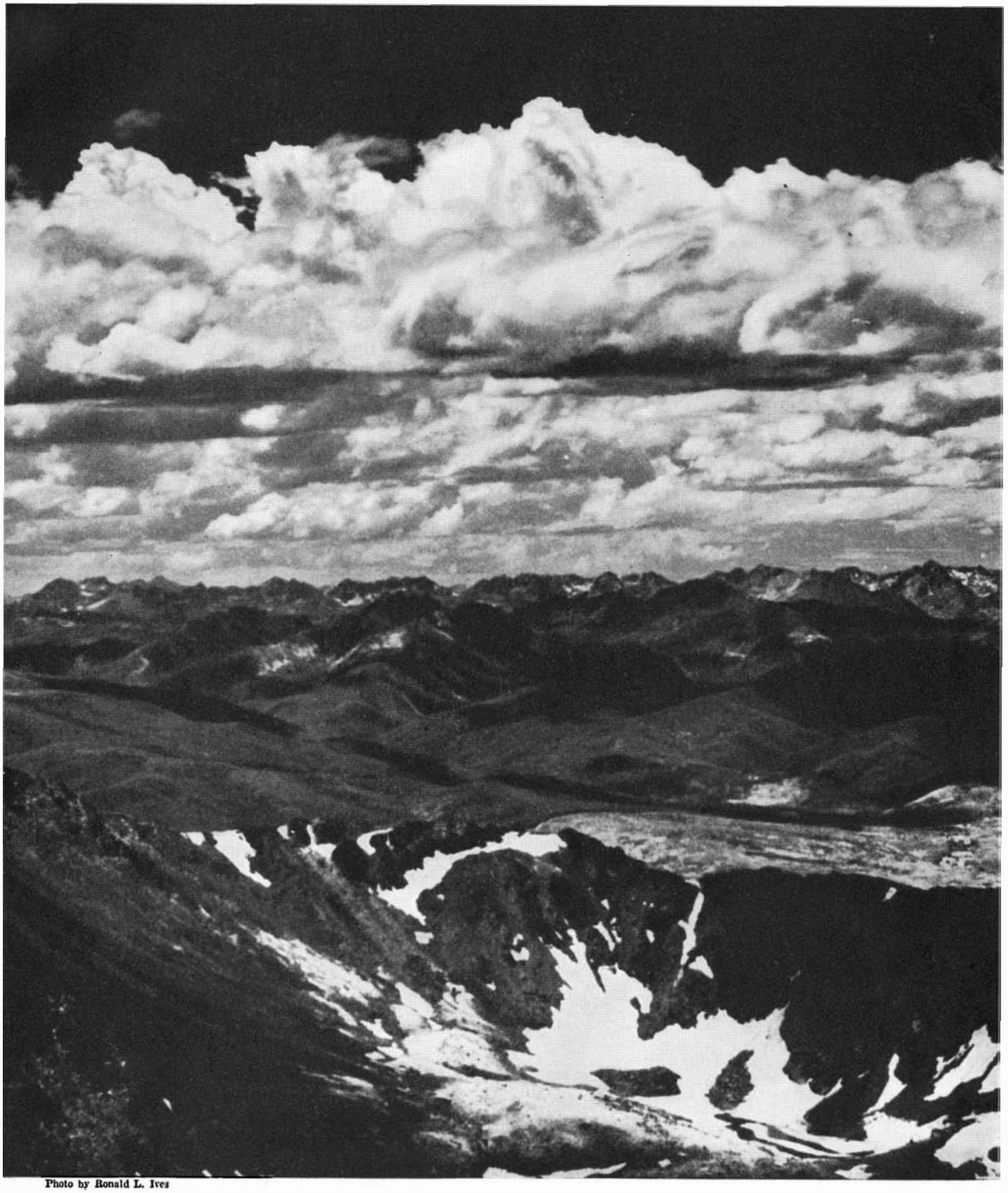


Photo by Ronald L. Ives

INFRA-RED REVEALS NEW BEAUTIES OF NATURE

INFRA-RED photography, coming into wider use as its merits are more fully appreciated, has been employed in this case to give a striking view of the mountain ranges of central Colorado. The camera was set up on Arapaho Peak; through the notch to the left of the center of the photograph shows Pyramid Peak, 120 miles distant, in the Elk Range. The mountain ranges shown are the Blue and Mosquito in the center ground, and the Sawatch, Gore, and Elk through the gaps in the skyline.

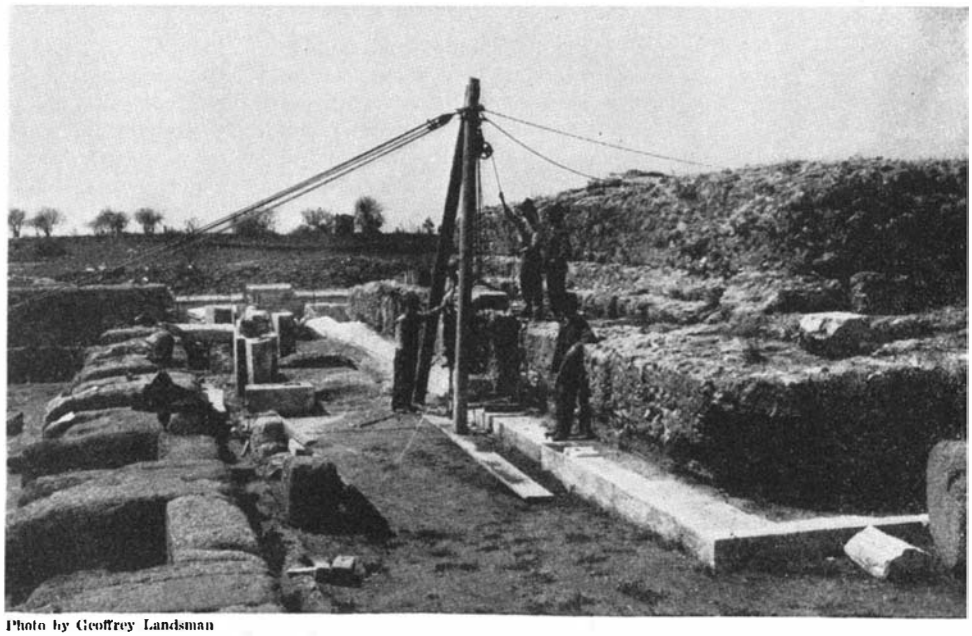


Photo by Geoffrey Landsman

Figure 1: **Removing the inscribed street-corner altars from Temple *A***

The Road to Empire—I

Ancient Minturnae, an Early Roman Town, Stood in the Way of Rome's Great "Lincoln Highway"... Excavations Reveal the Type of Roman Life

By **JOTHAM JOHNSON**
University Museum, Philadelphia

OUR Italian expedition was something of a surprise to all concerned.

We left New York vaguely expecting to excavate Stabia, which was destroyed by the eruption of Vesuvius in 79 A.D. together with Pompeii and Herculaneum. Italy had offered us a concession there, and on our arrival in Naples we were solemnly escorted to one of the finest vineyards in southern Italy, where abortive excavations a century ago had located a few buildings under 30 feet of volcanic ash.

Anyone who wants to dig Stabia will have to lay out most of his first year's budget for real estate. That was bad. Besides, I had felt all along (with many colleagues) that enough Pompeian art had already been found to satisfy every taste. It was clearly up to Italy to suggest an alternate site.

Italy mentioned Minturnae, and we motored out to see it. Minturnae lies in a checkerboard of wheatfields and vineyards, 50 miles north of Naples, along the Mediterranean coast, near the mouth of the River Liris. Its identity has never been lost. The ancient theater and the aqueduct rise conspicuously beside the motor road, and farther back we noticed the ruins of two temples and an amphitheater. I judged that, in general, the ancient ground level could not be more than three or four feet down, in some places no doubt less. Easy digging for us, but easy digging also for all the treasure-hunters of two past centuries; in 1819, for instance, an Austrian general named Nugent had found a quantity of Imperial sculpture and inscriptions there, and other discoveries have served to keep the site from oblivion.

The little plain is shut in on north and east by majestic mountains, on the southwest by the sea. On the nearer hills stand a half dozen modern towns, white against the blue haze. We expressed mild enthusiasm, and returned to Naples in a gentle summer shower.

SO far I had succeeded in concealing the fact that I had never heard of Minturnae; I now hurried to a classical encyclopedia. A few facts stood out, handed down in the pages of the Roman historians.

The Ausones, alias Aurunci, were one of the earliest Italic peoples to colonize southern Italy. When seen through Roman eyes they were a tribe of the backwater—uncivilized, untrustworthy, unadjusted to Roman standards, fit only to be subjugated; yet to long generations of Greeks Italy had been known honorably by no other name than Ausonia.

They settled in the delta of the Liris and built three drowsy market-towns, Ausona, Vescia, and Minturnae. They lived peaceably on the meat and grain and wine they raised themselves, and on fish from the sea. In the malarial marshes below Minturnae they built a primitive temple to Marica, Goddess of Fever, and a few Greek traders opened agencies at the river mouth, which provided a tolerable harbor.

In 314 B.C. the Romans, bent on a career of southward conquest in Campania, found these three walled villages a brief stumbling-block. One market-day a few Roman soldiers disguised themselves as farmers, hid swords under their cloaks, and entered the towns. The signal given, they killed the gate guards and opened the gates. Other troops lying hidden in the nearby woods rushed in, and the Aurunci were wiped out, or so Livy tells us.

In 312 B.C. Appius Claudius surveyed the first stretches of the queen of highways, the Appian Way, and fortified it with walled cities every few miles, like raisins on a string, until it knocked

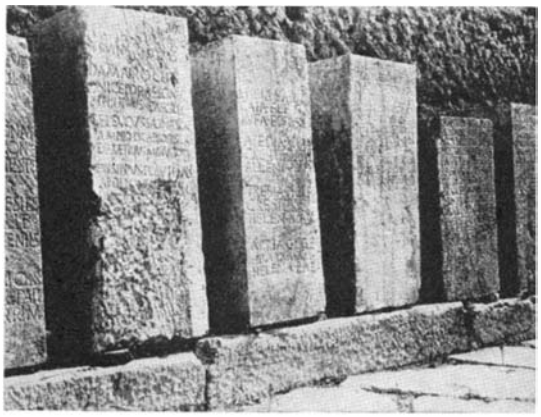


Figure 2: **Slave lists from the inscribed altars of Figure 1. These provided a fair "Who's Who" of the Roman community of Minturnae**

grimly at the door of Samnium, Rome's only remaining rival in Italy. Roman colonies were to Romanize the universe; so Rome had found the perfect pavement for her road to Empire.

As Rome's fourth citizen colony, founded in 295 B.C. on the Appian Way, Minturnae's real history began. A fort was built, a forum laid out with temple and shops, and the business of a city began. In 207 B.C. a river of blood flowed in the gate. In 191 B.C. the Temple of Jupiter and the shops were "touched from the sky," Livy's euphemism for "struck by lightning."

The city developed an important industry in iron. In 133 B.C., when Tiberius Gracchus was assassinated, a wolf slashed a sentry and escaped, and in the same year a slave uprising was put down handily: when 450 had been crucified the rest went back to work. In 88 B.C. Marius the Dictator, driven from Rome by his potent rival Sulla, escaped to the south only to be trapped in the marshes near Marica's temple. He was confined briefly at Minturnae, but a sympathetic magistracy released him and put him on board a ship bound for Africa. Later Cicero in his letters frequently mentions passing through the city, bound for one or another of his many villas. When Tiberius was in residence at Capri the soldiers and courtiers and messengers who shuttled between there and Rome stopped to revel in the inns of Minturnae. Then Minturnae became just another Roman provincial city, and survived until the Longobards destroyed it about 589 A.D.

This was not much, but it was something, and it was more than we know of most ancient cities. If pre-Roman Minturnae had vanished in 314 B.C.—and no one today knows where to look for its sister cities, Ausona and Vescia—we were not likely to find it without an intense search.

The Roman colony, on the other hand, might prove to lie under the Imperial city, and might be worth digging; these primitive colonies were the laboratories where Rome, stifling in her own congestion, performed the experiments in fortification and city planning and sanitation which she could not carry out at home. In general they are so overlaid with later buildings that they make dull digging, but at Minturnae, in prospect at least, the sky was the limit; we might hope to find walls, temples, altars and sacrificial deposits, porticoes, shops, iron foundries, potteries, private dwellings—the whole dim spectrum of primitive Roman life.

I hastened to notify our prospective hosts that the University Museum would be delighted to excavate Minturnae, and a few days later we opened our first trench.

I won't set out to tell you all we found; Mr. Munn has point-blank refused me the next 50 issues of Scientific American. Some of our discoveries would concern students of Roman architecture and of ancient art; others are of more special interest in the field of Roman history, confirming, adding to, and frequently changing our earlier conceptions.

THAT first week, for instance, we dug around the two temples we had noticed on our first visit and named them *A* and *B*. Temple *A* belonged to the early Empire. It rose from the margin of a paved street which we later discovered to be the Appian Way, bisecting Minturnae from west to east. The block in which *A* stood had been the forum of the original Roman colony of 295 B.C., though it was some time before we were in a position to prove that.

At the beginning the colonists had been satisfied with a simple forum which contained only a small temple and a few unsanitary shops. Ashes covering their foundations told us that these buildings had presently been burned. All this we had already learned to expect from the pages of Livy, who mentioned that they were struck by lightning in 191 B.C. A hoard of coins which turned up under the floor of one of these ruined shops belonged to the years preceding 190 B.C., a welcome check on Livy's reliability.

After the fire (and this Livy neglected to tell us) the colonists pooled their forces for reconstruction. They replaced the temple with a great new shrine, dedicated to Rome's Capitoline Triad—Jupiter, Juno, and Minerva. Accordingly this was a triple-cella temple, the seventh such so far found in all Italy. No one regretted the lost shops; where they had stood the ground was leveled over, and presently a vast three-winged portico was built, enclosing the square on west, north, and east, with the temple in the open south end of the U.

In and around the foundations of these buildings we found the remnants of their decoration, molded and gaily painted terracotta tiles and plaques. From these we could gain an idea of the temple's heavy wooden superstructure which, like contemporary Roman temples at other sites, proved to be a pure derivation from Etruscan models and patterns.

The three-winged portico was a different story, because the idea of such a building had come from Greece to Italy only in the previous decade. We may suppose that sophisticated architects of the metropolis had learned how to handle it by 190 B.C., but the oldest one yet found at Rome is a century younger than the one at provincial Minturnae, which remains unique, a merry hodge-podge of Greek plan, Roman foundations, Greek columns, and Roman roof construction and terracotta decoration.

No one has ever seen anything like this Roman forum, as rebuilt after the disastrous fire of 191 B.C. and now completely excavated; it is one of the most diverting lessons in post-war archeology.

Imperial Minturnae was wealthy enough to lavish rich temples on all her gods, but in the 1st Century B.C. many of them still had to be content with modest street-corner shrines. Each was attended by a group of 12 pious slaves, who had the privilege of setting up an altar, carved with their names, each year.

About 50 B.C. another bolt of lightning struck the big temple and it went up in flames, taking the portico and a good deal more of the city with it. The forum was once more a heap of ashes. We'll come back to this next month.

Figure 3: **The Minturnae Venus. Originally a ribbon of gilded bronze was used to "hold" the hair in this elaborate coiffure. The ears were pierced for earrings, now lost**

In the new period of reconstruction which followed, room was found in the forum for Temple *A*, and 29 of these inscribed altars, damaged in the fire, were used to fill out *A's* foundations. We dug them out—Figure 1 shows us at

work; Figure 2 the result—and lined them up against a long wall.

When we had time to read the names we learned a lot of interesting things. Each slave gave his master's name as well as his own, and so we acquired a unique Who's Who of 200 citizens wealthy enough to own slaves, among them a C. Marius and an L. Cornelius. 'Sulla' was the cognomen, equivalent

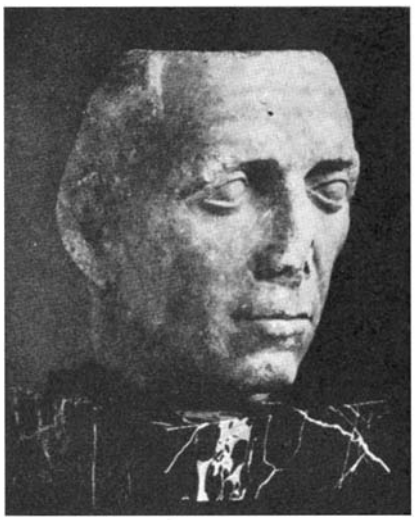


Figure 4: **Portrait of a Roman gentleman. It is now at Philadelphia**

to a middle name, of L. Cornelius Sulla, and it is possible that the names on the stones belong to these great figures in Minturnae's history; it is also possible that they are mere coincidences. But the name of C. Titinius appears as a slave-owner in three places to prove truth in the Marius story, for during his sixth consulship Marius presided at a divorce suit between C. Titinius and his wife Fannia. He decided for the husband, and when he was captured at Minturnae he might have had opportunity to regret it, for he was imprisoned in Fannia's house; but the lady turned out to be magnanimous.

We searched for Fannia's name on the lists, but without success. We did, however, find cousins of the poet Vergil; and a Pirana whose name shows that her family came from Pirae, though that community was already extinct when Minturnae was laid out; and a Vitulanius, 'from Vitulanum,' whose name gives the dingy modern village of Vitulano near Benevento a hitherto unsuspected antiquity of 2000 years; and many more.

While all this was going on around Temple *A*, another gang was hard at work at Temple *B*. *B* was of concrete, a few years older than Temple *A*; I think it was built soon after Julius Caesar's death. We discovered many pieces of sculpture there; for a while I believed we had found an ancient museum, but that was before I knew what we were going to find elsewhere at Minturnae.

Some of the pieces lay within a few inches of the surface, and were grooved by plow-points; certainly modern treasure-hunters had passed this area by. The early Christians hadn't, though; they had burned the pagan temple and overthrown the false gods and smashed the portrait statues of the emperors, and left us to fit the pieces.

I identified an Aesculapius and a bust of Germanicus, and then a tree-trunk, with a fragment of leg attached, bearing the tantalizing inscription *Callimachus and Gorgias the Athenians made this.* One memorable day as I was sitting working in the office a workman came in carrying the lovely Minturnae Venus (Figure 3).

IN one corner of the sanctuary we came on a prostrate marble slab like a flat tombstone, but when we turned it over we read upon it the dedication of a memorial statue of Julius Caesar. We wanted desperately to discover at least the head of this statue. The best we could find was an unidentified head of appropriate date; it *might* be Caesar.

Along the east flank of Temple *B* was a concrete trough built to catch the drip from the temple's eaves, late in Minturnae's history. Under one end of this we caught sight of some fragments of terracotta sculpture, and since the trough was of little scientific interest we measured it, photographed it, and condemned it. Giuseppe Imperatore raised his pick high over his head and brought it down neatly into a vulnerable crack in the masonry. Out rolled a ghastly marble skull and lay there blinking up at us. Figure 4 shows it cleaned and mounted for polite exhibition in Philadelphia; if you had seen it that first minute, slimy and grey from its long incarceration, you'd never have forgotten it. And neither will I.

We were not neglecting our investigations into Minturnae's topography. In isolating Temple *B* we had ventured below the classical ground level, and at both north and south ends of the temple we had found the foundations of a massive wall of rough limestone blocks, much older than the temple straddling it. We stared stupidly at this for weeks before we realized that without conscious effort we had come upon a stretch of the fortification wall of pre-Roman Minturnae, the Ausonian town which Roman soldiers had sacked in 314 B.C. To the east of this wall lay the primitive fort, and looking a little more sharply we presently recognized the towers which marked its northwest and southwest corners. Later I spotted the foundations of the northeast corner tower in the bed of the Liris.

West of it lay the Roman colony of 295 B.C. We were surprised to find that this wall had continued in use after the Roman colonization, as a sort of partition between the halves of this curious double city. Figure 5 shows the junction of the two cities; to the left is the northwest corner tower of the pre-Roman wall of polygonal limestone masonry; the rest of the foreground is taken up by the ashlar wall which defended the Roman colony.

In the middle of the west wall of the early town we made one of our most interesting discoveries: the location of the main gate, to which Rome's highway to Empire was directed in 312 B.C. But, according to Livy, Minturnae lay deserted from 314 B.C., when the Romans wiped out the Aurunci, until 295 B.C. when the colony was founded. The Appian Way shows that it was inhabited in 312 B.C.; so, for once, we catch Livy in error. A few Aurunci did survive to carry down their old traditions.

Figure 5: **At the left is the ruined square tower from the earliest city wall, and at the right is a part of the wall built by Roman settlers, 295 B.C. See the text**

That Mantis Appetite

Gluttonous Praying Mantis . . . Ugly . . . Harmless to Humans . . . Beneficial . . . Devours other Insects

By PAUL GRISWOLD HOWES

NEARLY every insect that has been accidently imported into the United States from foreign countries has become either a nuisance or a real menace. Witness the ravages of the European corn-borer, the dreaded Japanese beetle, and a dozen others, in the attempted eradication of which the government and the states have already spent hundreds of thousands of dollars.

It is, therefore, interesting to find that the oriental praying mantis, which accidentally arrived in this country 30 or 40 years ago, and which has since excited a great deal of interest and comment, is one of the most highly beneficial and valuable insects in the world. (It belongs to the family *mantidae*, some species of which are indigenous to America.)

In the state of Connecticut, this insect was practically unknown in 1925. In 1926, one or two were captured, frightening their finders into telephoning for police aid. As each year passed, the mantids increased until now they are common objects in the months of September and early October.

Mantids possess enormous appetites for all other kinds of insects. They are very large creatures, measuring over four inches in length when mature; and their wings, when expanded in full flight, may spread over six inches. Their flight is powerful and they have been found crawling into windows of skyscrapers dozens of floors above the streets in New York City!

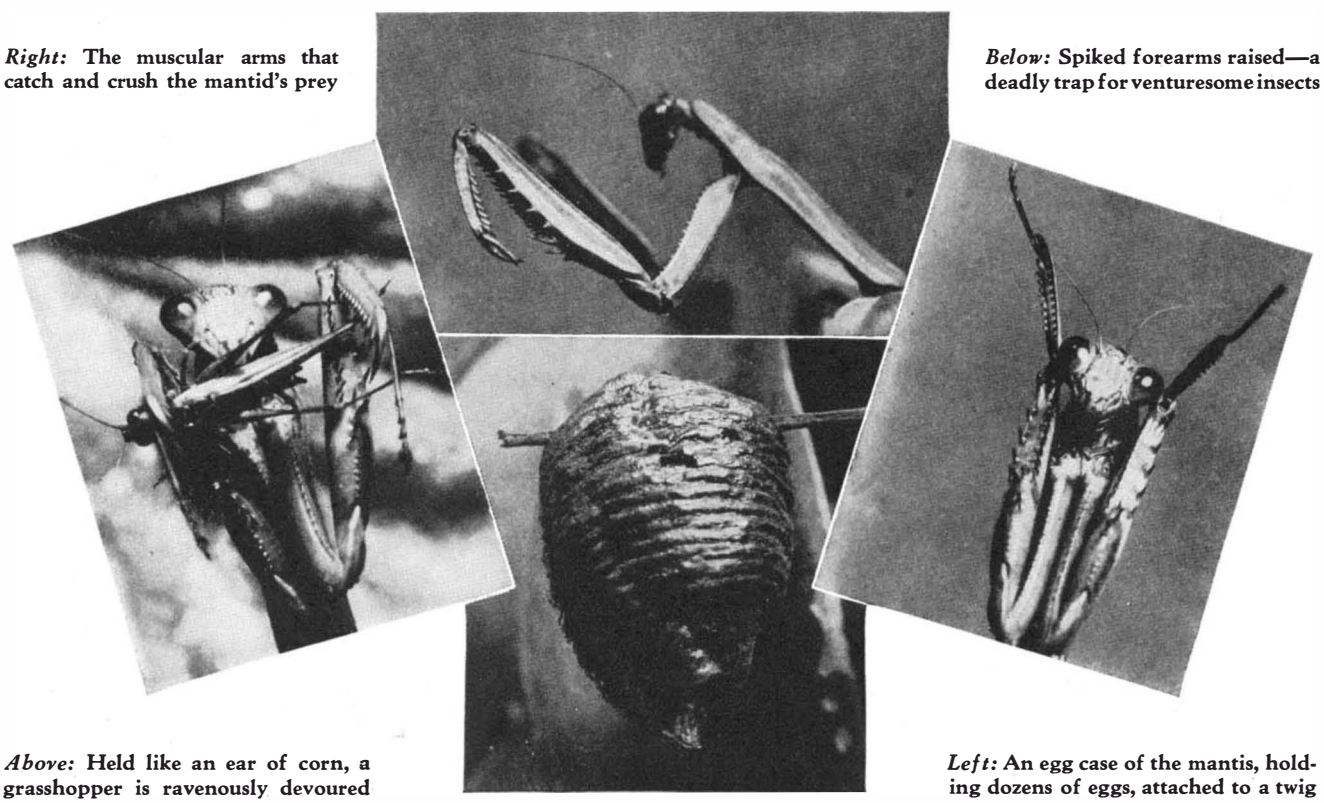
THEIR appetites—their stomachs if you like—are enormous, and they eat with the frankest bad manners, gluttony, and brutality. Look at the unfortunate grasshopper caught in the lightning-like gesture of the wicked forearms of the mantis. In an instant the victim is crushed and killed, and then, strangest of all, the mantis eats his victim for all the world like a human being eating corn on the cob!

These insects should never be killed. In a season they account for large numbers of foliage- and crop-destroyers. People should learn to recognize their curious egg cases also. In Connecticut, and doubtless in other states where the mantis has arrived, some people hunt for the egg masses after the leaves have fallen and place them in their gardens, where the new generations of mantids may feed upon harmful insects.

The eggs are deposited late in September or in early October. Inside the tough egg cases are dozens of elongated eggs which hatch the following spring. The young take most of the summer to mature, but from the very first they hunt out and kill every other insect in their particular neighborhoods.

When full grown in the fall, fighting appears to be a favorite pastime among the males and this, of course, is due in some measure to sexual rivalry.

Despite their violent natures, the mantids are entirely harmless to human beings. The more knowledge that may be spread in regard to them, the better it will be for our vegetation; and we should be thankful that for once a foreign insect so strong and ravenous has proved itself a distinct asset instead of a pest.



Right: **The muscular arms that catch and crush the mantid's prey**

Below: **Spiked forearms raised—a deadly trap for venturesome insects**

Above: **Held like an ear of corn, a grasshopper is ravenously devoured**

Left: **An egg case of the mantis, holding dozens of eggs, attached to a twig**

OUR POINT OF VIEW

New Naval Treaty

FROM amongst the welter of international arguments—the diplomacy that savors more and more of pre-war intrigue with its secret commitments and traded, selfish co-operation—there stands forth one more or less "open covenant openly arrived at." This is the new tripartite naval treaty, signed recently in London by representatives of France, Great Britain, and the United States. Even here there was some trading, but the negotiations showed so strong a desire among the high contracting powers to discover a workable agreement that concessions were almost eagerly made. The most unfortunate feature of the business is that Japan bluntly refused to consider a treaty after being denied her basic demand of parity with Britain and the United States, and walked out of the conference.

Perhaps the three most important provisions of the new treaty are: 1—There shall be no capital ships over 35,000 tons; 2—Cruisers shall not exceed 8000 tons; 3—Each contracting power shall give to the other two complete details of projected construction prior to laying down the keels. In addition, the treaty reclassifies certain types and specifies guns and armament. Thus no capital ship under 17,500 tons may be laid down or acquired prior to January 1, 1943. A like restriction is placed on capital ships whose main armament consists of guns of less than 10-inch caliber.

Aircraft carriers are apparently the only type, therefore, which may be built in the tonnages between 8000 and 17,500, but carriers must not exceed 23,000 tons. No submarine shall exceed 2000 tons standard displacement or carry a gun exceeding 5.1-inch caliber. To prevent what might be construed as an unfair advantage of one over the other, the treaty stipulates that, in time of peace, no merchant vessel shall be prepared for armament, except that decks may be stiffened to mount guns not exceeding 6.1-inch caliber. Emergency requirements of the national security of any one of the contracting powers, give that power the right—upon notifying the others and giving reasons—to lay down or acquire surface vessels of any standard displacement up to 10,000 tons. The same right may thereupon be exercised by the other two.

Limited though it be, the treaty is welcomed by all those who sincerely believe in the principle of limitation of naval armament by agreement among the powers. It is too bad, however, that Japan and Italy could not be induced to consider the problem fairly and lend their friendly co-operation. Suspicion is almost certain to be directed toward them. And, that, in a world already mad, might have, if not disastrous consequences, then at least the effect of increasing naval expenditures. The several naval treaties have sought to avoid just that. It is the general hope, therefore, that the "escape clause" of this latest treaty need never be exercised.

A Kingdom for a Book

IN 1921 John Mills wrote a book entitled "Within the Atom," that was destined to merited fame as the outstanding popular work—*the* popular book—on atomic physics. Every scientist remembers that book.

Alas, within five years it was largely out of date, and within ten years prehistoric. Now it is a museum piece—so rapid have been the strides of the physicists, leaving it far behind.

Though many a writer has tried his level best to "do a book" that would equally merit unstinted praise, none of the numerous attempts have seemed to win the same fame. Today, as far as first-class popular expositions on atomic physics are concerned, the world is bookless.

In other fields books may go on and on—Bertrand Russell's "ABC of Relativity," a contemporary of "Within the Atom," is still in the running, it too having been an outstanding exposition in its field. But relativity has kindly "stayed put," while atomic physics is as slippery as an armful of eels. Even a perfect book—*the* perfect book—might be out of date within the year.

Nevertheless, the world awaits such a book. What writer will gamble with fate?

Horns or Brakes?

REPORTS from England indicate that the "anti-horn" campaign inaugurated sometime ago as a safety measure for motorists is highly successful; a similar experiment has been tried in New York City and, while the ordinance is not very strictly enforced, the results are satisfactory enough to show the merit of the idea and to warrant its application in every community in the country.

"Anti-horn" campaigns have two definite objectives. First, they are aimed at a much-to-be-desired reduction in the noise level of our more congested areas, and secondly, at the safety of the motorist who all too often is inclined to rely more on his horn and less on his brakes to keep himself out of trouble.

It is trite to say that noise is one of the objectionable features of our mechanized civilization; recent studies by qualified investigators have pointed out, in a manner that cannot be refuted, the downright harmful effects of noise on the human nervous system. It is all very well for some people to say that they have become used to the noises that daily assail their eardrums, but they ignore or are not aware of the cumulative effect that these "unnoticed" noises have on their nerves and, consequently, on their general health. Thus, any local or state law that can control even a portion of the noise incident to motor travel is deserving of consideration, and should be given the whole-hearted support of the general public.

But even more important—at least from the dramatic standpoint—than the effects of noise on human beings, is the effect that "anti-horn" campaigns can and do have on the safety factor in motoring. These campaigns stress strongly the reliance that many motor-car operators place on their horns rather than their brakes. To see some of these drivers approach a crossing at high speed, sound their horns imperiously, and speed across the intersection without slackening in the least, makes one wonder how they ever lived to attain their present ages. Perhaps the answer is that they never happened to try this particular fool-hardy procedure at the same time and in the same place as another motorist with the same lack of regard for the rights and safety of others!

Horns have their places in motor-car driving; so have brakes. But when the driver substitutes the horn for the brake and expects the other fellow to keep out of his way, he is expecting too much of human nature. Once more we reiterate that automobile accidents can be reduced in numbers and in seriousness if drivers will remember that they are handling potential engines of death, that they do not have exclusive rights on the highways, and that they should show the same courtesy to others as they expect shown to themselves.

We offer a slogan: When in doubt, use your brakes—not your horn!

A Mountainous Earthen

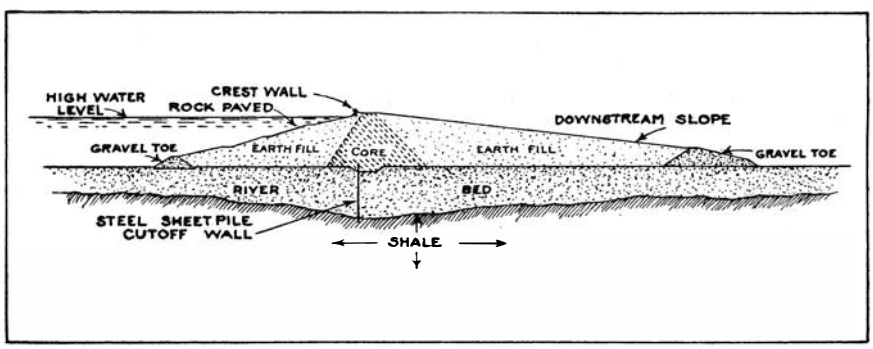
Fort Peck Dam . . . Aid to Navigation on "Big Muddy" . . . 100,000,000 Cubic Yards of Earth in the Dam . . . Unique Engineering Problems

By R. G. SKERRETT

WHERE dinosaurs wallowed one hundred million years ago in northeastern Montana, and a great inland sea then linked the Gulf of Mexico and the Arctic Ocean—splitting the continent, as we know it today, in twain—Fort Peck Dam is now under construction. The dam is to create a reservoir capable of impounding 19,500,000 acre-feet of water that can be released, when needed, to fill a navigable channel that is to make practicable modern water-borne traffic on the lower Missouri River between Sioux City, Iowa, and the mouth of that stream, a stretch of 768 miles.

The plan is to deepen that channel to eight or nine feet and to extend it up to Sioux City. The combined betterment will cost in the end probably more than 140,000,000 dollars, but it is estimated that such a channel will permit an annual movement of about 12,000,000 tons of freight at a saving of something like one dollar a ton. To keep such a channel supplied with water at certain low stages, a part of the spring floods must be conserved and released in sufficient volume to make up deficiencies during other seasons.

The reservoir above the Fort Peck Dam is the largest of the four that have been projected as a means of stabilizing the Missouri River and reducing its ravages when in flood. Its construction has been undertaken because of its magnitude and the fact that it would give unemployment relief to a large number of people in that section of the country. The working force has numbered 7200.



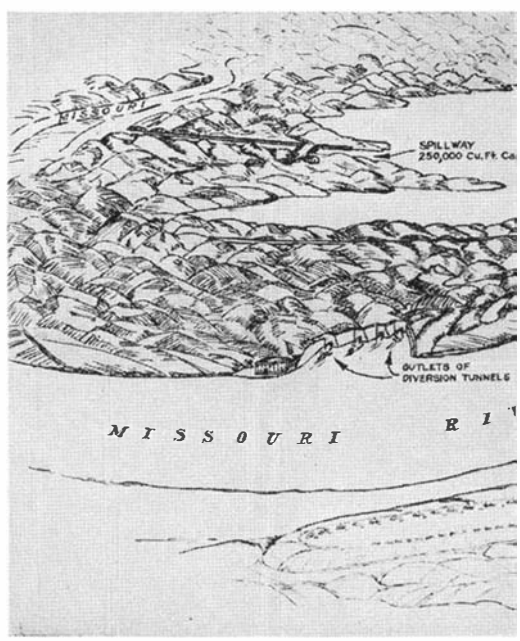
Transverse cross-section of the Fort Peck Dam. Note its various elements: earth fill, compacted core, gravel toes, rock paved upstream face, crest wall, cutoff wall

The Missouri River fluctuates greatly in the volume of its flow. At its low-water stage, it has discharged into the Mississippi as little as 12,300 cubic feet of water per second, while the maximum outpouring at flood stages has reached as much as 546,000 cubic feet per second. Droughts and seasonal abnormal rainfall and sudden melting of snow high on the slopes of the Rocky Mountains explain the wide differences in the height of the river which, at some points, may vary from 16 to 38 feet according to weather conditions.

During the last 30-odd years, many millions of dollars have been expended in improving the Missouri River between its mouth and Kansas City, a distance of 388 miles; at the present time there is a fairly stabilized channel having a general depth at low water of six feet.

The Missouri River has a length of nearly 2500 miles, a total fall of 3630 feet, and drains an area of 528,800 square miles. Throughout most of its length the river is a typical alluvial stream, characterized by instability of channel, relatively steep and frequently changing slopes, easily eroded bed and banks, and an enormous quantity of suspended material and bed sediment. It is, therefore, easy to understand why the river has become familiarly known as the "Big Muddy." Property losses due to erosion and inundation yearly total an equivalent of several millions of dollars. Such are the principal reasons for rearing the Fort Peck Dam which, with its initial appurtenant features, will entail an expenditure of 84,200,000 dollars, according to the estimate of the Corps of Engineers, United States Army, under whom the great undertaking is going forward.

BECAUSE of happenings in the long past, the damming of the Missouri in northeastern Montana has presented a complex problem both to the men that designed the dam and to their brother officers now in charge of its construction. The prehistoric sea that once occupied the region built for itself, in the course of eons, a sedimentary bed that survives today in the form of a firm stratum of clay shale that has a vertical thickness of fully 1000 feet. Two succeeding periods of glaciation cut and ground that formation as mountainous bodies of ice moved eastward during their dissolution. Then the Missouri River made other changes by carving for itself a fairly deep channel in the shale as that stream journeyed seaward. Subsequently, the river progressively raised its own bed by depositing water-borne sand, gravel, and silt upon the underlying shale until the accumulation attained its present depth of 160 feet and more. The adjacent flood plain, where not made up of aggregations of glacial till, is mainly composed of al-



Dam

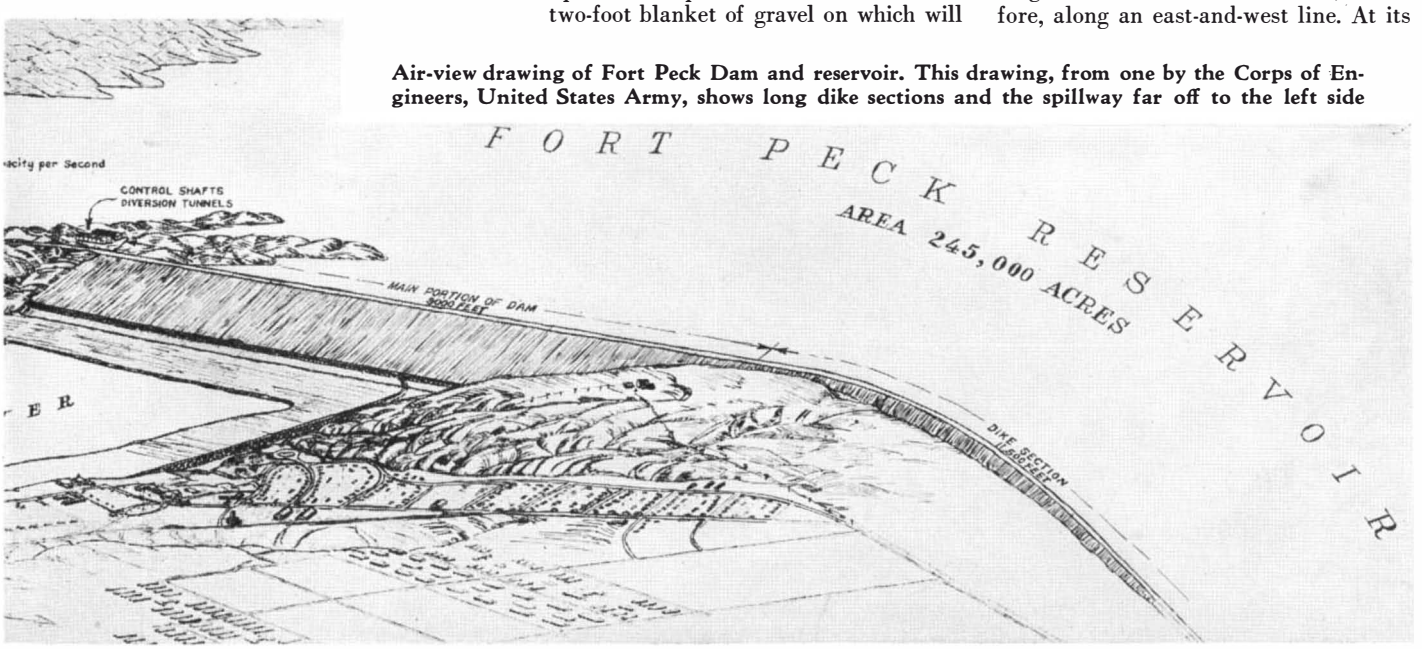
Looking westward toward the trestle-enclosed area. Dump cars used this trestle for placing the dam's gravel toes. In foreground are excavations for the valve shafts

luvial material placed there by the river when in its flood stages.

The great majority of modern dams of large size are of masonry construction and commonly built of concrete; but all such dams are usually set on solid rock or else supported by piles that are driven far enough into an underlying formation to provide the necessary stability. The prevailing thickness or depth of the alluvial overburden resting upon the underlying shale made this common procedure impracticable at Fort Peck. Therefore, the Army engineers decided to erect a monster bulwark of earth and to dredge that material directly from the river bed or from the contiguous flood plain. When finished, the Fort Peck Dam will be the largest earth-fill dam in existence. Its magnitude is essential because the alluvium of which it is to be formed must be arranged high enough and strong enough to confine an immense volume of water. The lake so brought into being will extend upstream a distance of 187 miles and have a width where broadest of 16 miles. Thus, the very mixture of sand, gravel, and clay that the river has deposited over a very long period of time will be dredged and pumped into an area surrounded, where necessary, by suitable dikes of gravel to build up gradually a massive impounding barrier directly athwart the normal flow of that very river. In other words, the engineers are utilizing the readiest material to be had in that isolated region to construct the dam that is to help regulate the year-round flow of the Missouri and to improve its navigability and its economic value.

The main body of the Fort Peck Dam is to have a crest length of substantially 9000 feet. From the lowest point of its core wall to the crest that will carry a broad roadway, the dam will have a height of 273 feet, and will be the means of raising the water in the reservoir to a flood level 220 feet above the present river bed. To assure a firm footing for the dam, that structure will have a transverse basal spread of 2875 feet—more than half a mile, and the upstream and downstream faces will slope gradually to the crest which will have a width of 100 feet. The upstream side of the crest will be surmounted by a masonry breakwater which will increase the total height of the dam by 14 feet. The entire upstream slope will be covered with a two-foot blanket of gravel on which will be laid a massive course of ponderous boulders. This covering will protect the upstream slope from the erosive action of storm waves or the scouring attack of heavy floating ice carried on the surface of the lake in winter. The boulders are of glacial origin, and are being gathered from deposits 70 miles away; the 5,000,000 cubic yards of sand and gravel, for concrete and other purposes, are being obtained from immense glacial deposits in the vicinity of Cole, Montana, 80 miles distant by rail from the dam site. Neither transportation of this material nor any other work could be begun at the dam site until the area was made accessible by a branch line 12.2 miles long that taps the main stem of the Great Northern Railway at Wiota, Montana.

Where the dam is rising, the winding river flows from south to north, and the longitudinal axis of the dam is, therefore, along an east-and-west line. At its



Air-view drawing of Fort Peck Dam and reservoir. This drawing, from one by the Corps of Engineers, United States Army, shows long dike sections and the spillway far off to the left side

western end, the dam will be joined by a massive earthen dike that is to extend westward a distance of 11,500 feet. The combined impounding structure will, accordingly, have a length of about 3.9 miles. The final dimensions and form of the dike are undetermined and are awaiting the outcome of large-scale model tests being made near the dam.

The main body of the dam will be tied at each end to a bluff that rises to a height of about 300 feet above the floor of the valley. The bluffs are 7500 feet apart, and are outcroppings of the prehistoric shale that underlies the bed of the river. The formations will provide satisfactory anchorages for the two flanks of the dam; the eastern bluff, because the shale there is sounder, provides better rock through which to drive the four large diversion tunnels that have a combined length of 25,268 feet —the shortest being 5370 feet long and the longest being 7254 feet from end to end. The river will be detoured through the tunnels when the construction of the dam reaches a stage requiring the blocking of the stream. Subsequently, the tunnels will be fitted with immense valves and will then control the water released from the lake to maintain a satisfactory flow in the improved channel between Sioux City and the Mississippi.

To reach the firm subsoil of the ancient river bed to assure a stable foundation, an area about 2800 feet wide and 8000 feet long had to be cleared of the unstable topsoil to a depth ranging from 3 to 30 feet, removing, all told, about 4,100,000 cubic yards of material. The remaining subsoil, while composed for the most part of fine-grained sand, is interspersed with layers of coarse sand, gravel, and clay.

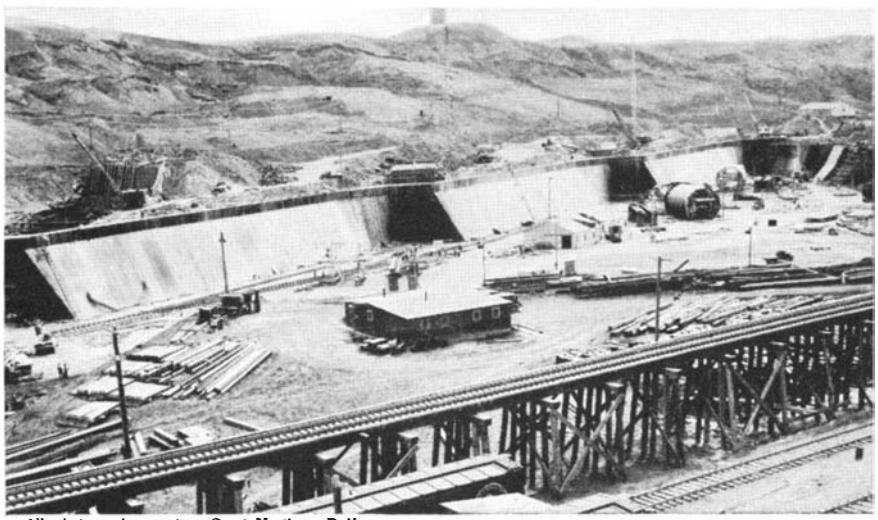
As the porous sand and gravel might permit water to work under the dam and undermine that structure—especially whenever the level of the reservoir should induce a considerable hydrostatic head—the Army engineers have provided a cut-off wall formed of interlocking steel-sheet piles that have their bottom ends lodged firmly in the shale and their top ends projecting 20-odd feet above the ground. These tops will later be embedded in the basal section of the impervious core that is to act as a backbone for the dam. Some piles have been driven to the great depth of 163 feet; each pile is made up of two sections that are welded together to assure the necessary combined length. The piles have been driven by gantry cranes that have towers approximately 200 feet high.

THE lower section of each pile, about 80 feet long, was sunk its full length with the aid of an ingenious hydraulic spade that excavated a hole into which the pile could be dropped. Each spade was made up of a steel pile 190 feet long that was equipped with tough steel teeth at the lower end that projected beyond multiple jets that operated at a pressure of 200 pounds. The spades greatly simplified and expedited the work of getting the lower sections of the piles for the cut-off wall planted without hammering. When the lower length was sunk, then the upper length of a pile was welded to its companion and the completed pile was driven down and into the shale by a powerful pneumatically operated hammer. From end to end, this exceptionally deep steel diaphragm has a length of 10,146 feet. Where the diaphragm crosses the river, the piles are level with the water bed to leave an unobstructed channel for the dredges, lighters, and other craft employed on the undertaking.

The four diversion tunnels that pierce the bluff at the east end of the dam have a maximum excavated diameter of 32 feet 2 inches; but, when the thick reinforced-concrete linings have been constructed, the internal diameter will be reduced to 26 feet. Up to the close of last year, the contractors had completed the pilot tunnels which will be enlarged to the full dimension just cited; the downstream portal structure, a large part of the upstream portal structure, and the excavation of the control shafts had been completed; and 5000 feet of the main tunnels had been enlarged and lined. The control shafts will contain the great valves that are to regulate the release of water from the reservoir. All work of tunnel driving and shaft sinking has been made extremely difficult because of the tendency of the penetrated shale to crumble rapidly when exposed to dry air. Therefore, it has been necessary to keep the air moist by continuous spraying to minimize crumbling until the rock could be coated with an atomized bituminous mixture to seal the shale surfaces before the concrete lining could be placed.

At the present time, the dam site is bisected by the river, and placing of the earth fill has, therefore, been carried forward in two sections. The plan is to raise these sections to a height of 100 feet, then to shut out the river, and next to construct the intervening section and so bring the entire structure up to a common level. It is believed that the tunnels can be finished so that the river can be diverted into them by the middle of 1937. When cold weather called a halt on dredging and pumping, the dam contained 21,742,000 cubic yards of hydraulic fill, independent of the gravel placed in the upstream and the downstream dikes or toes and the sand barriers or dikes erected at the river bank of each section. The dam will contain 100,000,000 cubic yards of earth fill when finished; the body of the structure is now somewhat more than one fifth completed.

Placing steel work in one of the tunnels before lining with concrete



All photographs courtesy Great Northern Railway

The outlet portals of the four control tunnels that will have a diameter of 26 feet when lined with concrete. These tunnels range in length from 5370 to 7254 feet

To upbuild the Fort Peck Dam, the Army engineers designed and then constructed at a shipyard, called into being nearby, four floating dredges that began operating in the fall of 1934. Each vessel carries two 28-inch pumps driven by 2500-horsepower electric motors. A ro-

tary cutter seven feet in diameter digs into the river bed or into the area of any one of the marshy borrow pits, and the excavated material is picked up by the suction pumps and driven through a 20-inch pipe line to a floating relay station or booster plant. That plant has two more pumps that force the muddy mixture along to a land booster plant. and the latter transmits the heavy fluid through a succeeding pipe line to the arranged discharge point within the dam area. Each of the four dredging outfits and their associate boosters is capable of moving the heavy mixture a total distance of 17,000 feet and raising it to a maximum elevation of 240 feet. The four units were expected to

The pipe line, through which the mud and water solution for the core is pumped, rests on pontoons. In background is a suction dredge at work. A floating booster pump plant is in the center

Below are shown outlets of two of the pipe lines discharging the earth-fill —a muddy mixture—into the dam area. The mud settles out; water is drawn off at a distant point

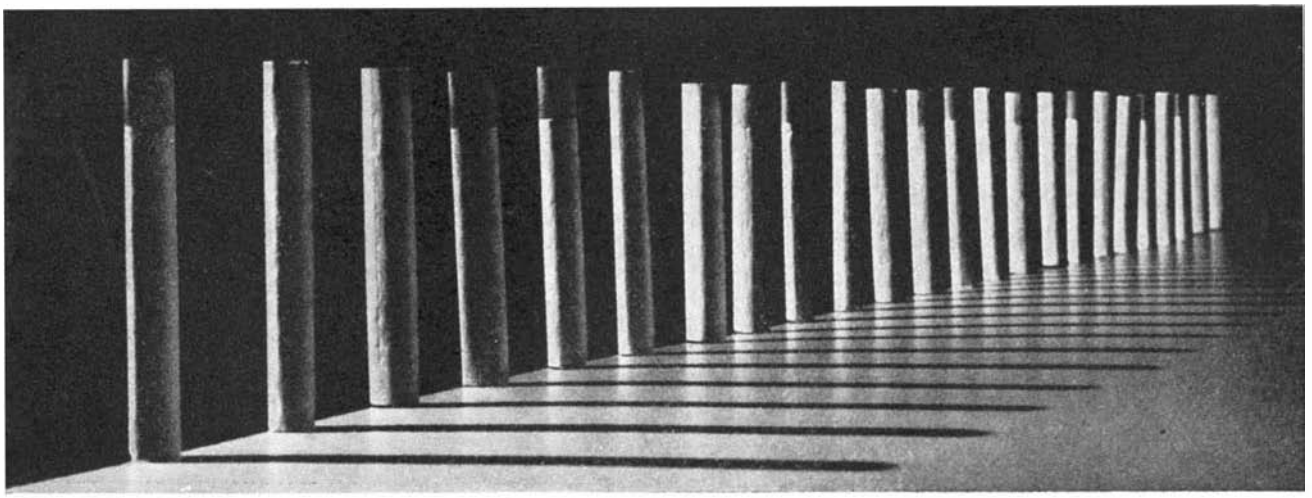
maintain a schedule of 3,000,000 cubic yards each working month, but they have exceeded that.

As the muddy mixture leaves each discharge pipe it falls on a timber platform that scatters the flood and robs the stream of any scouring force, and most of the solid matter settles into place. The excess water is drained away through wooden sluiceways that are stepped and staggered so as to lead the escaping water, without destructive turbulence, back to the river. In this manner the earth fill is distributed and progressively compacts itself as it mounts higher and higher and the water drains out of it—the weight of the accumulating mass increasing the pressure and hastening solidification. The central core wall will be composed of fine silt while the enveloping so-called shell will be made up of an earth fill consisting of larger particles. The core-wall will have a base spread or width of 500 feet and its sloping sides will rise sharply to a crest about 60 feet wide. Hundreds of exploratory drillings into borrow pits and the river bed revealed the composition of the alluvial stratum that is supplying the material for the dam, and a careful check is being continuously kept on the exact nature of the mud that is being dredged and pumped into each part of the dam so as to assure uniformity in the shell areas and the proper fineness of the material going into the core-wall body.

Three and a half miles eastward from the dam, nature provided a narrow dry valley or coulee that is being turned into a spillway and a channel to lead excess flood water back into the river at a point about eight miles below the dam. That spillway is to be equipped with 16 gates 40 feet long and 26 feet high; and when those barriers are raised, the spillway will be able to carry off a maximum estimated flood of 254,000 second-feet of water. The spillway will be a unique and very large structure built mainly of reinforced concrete and carefully designed to be enduring in spite of the physical difficulties and the none-too-stable character of the shale lying immediately beneath the excavated channelway.

THE Fort Peck Dam is so diversified in its arrangement and the tasks involved in its construction are so varied that the present article has been limited to presenting only the broad aspects of the subject. Enormous quantities of earth and shale have had to be cleared away with exceptional rapidity, and ways and means have been employed that establish new records of performance. What has been done at Fort Peck has shown the feasibility of still greater construction jobs. In that section of the country the thermometer mounts normally to 110 degrees, Fahrenheit, in the summer, and drops to 40 degrees below zero, Fahrenheit, during the bitter winter season. To house comfortably a working force of more than 6000 persons in the immediate neighborhood of the dam, the Government created the well-ordered township of Fort Peck, a self-contained community of separate dwellings and dormitories, stores, a motion picture theater, community hall, hospital, grade school, fire department, an ample water supply and sewage system, and other essential facilities. In neighboring communities of recent creation are accommodations for those other people that are identified directly or indirectly with the work at the dam. The electric energy used for many purposes in the town and in connection with the project is transmitted from Great Falls, Montana, over a 288-mile power line built especially to serve Fort Peck. The current is transmitted at 154,000 volts. The most modern apparatus has been used to excavate and to carry away many million cubic yards of material in astonishingly short periods, and that has been accomplished by the closest kind of co-ordination between the excavating machinery and the scheduled movements of capacious and high-speed motor trucks.

All in all, the building of the Fort Peck Dam is a truly vast undertaking. Nature has not made that monumental job an easy one, but, even so, the work is being done well and withal expeditiously by the men responsible both for its direction and its execution. The project should command the interest of the general public and the close attention of engineers and constructors the world over.



Photographs by Jacob Deschin

If You Smoke

Was Father Right? . . . Why We Smoke . . . Cigarettes Least Harmful . . . The Newer Moistening Agent . . . Acidity . . . What Answer Gives Science?

By ALBERT G. INGALLS
Associate Editor

"IT prepareth the stomache for meat; it maketh a clear voice; it maketh a sweet breath."

This was probably the first high-voltage tobacco advertisement. Its writer was William Barclay, Doctor of Physicke, and the time was 322 years ago. Dr. Barclay was not selling tobacco. He merely entertained some illusions.

No modern writer of cigarette advertising has attained to higher levels of ballyhoo than this, but a few of them are doing their best. College coaches must smile when they see advertisements that suggest the benefits which their best athletes would obtain from smoking, and a large part of the public doubtless smiles with them. How many smokers would claim that smoking improved their health? Most of us who smoke do so for a single reason, but it is a fairly good one: because we like it. The real harm it does to a few of us, and the small harm it does to the rest of us who smoke, is only a minor charge against our enjoyment—considerably too small a charge, most of us think, to outweigh the pleasure we get out of smoking. If this were not true we would not smoke. The charge against some other habit might be so high that it would outweigh the pleasure. For example, the charge against the murder habit is so heavy, and the harm the hangman would do us is so extensive and permanent, that many of us do not acquire it. It is also dangerous to climb mountains and stepladders, play football, to cross the street, or merely to exist, but the risk is so small that we willingly accept it. With all of these things, as with smoking, the harm or the danger is a matter of degree.

Here are some of the things that *can* happen to you if you smoke: cancer of the tongue, toxic effects on the brain, muscular tremor, jumpiness, irritability, neuralgia, vertigo, insomnia, headache, aphasia, lowered mental efficiency, tobacco amblyopia, deafness, tinnitis, tobacco heart, high blood pressure or low blood pressure, hyperchlorhydria, tobacco dyspepsia, spastic constipation, pharyngeal catarrh, and a round scolding for dropping ashes on the rugs or leaving butts on flower pots. And so it is a wonder that any of us are alive at all. Since the human race has not yet gone to the bow-wows there must be a discrepancy somewhere, for only a member of the Anti-Tobacco League would read such a scare-you-all list perfectly straight-faced. Most of these things don't happen or, if they do happen, they do not all happen at one time; while a single minor difficulty is often a rather companionate thing to have, as in the case of a dog that feels lonesome without at least one flea.

YOUR grandfather—or possibly your father if you are old enough—probably thought cigarettes were sissified. He asserted that a youth who began the cigarette habit would "kinder peter out," if not worse, and he believed it. He called cigarettes "coffin nails," but he made no objection to cigars or a pipe. But every generation has thought the next generation was "kinder petering out." Those who were supposed to peter out grow up and in their turn worry about the next generation.

When you were 21, and grandfather or father perhaps suspected you *might* have tried smoking once or twice, you had already tried it first when you were eight, had smoked cornsilk often till you were 12, and then graduated to Bull Durham, which you as a budding racketeer accepted once a week from your older sister's boy friend, as a *quid pro quo* for not hanging around too close when he made his call on Sunday nights. So, when you had reached a full 21, your grandfather or your dad thrust a *cigar* at you and said, "Here—if you must smoke, get behind one of these and be a real man."

By definition, if smoking injures the race more than it helps, it is immoral in itself—and to the net extent that it injures. But there are really heavily immoral conditions that need attention first—enough to occupy us for the first 1000 years. In the meantime we shall probably smoke.

The editor of this magazine receives occasional letters from persons who seem vigorously opposed to smoking and tobacco advertisements. But, since all of its editors smoke, any apology for the

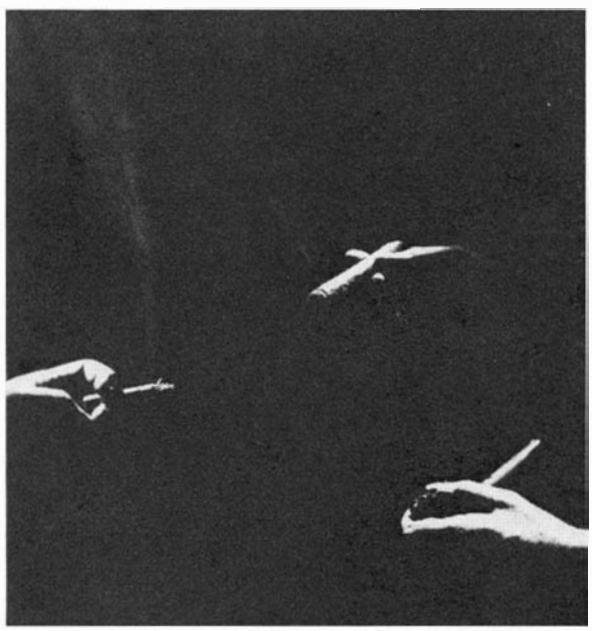
addiction would be hypocritical. Being smokers, and supposedly "scientific"—although scientific people often do the most unscientific things—they have endeavored to find out, largely from literature buried in medical libraries, what scientific angles smoking has, and the following notes present some of the more important findings. It seems odd, considering that the tobacco industry ranks as one of the largest of the world and that there are many millions of tobacco users, how few of the discovered scientific facts about smoking have been made generally available to the public.

What of the effect of smoking on the mind? Professor J. Rosslyn Earp tried to find out whether the best scholars at Antioch College were smokers or non-smokers. Probably the average smoker would concede this point in favor of the non-smokers at the outset. Professor Earp compared the grades of 177 smokers and 176 non-smokers and reported his findings to *The Lancet*, a leading British medical journal. Of the non-smokers, 31.8 percent failed to graduate, while 57.1 percent of the smokers failed. He also cites other investigators. In the Army alpha test (which, however, has lost at least a part of its earlier prestige) S. N. Powers found that high school boys who smoked were given a quotient of 98.6, but those who did not smoke reached 112.5. The Miller and Terman tests gave comparable results. E. L. Clarke found that 18.3 percent of smokers and 68.5 percent of non-smokers at Clark College won honors in scholarship. George L. Meylan of Columbia University found smokers and non-smokers failing in the ratio of 10 to 4. To labor these differences would be useless, for probably few will dispute them. Just what they signify is harder to pin down. In *The Lancet*, Prof. Earp says:

"SCHOLARSHIP demands the *exercise of attention* which cuts off the individual from his fellows. This solitude of mind is incompatible with the gregarious instinct. According to this theory, the tobacco habit has only an incidental connection with low scholarship by being related to the gregarious tendencies of man. The smoker smokes because it is a social habit. He has low scholarship because he is sociable. If some disease yet undiscovered should strike the tobacco crops and sweep that vegetable from the face of the earth, those who now smoke would not, according to this theory, advance in scholarship. They would continue to employ their leisure hours in social intercourse rather than in study.

"The Habit of Smoking Devitalizes Ambition.—This is the theory which is expressed by Emerson in the following words: 'The believing we do something when we do nothing is the first illusion of tobacco.' Whether the fumes of burning tobacco are poisonous or not, there is no doubt that the habit once established gives rise to more or less craving for this form of indulgence. It is contended that in satisfying this craving, other less insistent cravings, among them the craving for knowledge and scholastic success, tend to be neglected. The observations that 'heavy smoking' is more closely associated with low scholarship than 'light smoking,' and that as time goes on the smoker's scholarship tends to decline, are not out of harmony with this theory. We should also expect to find the smoker's intelligence unimpaired, as, in fact, we do.

"That some poison or poisons in the smoke acting upon the central nervous system produce a *deterioration of nervous tissue* leading directly to a lower mental output. This is the only theory, as far as I can see, which would explain an independent association of 'inhaling' with low scholarship. The amount of time given to social intercourse by those who inhale surely cannot be greater than that given by those who do not inhale. The much greater absorption of the vaporized products of tobacco is, indeed, the only obvious distinction which delimits the first group from the second. This theory is also supported by the observations of the progressive decline in the scholarship of smokers and by the lower scholarship of the heavier smokers. It is supported also by the nerve injuries known to be associated with excessive use of tobacco—e.g., amblyopia, deafness, tachycardia—and by the nature of the poisons which tobacco is known to contain.



"On the other hand, we have to remember that many men of great intellectual eminence and achievement have been smokers. We note, too, that intelligence as measured by psychological tests is not affected by smoking. Moreover, if a chronic poisoning process of any considerable significance is taking place it is astonishing that the correlation coefficient between scholarship and the length of time of indulgence in tobacco is negligible.

"On the whole," Professor Earp concludes, "it seems likely that more than one, perhaps more than all, of the explanations ventured above are necessary to cover all of the facts," and he later sums it up thus: "That non-smokers excel in scholarship seems to be indisputable. The reason or reasons for their excellence are still very uncertain." In his articles Professor Earp does not moralize.

A QUESTION which may be asked at this point is this: To what extent does success in life (whatever "success" really is—and in turn who can answer that?) depend on scholarship, and to what extent on sociability—on mixing with others, thus acquiring tact, gumption, and, in short, becoming better adjusted to life and obtaining a better chance at success through sociability? For it is not as easy to isolate the ultimate values in life as it is to compile statistics. Who can say, for example, that a man who attained high scholarship, won distinction, and made millions (at the cost of a lot of work), is better off and really has succeeded better, than another who, at 85, looks back on a moderately commonplace life during which he did only fairly well in school, made no millions, and won no special distinctions, but burned two full cords of cigars or cigarettes or a cartload of pipe tobacco, and was serene and happy?

Thus, in final analysis, the whole question of smoking leads us to unanswerable philosophical questions. There is no final or "correct" answer to it, even in the realms of science. Your own answer to the question is, for you, probably the correct one.

Walter L. Mendenhall, M.D., Professor of Pharmacology at the Boston University School of Medicine, has neatly summarized some of the scientific facts surrounding smoking, in a little book entitled "Tobacco." One of the first things he mentions is that, in Holland, children smoke. Thirty percent of the boys smoke before they are nine, 50 percent before they are ten, and about 80 percent before they are eleven. He finds no evidence substantiated by scientific facts to support the claim that

tobacco stunts the growth. What we often hear, regarding the "sturdy Dutch burghers," seems to belie what we should expect as a result of Dutch boys' early smoking. All of this is definitely contrary to a rather sacred tradition. Nevertheless, if it is true, a lot of boys and grown men owe their fathers a return session with the slipper. This is not, however, a recommendation that children take up smoking. That question may well be left to their parents.

Prof. Mendenhall discusses the bodily effects of tobacco under five headings. To the circulatory system it carries an increase of pulse rate—5 to 10 beats per minute—and a slight rise in blood pressure. Ordinarily, this is no disadvantage but it shows up in athletics where there is already heavy stress. To the alimentary tract the excessive use of tobacco causes loss of appetite, seems to favor duodenal ulcers, may possibly cause cancer in the mouth, and commonly causes chronic intestinal catarrh. To the respiratory tract, prolonged, continuous smoking may cause chronic irritation of throat and larynx, also bronchitis and tonsilitis. To the eyes it may cause dimness of vision, derangement of accommodation, and dilated pupils.

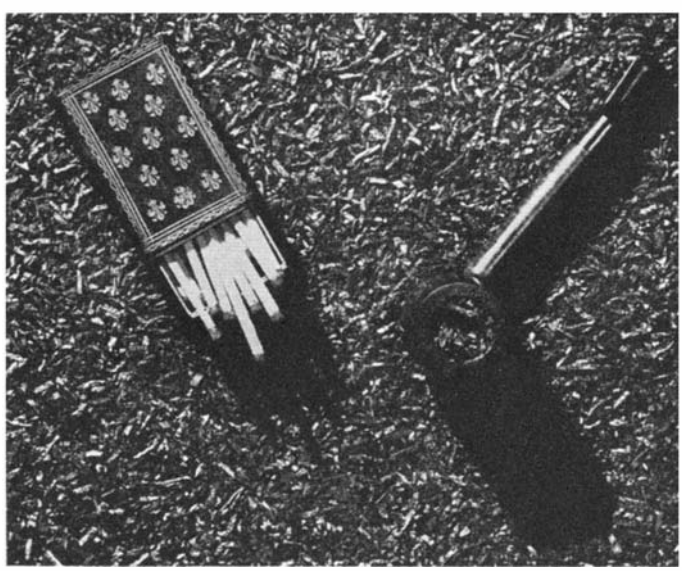
The most interesting effects of smoking are those which occur to the central nervous system. Like alcohol, tobacco is often called a "stimulant"—it is said to pep you up—but instead, much like alcohol, it is mainly the opposite: a sedative. Professor Mendenhall points out that it has an effect similar to that of rest, and he calls cigarettes "a package of rest." This is probably the main basis of the smoking habit, although in many cases the "feel" of the cigarette or pipe or cigar in the mouth is the basis of the same habit, on its own account. The source of the "rest" in tobacco is the nicotine in it. Perhaps this accounts for the well-known fact that de-nicotinized tobacco has cut no wider swath than de-alcoholized beer once did; or, to put it as cynically as the anti-tobacco group doubtless would regard it, "When the cussedness is very painstakingly removed from their tobacco the ingrates don't seem to want it. This looks like total depravity." Such a statement would be substantially correct, as nearly every smoker, with a chuckle, would both admit and assert; for life without a little cussedness is pretty tame. Nicotine, then, has a calming effect on the central nervous system, and this is probably the main reason why smokers smoke. But nicotine also has bad effects. Few smokers will deny this.

Prof. Mendenhall points out that the nicotine in tobacco is probably not the element responsible for the throat irritations caused by smoking, but that this is chargeable to the tarry substances in it. Ammonia, a gas, is also derived from a cigarette, and this is an irritant.

Finally, he states a fact which is not always quite frankly stated when the percentages of nicotine in various kinds of tobacco are given. "The nicotine in tobacco has no strict relation," he says, "to the amount of nicotine appearing in the smoke." He cites the following sets of data, for a cigarette smoked in ten minutes by intermittent suction. The first column states the analysis of the smoke drawn through the cigarette, while the second column gives that of the smoke collected from the burning end of the cigarette.

	Mainstream (mouth)	*Sidestream* (end)
Carbon dioxide	21. cu. cm.	336. cu. cm.
Carbon monoxide	3. " "	12. " "
Nicotine	0.2 mg.	9. mg.
Ammonia	0.0 "	3. "
Aldehyde	0.4 "	1.3 "
Furfural	0.0 "	0.4 "
Acid, tenth-normal	0.5 cu. cm.	

There is no question but that many—very many—smokers are inconsiderate of others who do not smoke; in fact, smokers are inconsiderate of one another, since many who love the cigar regard cigarette smoke as obnoxious, and many cigarette smokers dislike the acid smell of cigar smoke; while a potent pipe, such as one of my editorial colleagues possesses, is easily competent to break up a riot or stop a dog fight.



A few years ago Sir Humphrey Rolleston who, by the way, was personal physician to the late King George V, and is Professor of Physic at Cambridge University, in an address given before other physicians and published in *The Lancet* dwelt at some length on the medical aspects of smoking. He, too, pointed out that the important thing to know about tobacco is not its nicotine content but how it is smoked. "The nicotine content of the tobacco and of its smoke," he says, "do not vary directly the way in which the tobacco is smoked and the degree of combustion being the important factors; thus Virginia cigarette tobacco contains (1.4 percent) nearly twice as much nicotine as Manila cigar tobacco, and yet the cigar smoke contains more than double the amount of nicotine in the cigarette smoke (Dixon); the smoke of Virginia cigarette tobacco contains 0.06 percent only of its nicotine content when smoked as a cigarette, but when burnt in a pipe 37 to 53 percent of its nicotine content.

"THE degree of combustion is most complete in cigarettes of all kinds, least in a pipe, and midway in the case of cigars. In pipes, as much as 70 or 80 percent of the nicotine in the tobacco may pass into the smoke; a good deal, however, turns on the length of the mouthpiece; a long pipe is, therefore, better than a short one; thus a clay pipe or a churchwarden allows the nicotine to condense in the stem, to such an extent that very little passes into the smoke. It has been stated that a smoker who re-lights a pipe or cigar absorbs more poison than he would from 10 ordinary smokes (Kionka). According to Dixon the smoke of one cigar contains as much nicotine as 12 to 18 cigarettes.

"The general opinion," Sir Humphrey goes on to state, "is that cigarette smoking is the form likely to give the worst results, then cigars, and lastly, pipes. On the other hand, the order has been reversed. The content of nicotine in cigarette smoke is much less than that in the smoke of pipes, that of cigar smoke being between these two extremes.

"The effects of cigarette smoking appear to be chiefly due to carbon monoxide (Dixon), pyridine, furfural, and ammonia, whereas cigar smoke is powerful mainly on account of its nicotine content. Virginia cigarette smoke contains furfural, while Turkish cigarettes supply very little, and cigars and pipe tobacco none. Furfural, pyridine derivatives, ammonia, and carbon monoxide are distillation products from vegetable material, and are not, like nicotine, in any way special to tobacco, but by their irritating effects on the mucous membrane of the throat and upper air passages may in some way account for the evil reputation of cigarettes."

Chemical analyses, figures, and statistics are interesting but, like all statistics, they must be interpreted in terms of

something else, and often that interpretation runs off the track en route. Since the aim is to ascertain the relative harm done to the body by smoking in its various forms, perhaps the body itself is our safest gage of the extent of that harm. In other words, our feelings in many if not most cases tell us directly, without recourse to any roundabout scientific indications. We know when we have had enough dinner or enough chocolate candy, because Nature tells us so. Likewise most of us doubtless know when we are smoking too much, and some of us then cut down on our smoking. The remainder pay a doctor to repeat back to them, as doctor's orders, what they practically know already, or else they go on until something happens. Certainly attempts to prove by science that, because there is "so many times as much" of this or that in cigarette or cigar or pipe smoke, such forms of smoking are "so many times" worse for us than some other form, as has sometimes been deduced, seem unwarranted. The experience of the individual as well as the integrated experience of millions of smokers, may have more force here than such theory.

SOME research performed by Doctors Irving S. Wright and Dean Moffat of New York, and reported in the *Journal of the American Medical Association*, reveals facts which may interest case-hardened old smokers whom many of us suppose to be wholly immune to such "juvenile" effects as nicotine nausea. (Sherlock Holmes, being a hard-boiled smoker, always saved up all the choice "plugs and dottels" which he had knocked out of his last night's pipes, and enjoyed them as a sort of special matutinal relish.) Under controlled conditions, these doctors caused groups of confirmed smokers to smoke standard brands of cigarettes, and they found that, with too rapid smoking, even "experienced and heavy smokers showed some of the most profound temperature and symptomatic reactions." Some of them broke out in cold sweat, and underwent nausea, vomiting and fainting. What of this? The interpretation put on it by the two physicians is that the subjects did not smoke in the experiments as they naturally smoked elsewhere. They became so impressed with the occasion that they smoked faster and inhaled deeper than they would on average occasions, and this made them sick. This served to bring out the fact that all smokers unconsciously maintain a close balance between the desired and undesired effects of smoking, by varying the rate of smoking *from moment to moment*. But, the two researches state, "These subjects continued to smoke after the desire to do so had become over-satiated." The assertion is then made that "habitual smoking does not result in the development of an immunity to the toxins of cigarette smoke." This is likely to be contrary to many of our beliefs about case-hardened smokers whom we supposed no amount of steady, rapid smoking would possibly feaze. Tolerance to nicotine is never absolute for any one. In tests mentioned by Dixon, non-smokers vomited with one to two milligrams of nicotine taken by mouth. Smokers required eight milligrams, but no matter how hard-boiled as smokers they were, they vomited when they got too much nicotine. "If a cigarette smoker were to puff 10 cigarettes on end he would probably receive about 20 to 30 milligrams of nicotine—enough to produce a profound physiological effect," Dixon states. "The amount of nicotine in pipe and cigar smoking is much higher. In our experiments cigar smoke contains about twice as much nicotine as cigarette smoke."

Doctors Wright and Moffat accuse nicotine, not carbon monoxide or other constituents of tobacco which it has been the style more recently to accuse, as the offending member. They also point out that the amount of nicotine in a given kind of tobacco, cigarette, or cigar is not the vital consideration but "how much is actually absorbed through the mucous membranes and ulveolar walls into the blood stream." They cite some examples: Havana tobacco has 1.5 percent nicotine, Maryland tobacco 2 percent, Virginia tobacco 6 percent, Kentucky tobacco 8 percent. But "the amount of nicotine and other products in the inhaled smoke is influenced greatly," they state, "by, first and foremost, the amount of moisture present, and also the tightness of packing, the length of the cigarette and the rate of smoking. The drier the tobacco, the greater the destruction of nicotine. Dixon states that the water content of the tobacco is more harmful to the smoker than the original nicotine content."

As just stated, the drier the tobacco, the greater the destruction of its nicotine when it is smoked. But a bone-dry cigarette is unpalatable, hence all cigarettes contain a hygroscopic agent. The hygroscopic agent which is most commonly used in cigarettes is glycerine. Another which is used is di-ethylene glycol. A dish or bottle of either of these liquids, if left open for a period, would extract water from the air and increase in volume, even on a dry day or in a desert. Which of these two hygroscopic agents is superior for use in cigarettes is a question about which much debate is going on at present. Numerous tests have been made. One, which was described in *The Laryngoscope*, by Dr. Frederick B. Flinn of the Department of Physiology at Columbia University, pointed toward di-ethylene glycol as the better moisture retaining agent, since it was said to cause less irritation of the mucous membrane. Experiments were made on 100 smokers who smoked a daily average of 28 cigarettes containing glycerine, and who had congested pharynx and larynx, coughs and tongue irritation—the familiar symptoms. After three to four weeks on cigarettes containing di-ethylene glycol the throat congestion had disappeared in 62 percent of the cases, and the remainder were improved. Then cigarettes with the same tobacco mixtures but with glycerine instead of di-ethylene glycol were secretly substituted, whereupon 80 percent of the subjects showed a return to the congested condition of the throat within a week, and in many cases the patients refused to go on smoking the cigarettes and the situation had to be explained to them. "The results from clinical evidence show rather definitely," Dr. Flinn states, "that the combustion products of glycerine are more irritating to the throat than the combustion products of di-ethylene glycol. The combustion products of di-ethylene glycol cause only a slight irritation, if any, of the throat." And he adds that there may be some evidence that they may be beneficial where irritation is present.

If these findings—and other investigators have reached similar ones—are true, why is it that most brands of cigarettes still contain glycerine instead

(*Please turn to page* 354)

Some Remarkable Double Stars

By HENRY NORRIS RUSSELL, Ph. D.

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

IT is more than 100 years since serious interest began to be taken in the observation of double stars. Wilhelm Struve—the first of a notable family which for four successive generations has furnished the world with distinguished astronomers — surveyed the heavens with his nine-inch telescope (a large one for those days), discovering more than 3000 pairs. He completed his work by making accurate measures of the relative position of the components of every pair, and determining their places in the heavens, so that any astronomer could readily set his telescope on any star he wished. His completed memoir, with letterpress in Latin, then the best international language, might have been taken as the last word on the subject. Indeed, there is a tale of an English astronomer of that day who showed sadly to a friend a just-completed telescope, saying: "It has taken me years to get this instrument finished, and meanwhile Struve has reaped the harvest among the double stars, and there is nothing left."

More than 40 years later, an American amateur, who spent nights with the telescope after arduous days as a court stenographer, invested his savings in a six-inch refractor. This was smaller than Struve's, but as perfect in definition as could be made. With this apparently insignificant instrument Burnham discovered hundreds of new pairs—which the earlier observers had missed because of their closeness or the faintness of the companions—and began a career which led him to full-time work with the greater telescopes, and to the discovery of some 1300 new systems.

IN the long interval between these observers, Otto Struve, the second of the line, had found more than 500 pairs, and other astronomers added smaller numbers: but though some 5000 pairs were known when Burnham completed his work, there was none the less much to be done.

Two experienced observers at the Lick—Aitken and Hussey—planned a campaign, in which every star down to the 9th magnitude, in the part of the heavens accessible from the latitude of Mt. Hamilton, should be examined with the great telescope on nights when the air was really steady. This search led to the discovery of more than 3000 additional pairs by Aitken, and of more than 1000 by Hussey, before his too-early death cut short his work.

After this intensive search, by observers of the highest skill and experience, with one of the world's greatest telescopes, and in an exceptionally good climate, one might suppose that the sea of double stars was indeed fished out—except in the southern skies, where successful work is still actively in progress. Yet one of the most remarkable double stars on record has recently been found in this supposedly exhausted region. Its discovery did not come by chance, in the course of a general "drag-net" survey, but as a result of specific and competent planning.

The great majority of double stars are "physical systems"—that is, pairs which are actually close neighbors in space and in slow orbital motion. For a few dozen pairs, the motion is fast enough to complete a revolution since discovery (at most, within a century or so). For perhaps as many more, the observations cover a sufficiently large part of the orbit to permit a fairly good calculation of the rest: but there are thousands of other systems in which the motion is so slow that, even in a century, the angle has changed by but a few degrees.

We could not be sure that the stars of such a pair are really connected, were it not for the fact that the motion of the pair in space is usually much more rapid than the orbital motion of one component around the other. By comparing observations of the positions of the pair relative to other stars in the field, made at intervals of a few decades, it can be determined whether they are moving together, and hence form a physical system, or in different directions and at different rates. In the latter case we have an "optical pair" composed of stars which are at very different distances from the sun, but happen to be nearly in line with one another at the present time. Perhaps a hundred such cases are known—about as many as might be anticipated on the laws of chance.

There are of course thousands of pairs, especially the fainter ones, for which we have not yet enough information about the motion to settle the question.

If we had three good measures of the relative positions of the components of a pair, at intervals of 30 or 40 years (the third to check the others) and corresponding observations of the positions of both, or at least of the bright one, with reference to the background of faint and distant stars in the same field, we could weed out the optical systems, and classify the physical pairs into those that needed re-observation only about once in 100 years, 30 years, and so on.

Something like 2 or 3 percent of the whole—so far as observations go to date—turn out to be moving faster, so that there is hope that the grandchildren of the discoverer may see a good orbit calculated.

A very few move fast enough to complete a revolution during a single observer's working life. Aitken has had the satisfaction of publishing the orbit of a close pair which he had discovered and observed through a whole revolution. More recently Dawson, born in the United States but working in Argentina, has done the same for a pair of period four and one half years, the shortest then known. But these satisfying experiences come only as incidents in the long labor of making and publishing observations which only the astronomers of the next century will be able to utilize to the full.

Binary stars for which we know the orbits are of special importance, for, if the parallax has also been measured, we may find the real distance of the components, and then, by Kepler's Law, the mass. Fortunately, enough such cases are available to show conclusively that the stars are far more alike in mass than in almost any of their characteristics. To be sure, the brighter stars are the more massive: but a difference of a thousand-fold in luminosity (compared with the sun) corresponds to only about a five-fold difference in mass.

IT follows from this that a system of short period must necessarily have its stars close together—roughly at the distance at which a planet revolving around the sun would have the same period. For periods less than five years, the distance should be less than three times the earth's distance from the sun.

Now a pair as close as this could not be seen double, even with the greatest telescopes, unless it were pretty near us. Taking the minimum easily discoverable separation as 0″.15, the parallax would have to be at least 0″.05, and the distance not more than 60 light-years. For still shorter periods, the limit would be closer.

Reasoning of this sort led De Kuiper (of whose discovery of three white dwarf stars we spoke not long ago), to make a special study, with the great Lick telescope and on the finest nights, of those stars which are known to be our near neighbors in space, either by direct measures of parallax or on account of large proper motion. Among the red dwarf stars, which, owing to their faintness, may have been previously passed over, he found several fairly close pairs, for which one may be reasonably sure that the period will be less than 50 years—and one much more spectacular one.

This is a faint star, of magnitude 9″.2, known only by its catalog number −8°4352 in the Bonn Durchmusterung, with a large proper motion, and a very considerable parallax, 0″.148±0″.004, which means that it is four to one that the calculated distance, 22 light-years, is not more than one light-year in error. In July, 1934, Kuiper found this to be a close and almost equal pair, with a separation of 0″.20. Since that date the stars have been observed in revolution at a substantially uniform rate of 18° per *month*. This indicates that the real orbit is practically circular, and that we see it almost in plan, very little foreshortened by inclination of its plane. The period is 1.66 years—less than half the shortest previously found for a telescopic double, and the mean distance, 0″.185, corresponding to a true distance of 1.25 astronomical units—intermediate between those of the earth and mars. From these values, the combined mass of the two stars comes out 0.7 times that of the sun. Being very nearly equal in brightness, they are presumably equal in mass, each having 35 percent of the sun's mass, and 1/250 of the sun's brightness. The diameters cannot be accurately estimated but are probably something like one third that of the sun, which would make the density of the order of ten times the sun's.

These are remarkable values, but not without precedent, for three other stars are known whose masses are 23, 20, and 16 percent of the sun's, and luminosities 1/700, 1/1700, and 1/3000 of the sun's light. All these stars, including the new discovery, are red dwarfs, of spectral class M, and all agree well with the known relation between mass and luminosity.

Stars of still smaller mass may exist, and even be very numerous, without our having much chance to detect them.

A STAR of one tenth the sun's mass would shine so feebly, and be so red, that it would not show, even on long exposure photographs with powerful instruments, unless its distance was only a very few light-years. Smaller bodies would be effectively dark.

One, at least, appears nevertheless to have been identified. There is a well known binary pair Xi Ursae Majoris—one of Stuve's original discoveries—which has been abundantly observed for the last century, and is well toward the completion of its second revolution, the period being 59.86 years. From measures of parallax it appears that the system is 26 light-years from us, while the distance separating the components averages 20 astronomical units, ranging from 12 to 28, on account of the eccentricity of the orbit—that is, from a little more than Saturn's distance to a little less than Neptune's. A simple calculation then shows that the combined mass of the system is 2.3 times the sun's. The positions of the stars in the heavens have been observed separately and it has thus been found that the fainter star has 77 percent the mass of the brighter, making their masses 1.28 and 0.99 times the sun's.

So far, all is commonplace: but both components, when observed spectroscopically, show, beside the slow changes due to motion with the 60-year period, much more rapid oscillations, proving that each of them is attended by a companion too faint to be directly visible. For the brighter component, the revolution of the companion takes place in 1.83 years. Shortly after this fact had been discovered spectroscopically at the Lick Observatory, Hertzsprung, who was engaged, with great success, in developing methods for accurate photographic observations of double stars, found that his observations of this pair, unlike others, did not follow the smooth ellipse corresponding to the 60-year period, but showed a superposed oscillation, with a period of 1.8 years. It is the center of gravity of the bright star and its companion which follows the exact ellipse, and, by careful study of the measures, it was found that the average distance of the bright star from this point was 0.4 times the earth's from the sun, and that the orbit was turned almost edgewise toward us, being inclined 84° to the apparent "plane of the sky." The orbit of the main pair is inclined 57°, and the two orbits are so placed that their mutual inclination is 28°.

Now the distance separating the bright star from its invisible companion can be calculated from Kepler's Laws, and comes out 1.6 astronomical units. Hence the invisible companion is three times as far from the center as the bright star, and only one third as massive. We know the combined mass, and so can conclude that the principal star has 96 percent of the sun's mass (which is reasonable since it is of nearly the sun's brightness), while the faint component has but 32 percent the mass of the sun. Such a body would still be a *star*, giving out about 1/250 of the sun's light, and hotter all over its surface than an electric furnace: but no existing or projected telescope would enable us to see it so close to its bright neighbor.

The fainter member of the wide pair is also a spectroscopic binary. Berman, at the Lick, found that the period was only 3.98 days, and the orbit very small. The whole change in distance from us, as the visible star sweeps 'round this orbit, is but 350,000 miles. The real diameter of the orbit may be more, since it is possible that its plane is turned almost flatwise toward us. So we assume that its inclination is the same as that of the wide pair. We find that the star is 205,000 miles from the center. But by Kepler's Laws, as before, we can show that the companion must be 4,500,000 miles from its primary. It follows then that the companion is only 1/21 as massive as the others, so that the masses are 0.945 and 0.045 times the sun's. The larger mass is again a normal star, but the smaller one is without parallel in our observational experience, with little more than a quarter of the smallest previously known stellar mass.

SINCE the relation between the mass and the heat-radiation of a star is founded on good theoretical principles, we are fairly safe in estimating that such a body should give out about a millionth part as much heat as the sun. Its diameter is not so easy to estimate, but if we guess at a tenth of the sun's, we are probably not far astray. This would make the radiation per square mile 1/10,000 as great as for the sun, which demands a surface temperature 1/10 the sun's, or about 600° absolute—below a red heat, and thus the body would be dark, though not cold.

When stretched so far, however, the theory breaks down, for it assumes that the body is a purely gaseous mass. At any such temperature, there would presumably be a solid surface.

It is rather hard to decide whether such a body should be called a very small star or a very big planet. It is so small, and must be so faint, compared with its primary, that it seems planetary. On the other hand, its mass is 50 times as great as Jupiter's, and it is very probable that it is radiating enough heat on its own account to keep its surface hot even if not shining visibly.

There may be any number of such bodies in space. It is only by a combination of favorable accidents that we obtain evidence of this one.

It is fair to remark that the smallness of this companion is not fully proved. It *may* be that the four-day orbit is inclined at a low angle—in which case the division of mass between the two bodies is less unequal. But, since the two known orbits in the system are highly inclined, this is highly improbable—in the writer's judgment, at least.—*Princeton, April 5, 1936.*

Why Faded Fabrics?

Dye Fallacies . . . Few Cents Determine Fast or Fugitive Dye . . . Dyeing Economics . . . America Makes Fast Dyes . . . Public Must Demand Them

By DR. JOHN H. SACHS

THE author of the accompanying article is one of the foremost authorities on dyestuffs in this country, and has been prominently identified with the dyestuffs industry since its inception on its present basis in America about 19 years ago. He is now an executive advisor on fine dyes in the main office of E. I. duPont de Nemours & Company.—*Editor.*

ONE of the biggest personal nuisances in America today is that of faded fabrics. The economic waste due to this nuisance is enormous, certainly amounting to as much as 50,000,000 dollars annually. Everybody can recall instances in which useful articles of apparel or decoration have been discarded simply because their original color has faded to such an extent that good taste is offended by the result.

Today, man is more color conscious than ever before. He demands that his clothing, from cravat to hosiery, be colored. The pictures in his home are apt to be splashed with bright, often brilliant hues. His car may vary in color from a dark blue to a bright green. He is guided in his choice of food and drink by the natural or artificial color of the articles offered him. One might almost say that nothing else so influences his choice of one article as against another. Yet, too often the color of the material he has chosen rapidly fades; the very property upon which his purchase was based has been destroyed.

Perhaps we should have said that woman today is more color conscious than ever before. It is to her, the American housewife, that the nuisance is most apparent. She deplores it, complains about it—rarely to the right people—and the husband pays the bill for the new frock, the new coat, or the drapery which is purchased to replace the discarded article—dyed with "fugitive" colors.

"Will it fade?" is one of the commonest inquiries raised by women in retail buying. More often than not the seller evades the question, or says bluntly that the color cannot be guaranteed. In this day of scientific advancement on all fronts, and especially with the American chemist leading the world in accomplishment, it is only natural that women should begin to wonder why something is not done about this fading color nuisance.

The chemist's answer is that something has been done. As far as he is concerned there is no reason whatever why every fabric, regardless of its quality or price, should not be dyed in colors that will last fully as long as the fabric does itself under any reasonable service to which it is put. The nuisance and economic waste of fading fabrics—in draperies exposed to the sun, in gowns and wash dresses, in men's apparel, throughout the whole range of fabric uses, in fact—are entirely unnecessary.

WHY, then, the nuisance and how can it be stopped? Why the huge waste? Why faded fabrics at all? Here again the answers are plain. However, in order to understand them it is necessary, first, for one to know something of the history and nature of the materials in use today for the coloring of fabrics, that is, the dyestuffs, or more specifically the coal-tar dyestuffs. This knowledge is essential to intelligent action.

Prior to 1856, all dyes were of animal or vegetable origin, obtained from the juices of berries, from roots, plants, the sap of trees, or, in the case of cochineal, simply by grinding the dead and dried cochineal bug. Then a young English chemist, William H. Perkin, accidentally discovered the first coal-tar dyestuff. He was trying to find a laboratory method for making quinine. In one experiment he sought to determine what would occur by the oxidation of aniline. The result was a black tarry substance which dissolved in alcohol to a beautiful reddish violet solution—mauve. This was the beginning of the coal-tar dyestuffs industry.

Coal-tar is a common by-product of the manufacture of coke. It is a heavy, black, viscous liquid with about the consistency of molasses. Its importance to the chemist came with the discovery that many of the products of nature when broken down are nothing but derivatives of three or four of its most common constituents: benzene, toluene, naphthalene, and anthracene. The discovery was like tearing down a house to find that it was built of bricks, mortar, wood, and nails, but with an important exception. There are many kinds of bricks, mortars, woods, and nails, whereas benzene, toluene, naphthalene, and anthracene are the same the world over. Regardless of where they are produced, whether in England, Germany, America, Japan, or in the wilds of Borneo, they are exactly and unvaryingly one thing. Add a molecule or take one away and they become something else entirely.

Very well then, the chemist argued, if nature combines the elements into compounds that can be broken down into the same products that are contained in coal tar, why not begin with coal tar and reverse the process wherever it is commercially feasible to do so? This is exactly what English and German chemists did. Starting with anthracene they produced alizarine, the valuable substance in madder, a plant dye. Not content to stop there, new dyes unknown in nature were soon produced from alizarine, while dyestuffs more valuable than alizarine were made from anthracene.

The early nineties saw the first successful manufacture of indigo from the coal-tar derivative benzene. There followed a procession of other valuable

dyes of every conceivable shade and brilliance, all obtained from a few substances found in the black, sticky by-product. It was learned that by combining these substances with one another, or with their derivatives, or with other common chemicals, it was possible to produce literally thousands of colors. Most of these colors are of no use commercially, but on one point they have a common characteristic that is as certain as night following day; that is, wherever applied, or by whomever applied, the same methods bring the same results. Each color compound is absolutely definite.

This is a vital fact for American women to remember in coming to an understanding of why one dress fades and another does not. The modern coal-tar dyestuffs are definite chemical compounds, usually of very high purity. Two cooks using the same materials, following exactly the same recipe in mixing these materials and baking two cakes under like conditions of temperature and time will produce identical articles. In just the same way will two chemists, using the same materials and recipe, arrive at identical dyestuffs. Thus, it follows that synthetic indigo made in America is similar in every respect to indigo made in England, Germany, or Japan.

The same may be said of any commercially important dyestuffs. No matter where made, it behaves similarly in its method of application to the fabric. It imparts the same shade and depth of color. If it be a "fast" color made in Germany, then it will be "fast" also if made by the same process in America. On the other hand, if it be a "fugitive" color made in America, it will be a "fugitive" color if made anywhere else —in England, Japan, or Germany.

LET us assume that there are a thousand dyes of commercial importance. This means that a thousand definite chemical compounds are being manufactured in the world today and used as dyestuffs; the important fact to understand here is that each country having a dyestuffs industry manufactures, for the most part, the same compounds as does any other country. Indigo is being produced synthetically today in at least seven countries, alizarine in at least six countries, while some of the less important colors—specialties—might be manufactured only in one.

If all this be true, why, then, the fault of faded fabrics? Is it due to the inferiority of American-made dyestuffs? Or is it because the American chemist is not so skilled as his English or German brother? Is he unable to make the more complicated compounds, which, as a rule, are the better dyestuffs?

The answer to all these questions is an emphatic "No"

There are many coal-tar dyestuffs with which any fabric can be dyed to any particular shade. Some of these dyestuffs may be very cheap in comparison with others. Therefore, any desired shade can be obtained on any fabric either with a cheap and probably fugitive color or with an expensive and probably fast color, it being almost generally true that the fast dyestuffs are the more complicated structurally and henceforth the more expensive. Why, then, are cheap and fugitive colors manufactured?

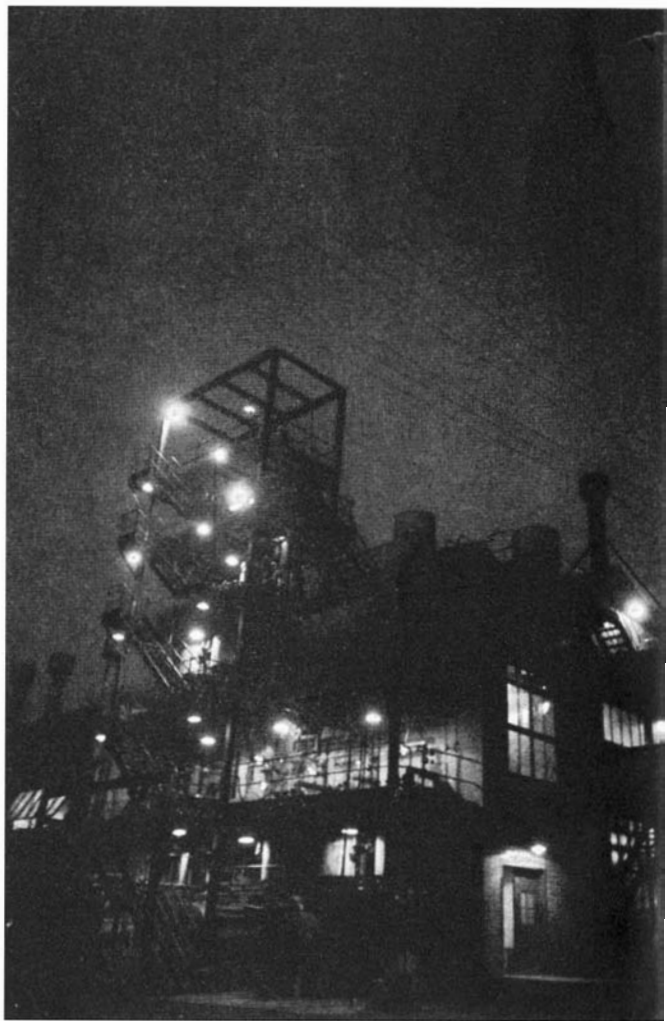
FOR many purposes fast colors are not necessary. During the Christmas season reds and greens predominate in wrapping paper, ribbons, and decorations. The wrappings and ribbons are soon discarded and destroyed. Furthermore, many colored fabrics are never exposed to sunlight; hence the colors need not be sun-fast. In many cases it would be sheer waste to employ expensive dyestuffs for materials which, having served their purpose, are soon deliberately destroyed. But herein lies the answer to the question of faded fabrics. *Cheap colors are available. In too many cases they are used for a purpose for which they are entirely unsuited. This is the genesis of the nuisance and a just cause for complaint.*

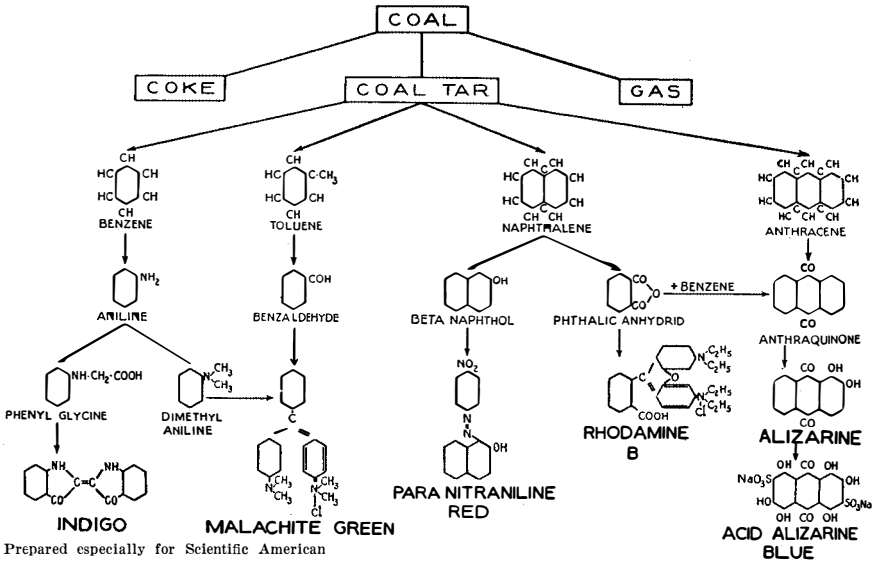
In the early years of the World War, the American textile industry was seriously handicapped by the lack of dyestuffs and other chemicals necessary to the industry, which up to this time had been readily procured from Germany. In desperation, some of the firms engaged in this business began to manufacture dyestuffs and other chemicals they required. Obviously, the first colors produced were the simpler ones, which, as a rule, are the fugitive ones. And who can forget the result? For a period of about five years no dependence could be placed upon the color in any dyed or printed fabric. It was during this time that the American public was educated to believe that Germany alone possessed the chemical skill to manufacture fast colors. And, in fact, this was the case at that time.

But the later years of the war saw the birth of a really great American dyestuffs industry. And the decade immediately following the war witnessed the growth of this lusty youngster into a full-grown adult. In no other field of the chemical industry was growth as remarkable as in the manufacture of dyestuffs. Practically all colors on which the Germans had enjoyed a monopoly until 1914 were scrutinized by the American chemist. He studied their properties and the technique of applying them to fabrics; most important of all, he developed processes for their manufacture, to get the same definite chemical compounds, mind you, that hitherto had been manufactured only in Germany. As a result, there are today in America a number of well-established, reputable firms engaged in the manufacture of reliable dyestuffs.

The answer to the problem of faded fabrics comes with an understanding of the cost of dyestuffs in relation to the value of the fabrics on which they are applied; in other words, the value of the dyestuff in a $50 gown or a $50 suit of clothes. In the gown the color may be worth from five to 30 cents, in the suit from 15 to 50 cents. But there are many gowns, many suits, and many yards of merchandise sold from the piece each year. When the cost of dyestuffs in a single gown, suit, or yard of cloth is multiplied by the number of gowns, suits, or yards of cloth, the aggregate is an item that must be given consideration. Let us develop this thought.

Exemplifying the spirit of the dyestuffs industry. The demand keeps this plant working 24 hours a day, seven days a week





Prepared especially for Scientific American

At least 30,000 dyes have been made from coal-tar, of which about 1000 are used commercially. In this family tree of six common dyes, we see how they are derived chemically from the four important raw materials contained in coal tar

Suppose a housewife desires to purchase 20 yards of an ordinary cretonne ranging in price from 20 cents to one dollar per yard. She visits a department store and chooses a pattern that meets her fancy. She makes a choice of a certain combination of colors which particularly pleases her. When she inquires about the fastness, the salesman informs her that he believes the material to be dyed with fast colors. The housewife does not consider that the value of the dyestuff in the fabric she buys is indeed a very small part of the price she pays for it. It can be safely said that the value of the dyestuffs in her 20 yards of cloth varies from 10 to 80 cents; that is, from one half cent to four cents per yard. She does not realize further that the dyer printed perhaps 100,000 yards of the material, or that he charged four to 12 cents per yard for his work, this price including materials, labor, overhead, and, of course, his profit. The dyestuffs alone for this amount of cretonne may have cost, therefore, anything from 500 to 4000 dollars.

TAKE, for another example, a cheaper fabric than cretonne—say, percale. This can be dyed or printed for three cents to six cents per yard, the cost of the dyestuff alone varying from one half cent to two and one half cents per yard. Percale is dyed and printed by the millions of yards and a single pattern of 100,000 yards is not unusual. Simple arithmetic applied here shows that the dyestuffs for this amount of material may be worth from 500 to 2500 dollars.

The same facts may be presented in another manner. Let us consider for any particular year the value of the important textile fabrics produced in America in relation to the value of the dyestuffs sold here. For the year 1933 the factory value of all cotton goods amounted to 874,581,000 dollars; the value of all silk and rayon goods, 244,261,000 dollars; and the value of all woolen and worsted goods, 442,399,000 dollars. Assuming that 50 percent of all cotton goods and 100 percent of all other classes of fabrics were dyed or printed, we have a factory value of 1,123,950,500 dollars for all dyed or printed fabrics. Now the sales value of all dyestuffs consumed in America in 1933 was 50,500,000 dollars. It is estimated that 75 percent of the total dyestuffs consumed was applied to textile fabrics, the remainder being employed in the leather, paper, and other industries. Therefore, the value of the dyestuffs applied to the fabrics becomes 37,875,000 dollars. This is but 3.37 percent of the value of all dyed or printed textile fabrics. If the assumption is made that there was an increase of 50 percent from the factory-value to the consumer-price of all dyed and printed fabrics, the relative value of dyestuff becomes 2.25 percent.

The outlay for dyestuffs and other chemicals necessary to dyeing or printing is a considerable item to the dyer, printer, or jobber, the latter the so-called "converter" of the textile business. But in relation to the value of the material he produces, this outlay is almost insignificant. Of course, the dyer, printer, or jobber is entitled to a fair profit in the conduct of his business. But competition is keen in the textile industry; the printing machines must be kept turning and the dyehouse must operate. The difference between the cost of fast color or fugitive color for the 100,000 yards of material may be the difference between an idle or busy factory. The result is a low bid, based on fugitive color, for the dyeing and finishing job—and the contract for the work is obtained.

The goods look nice. They are passed along to the "converter," the garment-maker, and finally to the consumer. Twenty thousand garments, sold for perhaps 10 dollars each, means 200,000 dollars' worth of second-rate merchandise. This is the result of a saving of perhaps 2000 dollars in the cost of the dyestuffs used. Here is the economic waste.

Recently my wife purchased a certain amount of medium-priced cretonne for a chair cover. In due time the cover was made and placed on a chair which stood before a window with a southern exposure. In less than six months the color, which was originally a clear blue, had faded into a dirty grey. The color on the back of the chair, shielded from the sun, survived. The value of the covering, at least from an esthetic point of view, was gone, and it had to be removed from the chair.

At my insistence my wife returned the covering to the store from which she had purchased the material. She was told that since the advent of American dyestuffs, and because of the difficulty of procuring dyestuffs of German manufacture, it was no longer possible to guarantee fabrics against fading. At another time she might have been told that a medium-priced cretonne did not warrant the use of expensive, and therefore fast, dyestuffs.

Responses such as these to customers' complaints are tommyrot. The salesman does not know the facts. He does not know that the value of the dyestuffs used in the merchandise he sells is a very small part of the cost. And being ignorant of this, he does not realize that the use of a cheap and fugitive color for the dyeing of any fabric which is expected to endure for a reasonable season is an economic waste. He does not know that America today possesses a really great dyestuffs industry. He simply is quoting an "alibi" which has been passed along by the manager of his store or perhaps by the wholesale house from which the goods were originally bought.

IF any fault is to be found with the quality of dyed fabrics being currently supplied to the American public, the fault lies entirely with an apathetic public. Better dyestuffs are available today than ever before. When the public is educated to dispute intelligently the arguments of the misinformed sales people, when they are insistent upon fast dye fabrics, then such fabrics will be available at only a trifling increase in cost. Fast colors are available for every reasonable purpose and, in using them, the printer and dyer can still make a fair profit. There is no reason whatever why the buyer should not demand a guarantee of fastness in the color of the fabrics which he or she purchases. The guarantee will come when the demand is general.

FARM TO FACTORY

Chemistry Points the Way . . . Soy Beans . . . Tung Oil . . . Starch . . . Wood Pulp . . . Cotton . . . Rayon

By L. F. LIVINGSTON
President, American Society of Agricultural Engineers

YEARS of scientific research are behind the idea of the industrial use of farm crops as raw materials. World changes in agriculture are tending to make nations more and more self-sustaining, which means that we must broaden our markets at home. One way to do this is by cultivating on American soil those agricultural raw materials we now import. The other way is by finding new uses for our crops in our manufacturing industries. We are following both of these methods of development.

Soy beans furnish the almost perfect example. Introduced in this country over a century ago from China, they were first grown in the South. Acreage was limited, however, and the beans were fed mainly to hogs, regardless of the fact that soy-bean oil was being imported from China for use in the paint industry. Then research tackled the problem and a wholly different story may be told today.

In 1935, almost 5,500,000 acres in 27 states were planted to soy beans alone. This was an increase of one third over 1934. Almost 21,000,000 pounds of American-produced soy-bean oil was used by industry. About half of this went into the making of paint and varnish. The balance went into soaps, linoleum and oilcloth, printing inks, edible compounds, and various other industrial products including automobiles. Gear shift knobs, engine distributor covers, ornamental door handles and other parts of automobiles are now being made out of soy-bean meal. Chemists have found more than 300 possible uses for it.

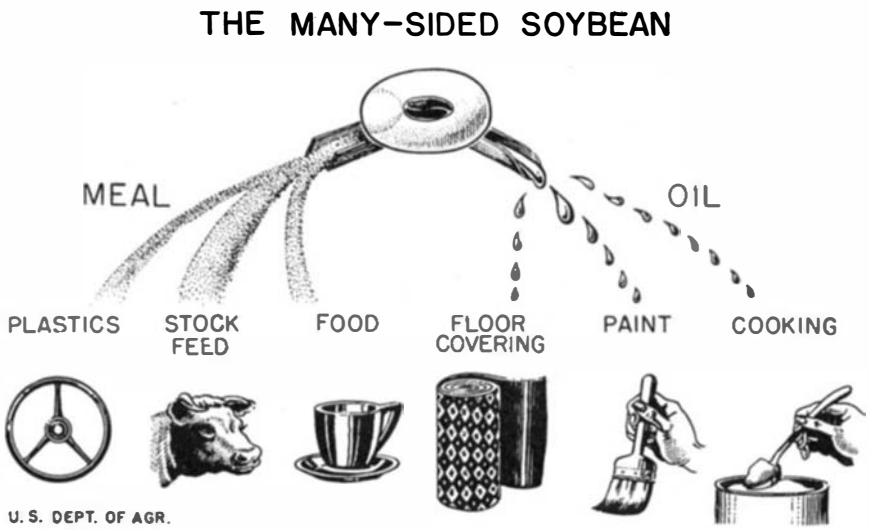
American factories buy nine tenths of all the tung oil China produces, although American-refined tung oil is superior. Southern farmers aiming at this market now have 250,000 acres in tung trees—it will require one million acres or more to fill the national demand. The American textile industry's annual imports of starch mount to hundreds of millions of pounds, and we are doing something about that too. Only recently at Hattiesburg, Mississippi, it was proved that a better starch is yielded by Southern sweet potatoes at a return of 40 dollars per acre to the farmer for the starch alone.

The Farm Chemurgic Council estimates that 50,000,000 acres may be planted to industrial-use crops within the next ten years "if man sets himself to the task." The Council estimates 8,000,000 new acres to provide woodpulp for paper and paper stock, a forecast that is based on the success of the experiments by Dr. Charles H. Herty with fast-growing southern pines. A paper plant to utilize southern pulpwood is now being built in Georgia at a cost of 4,000,000 dollars, which is concrete evidence of what industry thinks of Doctor Herty's proposition. It is estimated that the use of cotton as a reinforcing material in road construction will consume the output of 3,000,000 acres. Displacement of flaxseed and linseed now imported would add 3,500,000 acres to the American farmers' income-producing plant. And so it goes. The movement is yet in its infancy.

THE South abounds in unexplored possibilities for new crops. In southern Florida they have found that coffee and cacao may be grown if sheltered by larger trees. Rubber from American-grown plants is still a possibility. Artificial temperature control, to protect plants such as the tung tree from winter frosts, is gradually being developed to a practical stage, and what vistas that will open to southern growers only the future can tell.

In 1920, two thirds of the casein used by American industries was imported. By 1934, all but 4 percent of the needs for this dairy by-product were being supplied by home producers, who, with chemical and engineering aid, found it possible to compete with the dairymen of Argentina and elsewhere.

Through chemical conversion into cellulose, the uses of cotton have become literally hundreds. Cotton seeds, once a waste, now have a value of over 200,000,000 dollars in a cotton crop of 1,500,000,000 dollars. Cotton-seed oil, hulls, linters, meal, and cake, all have become valuable materials. Coated fabrics such as "Fabrikoid" consume cotton by the millions of pounds. Cotton enters into the manufacture of cements for leather, textiles, and paper; into water-proofing compositions, smokeless powder, gun cotton, blasting gelatin, coal mine explosives, toilet articles, electric insulators, motion-picture film, golf balls, and women's fingernail polish. The list is almost endless. Rayon is perhaps the outstanding example of chemically-wrought change in a raw material. This first man-made textile fiber, while it might be said to compete with cotton, at the same time really is cotton metamorphisized. And as rayon it has taken its place in fields where cotton as such never has entered. In the aggregate, it is said that the chemist has added 10 dollars per bale to the normal-time value of the cotton crop, and there is as yet no reason to believe that all the possibilities in cotton have been exhausted by research.



These and other uses of the soy bean are described in the text

THE TWELVE-

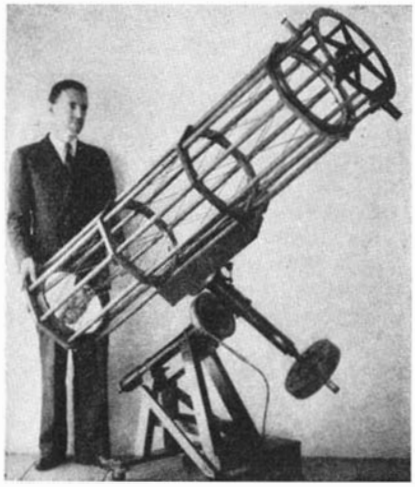


Figure 1: Pedersen. California

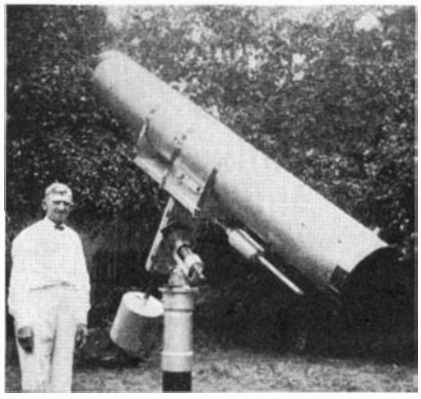


Figure 2: Haskell. Missouri

Figure 3: Schmigdall. Illinois

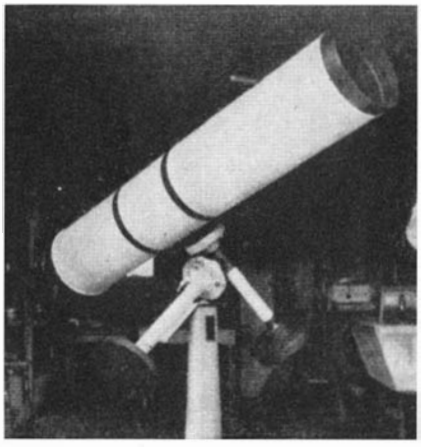


Figure 4: Lester. California

A LITTLE more than a decade ago this magazine published an article telling how a group of amateur astronomers in Springfield, Vermont, made their own astronomical telescopes. The response to that article suggested the publication of a book of instructions for making telescopes, since no book was available. A book was prepared and given the title of "Amateur Telescope Making." That book first appeared just ten years ago this merry month of May, and there was then a question whether the edition of 3400 copies would be completely disposed of even within the lifetime of those who prepared it. Instead, the edition lasted two years and it started a new hobby rolling in the U.S.A. Since that time it is estimated that more than 10,000 telescopes have been made by American amateurs.

Ten years ago the receipt of an actual photograph of a telescope made by an amateur was a rare event in the editorial offices, but today scores of them, received from readers all over the nation and all over the world, lie in a toppling pile on the corner of one editor's desk. Most of them depict instruments of ten-, eight-, or six-inch diameter—the latter is the usual beginner's size—but 12 of them happen to be of 12-inch instruments, all of the reflecting type, and these have therefore been sorted out for feature presentation. They suggest how far the telescope making hobby has gone since May 1926, when the attempted amateur construction of so large a telescope would have indicated either outstanding skill or outstanding hardihood. "The Twelve-Inch Club" has no headquarters, no officers, no dues and, in fact, no corporate existence, other than on these two pages. Its 12 members live in seven different states, from Massachusetts to California, and have never seen one another. They meet for the first time on these pages.

MOUNTED on a wooden trunk with casters, so that it may be wheeled out of doors, is the telescope shown in Figure 1, made by J. Arthur Pedersen, 2390 Monterey Road, San Marino, California. The tube is skeletonized, leaving the 12-inch concave mirror clearly visible in the photograph. Instruments of this size will magnify from 100 to 500 diameters, depending on the state of the atmosphere at the time they are used. The changeover from one power to another is made in five seconds, merely by substituting one small eyepiece for another.

Figure 2 shows a telescope made by John E. Haskell, 729 North Main Street, Springfield, Missouri. It has a 12½-inch mirror of Pyrex coated with evaporated aluminum, and, with a 700-pound car wheel which forms the base on which it stands, it weighs 1250 pounds. The eight-foot tube is made of 16-gage sheet iron and the polar axis of 2 11/16-inch steel. All the material except the glass was purchased from the junk yard, and the total cost fell less than 100 dollars. "Mars is fine and Jupiter's belt and his fifth moon are easily seen," the maker states.

Figure 3 is a photograph of an instrument built by C. H. Schmigdall, a maker of boring and milling machines, 307 Cass St., Peoria, Illinois. It is shown mounted merely temporarily on four legs, preliminary to remounting in an observatory

Figure 5: Tarbell. Missouri

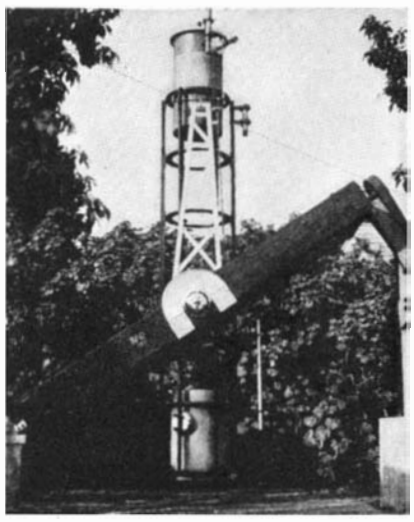


Figure 6: Dietz. California

INCH CLUB

dome of 14-foot diameter. It took two years to build this telescope, including, of course, making its paraboloidal mirror.

Figure 4 was sent by the "Amateur Astronomers of Long Beach," California. This "twelve-inch" is really a 12½-inch with a Pyrex mirror, a tube 15 inches in diameter and axes made of Ford housing assemblies. A drive, to keep the telescope in slow motion in order to offset the earth's rotation, is made of an automobile pump through which water escapes in an adjustable fine stream. William Edward Lester, 5327 Linden Ave., Long Beach, was the maker of this telescope.

FIGURE 5: E. D. Tarbell, 2235 East 67 Terrace, Kansas City, Missouri, compounded his telescope uniquely: the secondary mirror (which is a flat) reflects the beam of light at an angle, as in the Herschelian type. But the same mirror, when folded back out of the way, uncovers a conventional Cassegrainian convex, working with a diagonal and "side entrance" eyepiece. Mr. Tarbell also used Ford housing assemblies but reports them as being too light.

Figure 6 shows a very steady type of mounting—a rotatable wooden rectangle, parallel to the earth's axis, with the tube swung on pivots between its sides—as in the next figure. Top and bottom of the tube are solid, the remainder being larger and open. Ralph W. Dietz, 2187 W. 25 St., Los Angeles, California, is the maker. "I have used a magnifying power of 600 diameters with it," he states.

Figure 7: Edward Katyll, 3416 N. Keating Ave., Chicago, Illinois, was the maker. The solid double yoke is of steel —four Ford chassis irons fastened to a 12- by 30-inch channel. There is an electric drive. Weight of moving tube, with 12½-inch Pyrex mirror, 200 pounds. A very rigid mounting. Total cost 25 dollars.

Figure 8: Clarence T. Jones, an architect, 210 Glenwood Drive, Chattanooga, Tennessee, has a whole battery of telescopes of which the one shown, with semi-skeleton tube like the one in Figure 6, is the largest. It has an electric drive, fine setting circles and is a neat piece of construction.

Figure 9: This telescope is a 12½-inch Gregorian of 342-inch effective focal length, built by A. H. Hearn, Oklahoma City, Oklahoma. The Gregorian is a compound telescope—two mirrors—in which the image reaches the eye erect instead of inverted, as in the Cassegrainian.

Figure 10 shows a 12-inch Cassegrainian of effective focal length 192 inches, made by C. R. Tinsley, 3017 Wheeler St., Berkeley, California, and installed at the Mount Wilson Hotel on top of Mt. Wilson, for the use of guests. Weight nearly 1000 pounds. Ball bearings on each shaft. Eyepieces, diagonal, and finder by Kirkham. Telechron drive.

Figure 11: A. E. Dehais, 10 Nixon Ave., Worcester, Massachusetts, chose the fork and roller type of mounting and used an octagonal wooden tube.

Figure 12 shows two smaller telescopes with a 12-inch instrument made by B. L. Harrell, 105 North 10th St., Gadsden, Alabama. Mr. Harrell is collecting photographs of other amateurs' telescopes.

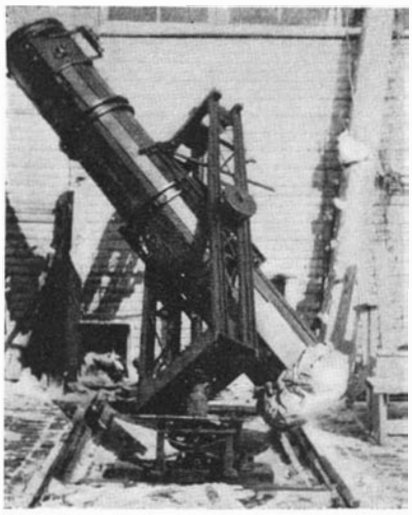


Figure 7: **Katyll. Illinois**

Figure 8: **Jones. Tennessee**

Figure 9: **Hearn. Oklahoma**

Figure 10: **Tinsley. California**

Figure 11: **Dehais. Massachusetts**

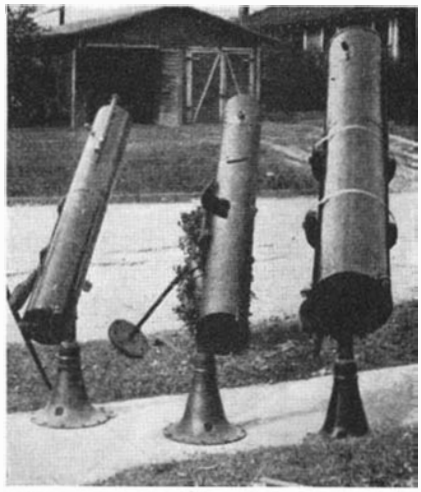


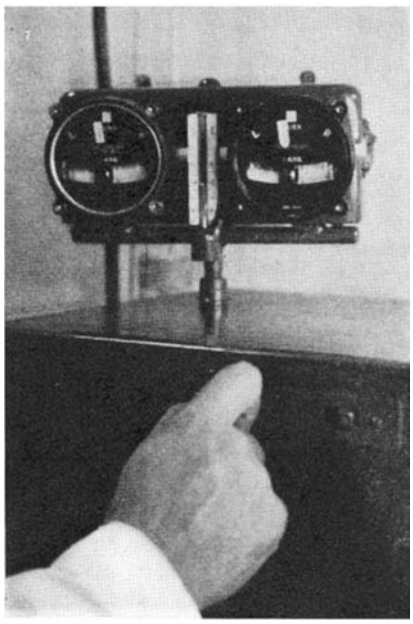
Figure 12: **Harrell. Alabama**

TRAINING PILOTS TO

Accurate Instruments Are Essential . . . Timed Turns . . . "Under the Hood" . . . Landing Blind by Radio . . . Major Problems in Radio Design

"RADIO flying," as the public usually terms the art of following an aviation radio range beam to its source, maneuvering for a landing, and finally bringing the airplane to earth under conditions of storm or fog, carries with it a broader significance, for it involves as an essential preliminary the ability of the pilot to fly "blind"—aided by instruments alone.

Instrument flying combines three elements: controlling the aircraft from information supplied by the instruments, the technique of performing certain definite maneuvers while "blind," and the proper maintenance and calibration of the instruments to insure that their indications are quantitative and not only



Checking a bank and turn indicator to make sure of its rated accuracy

qualitative. To this end, the instruments are accurately calibrated and with their aid radio serves as a positive guide which could not be followed in the absence of instruments.

In order to describe the use of radio in flight training, and some of the developments to be faced by the flight student when at last he becomes an airline pilot, it is desirable to preface those descriptions by an explanation of instrument calibration and a system of timed turns which make instruction in "radio flying" a relatively exact science.

First, the air speed meter of the training plane is carefully installed, checked and calibrated within close limits. Next, the altimeter and rate of climb indicators are calibrated to standard altitude tables in the laboratory. Then the turn and bank indicator is calibrated to a standard rate of turn, so that the turn indicator hand will move its width when the airplane is turning at the rate of three degrees per second, thus enabling the pilot at this rate to complete a full circle turn in 120 seconds. Engine instruments are calibrated against standards to insure their proper readings. The instrument man, the instrument shop, and calibrating methods become, therefore, inseparable parts of instrument flying and apply indirectly to radio flying.

The flying student begins his study of the technique of following the droning on-course radio beacon while yet on the ground, by becoming familiar with the aircraft instruments, their limitations and virtues. He is shown the method of calibration and given necessary instructions. Thereafter, while flying "under the hood," he is required to make all turns by watching the turn indicator hand and checking against time. The importance of this requirement will be seen later when we discuss a specific flight by radio.

In the training planes, the students, on first flights, practice straight flight and timed turns. This, it must be remembered, the student does without viewing the ground. In fact, throughout his first 20 hours of flight instruction, he can see nothing in the darkened cockpit but his instruments. He must get the turn hand in position in 10 seconds, and recover from a turn in the same period of time. Soon he learns three positions of the turn indicator hand: left timed turn position, right timed turn position, and straight for straight flight.

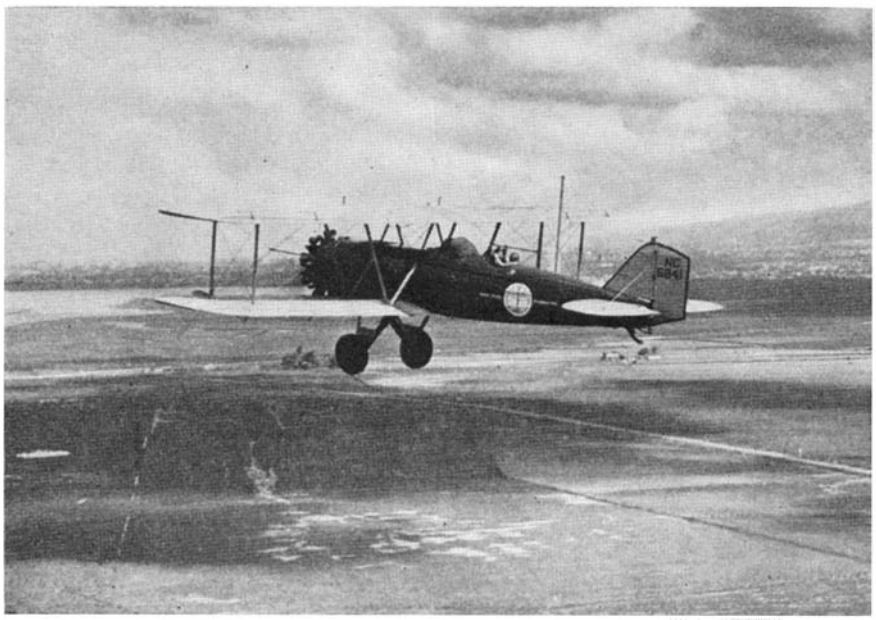
NEXT, he flies definite headings, learning to fly by compass without losing altitude or changing speed or direction. Finally, he considers his clock, timing himself as he executes 90, 180, and 360 degree turns. Having mastered these turns, he next flies the ship from an altitude of 500 to 3000 feet, adding timed spirals to his former timed turns, next moving into shorter turns of 12, 20, 30, and 40 degrees, still using units of time as his guide.

All this is leading up to the pilot's introduction to the radio beam and finally to landing by radio. While not all students actually are permitted to follow the landing beam to a landing, most of

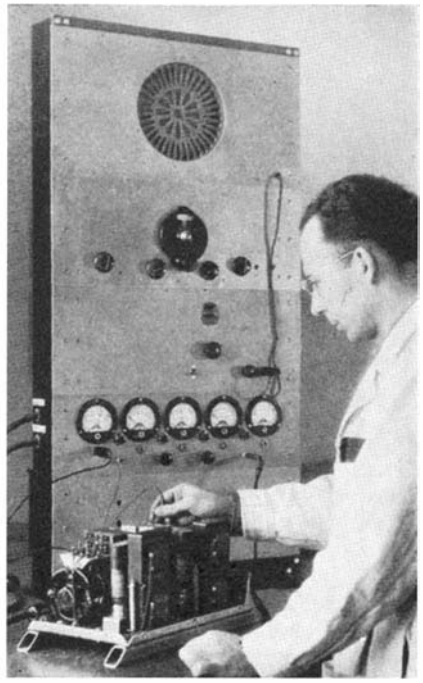
A student pilot checks out for a night flight on the radio range beam

Fly the Beam

By ALLAN F. BONNALIE
Director of Technical Instruction, Boeing School of Aeronautics



Student pilot under the hood, "blind"; instructor has hands off controls



Radio receiver test panel for both high- and low-frequency receivers

the advanced student pilots make approaches by radio.

When ready for this part of his instruction, the student, with an instructor in the other cockpit, climbs to 3000 feet by means of two timed spirals, one left and one right, and intermediate straight flight, coming out at last on the original heading. At that level, considered safe for all eventualities, the instructor orders him to find the beam. Here, then, is his real introduction to what in the future will constitute some of his frequent airline experiences.

Not knowing his exact location, he turns on his radio and flies a pre-determined compass course, which he knows will take his plane across the path of a beam. He first encounters repeating "A" signals, then the steady "on-course" signal. But how can he be sure which of the four legs of the beam he has encountered? Simple. He executes a 90-degree right turn to identify the beam. If this turn returns him to an A sector he knows from the "pattern" of the legs of the radio system which beam he has interrupted; he then turns left in a regular timed turn until he swings again into the on-course signal and heads for the cone of silence. The cone of silence is exactly what the term implies, a relatively silent space directly above the transmitting station from which radiate the beam's four branches.

On entering the beam at say, four miles from the field, he knows from instruction that the beam has a width at that point of some 1500 feet, that it will narrow, funnel-like, as he approaches the cone of silence. He very likely wanders from side to side, first into the "A" signal sector, then again into the "N" signal sector, pulling back each time to the steady signal (the center of the beam where the "A" and "N" signals blend) which will lead him unerringly to his destination.

THE cone of silence serves as a definite check on position. When suddenly the signal ceases, the student knows he is over the station, approximately a half mile from the field. Further, he knows that the signals will interchange as he flies out the opposite beam. If, before, the signal "A" came in when on the left, it now will reach him on the right side of the beam. Though it is not always easy to follow a beam, particularly in rough air, this procedure constitutes the elements of beam flying. Practice usually makes the tyro pilot proficient.

But the job is not yet half done. Given the airplane's position over the cone of silence, how will it be brought to earth? While most students are permitted to make only instrument approaches, occasionally one who is in the proper position and is handling the plane correctly is permitted to land "down the beam."

The radio-approach-and-landing work was started at the Boeing School of Aeronautics with the Department of Commerce Bureau of Standards type radio landing installation. A Boeing #40 instrument-equipped biplane was first fitted with the radio landing equipment and experimental antennas for development of the system and the method. Following hundreds of landings, the installation was placed in a tri-motor Boeing #80, a seven-ton passenger-mail plane used particularly for hooded flying by instrument and radio. Many experimental landings have been made with this equipment.

Assume, then, that the large transport plane has flown through the cone of silence, with an advanced student at the controls, headed west at 3000 feet. The pilot knows that the field lies behind him on the left. He holds the course for two minutes, then makes a 40 degree turn to the right, using the timed turn for the purpose, holds this new course for 45 seconds, and then turns left for 70 seconds. This brings him back to the radio beam, and he now follows its easterly course, losing altitude at 500 feet a minute until he levels off at 2000 feet.

As he approaches the airway's radio beam station, a neon light hooked up with the cone-of-silence receiver lights and he continues to hold his altitude, with an air speed of 110 miles an hour. The neon bulb is lighted when the airplane enters an egg-shaped radio field set up by a radio marker at the base

Students calibrating various instruments used in "radio flying"

of the cone of silence, and serves as a further check on position. This field extends upward some 12,000 feet, and is nearly one mile wide at an altitude of 3000 feet.

After passing through the cone, the student pilot continues flying easterly on the beam, along which he made his original approach, for four minutes, maintaining the same altitude and speed. He then switches on his landing beam receiver and makes a timed right turn to pick up the directional beam and the landing beam. That turn is made in one minute, or 180 degrees. Note the time element, for that is highly important.

The pilot has on the instrument panel a combination instrument embodying two hands, one vertical to indicate the directional beam, the other horizontal to indicate the landing beam. When the former is vertical and the latter horizontal, the ship is both on course and approaching the field at the proper altitude. Should either hand swing away from these positions, the ship is too far right or left, too high or too low. Therefore, all the student need do is keep those hands crossed at the center position to continue his proper descending path.

WHILE watching those hands, the pilot soon hears a distinctive high-pitch signal in his ear phones. He now is crossing a vertical marker beacon, and knows he is 2000 feet from the field. Seconds later, he hears a low-pitch signal. This informs him he is directly over the edge of the field. By consulting his sensitive altimeter, he determines whether he has maintained precisely the correct altitude, which now should be of the order of 100 feet.

With these invisible markers behind him, he continues his flight path and very shortly feels the wheels touch the ground. As soon as contact is made, he holds a straight course by watching the turn and bank indicator to insure a stop without ground looping. At no time has he used the altimeter, except as a check against coming in too low, until after crossing the second marker.

While the student may not be aware of the fact, he is making use of the latest equipment and methods provided by the Bureau of Standards and the airlines, consisting of the radio range beacons and vertical marker beacons of two types—the egg-shaped station marker and the vertical markers near the field, and two-way radio communication maintained by the airlines.

By virtue of a combination of visual and aural instruments, the student while making a blind landing need fix his eyes on only one instrument, the combination of crossed hands, except for occasional consultations of his sensitive altimeter. The station marker, which sets up the egg-shaped field and lights the neon lamp, is received on a small, rugged airplane receiver built at the Boeing School. It operates on a frequency of 91 megacycles, or 3.3 meters.

The Bureau of Standards landing system, consisting of the vertical and horizontal beams, is well known. Both beams operate on ultra-high frequencies. The horizontal beam, due to the transmitted power and reflection from the earth, describes on its lower edge a path which curves upward away from the transmitter, thus providing a more positive and surer guide for landings.

Perhaps the vertical markers are of greater interest in that they provide positive indication of the plane's distance from the airport, no matter in what type of weather it may be flying. On encountering the first the pilot hears a 1250-cycle tone, and in the second a 250-cycle tone. Single wires parallel to the ground serve as antennas.

Radio in aviation, whether in training or commercial flying, involves continuing experimentation. Definite problems are recognized, and they can be solved only through careful research. Experience at the Boeing School may serve as a case in point.

For a time we maintained ground-to-plane communication, using the beacon receivers on the planes, through the traffic control transmitter in the field flight house. It soon became difficult, because of other pressing needs for the microphone, to use this for distinctly educational purposes. Experimental work was therefore instituted leading toward perfection of a satisfactory high-frequency transmitter available to flight instructors on the ground.

One of the major problems of aircraft radio is the power supply, particularly for the lighter, instruction planes. In fact, the biggest problem with radio even for transport work lies in a suitable power supply. Our experiments have been directed toward development of a small wind-driven generator, mechanically and electrically tied in with the high-frequency receiver, this unit to be compact, portable, and light enough in weight to permit its use with a trailing antenna, probably from the top of the rudder or possibly from a mast antenna which is part of the unit itself.

FEW students in training today realize the complexities of the radio problems they will face when doing commercial flying. Developments in the offing promise efficient, time-saving communications thought impossible only a short time ago. At least one other landing system, developed in the Army and known as the Hagenberger system, is under trial. This consists essentially of two portable marker beacons, placed in a line at the end of the landing runway. By using a directional Kreuse loop, the pilot tunes in on both after having crossed the first and after several exploratory flights finally orientates himself with reference to the runway. He finally sets his directional gyro and approaches for a landing. No means of positively indicating altitude is yet provided by this system.

Further, visual broadcasting from ground to plane, and possibly from plane to plane, is approaching the point of practicability. This will take the form of written messages, received in facsimile. It consists essentially of a photocell which scans the message to be sent in rows of lines. After amplification, these are transmitted as a rapid series of signals, which, when received, will modify the intensity of the writing mechanism as it traces similar lines. Such a method will remove disputes over messages, but complicate the pilot's work.

No pilot can be said to be accomplished who is not capable of flying a plane by instrument and radio methods. In time of stress and strain, he should be able to utilize both to their utmost worth. By such methods as have been outlined are tomorrow's guardians of the airliners receiving basic instruction which will equip them to meet all conditions of flight with skill and precision.

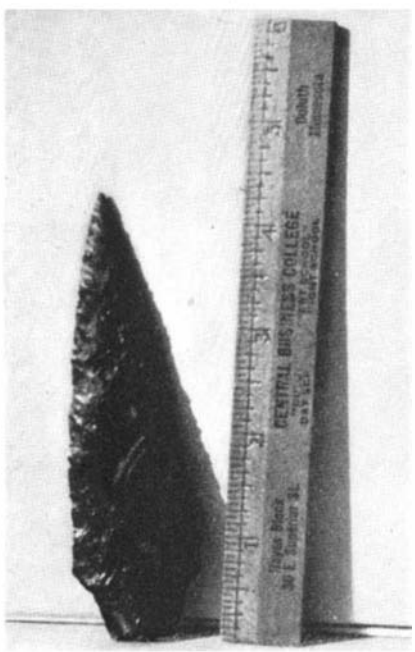
INTERGLACIAL MAN IN AMERICA

New Minnesota Finds May Date Earlier than Last Glacial Stage . . . Perhaps 20,000 Years Old

By C. E. HAGIE, Ph.D.
Superintendent of Schools, Aurora, Minnesota

FOR years archeologists and anthropologists have been seeking for proof of a glacial age human inhabitant of America. In recent years there have been finds which strongly support the assumption that man did inhabit North America during inter-glacial times. Up to the present time, nothing that has been discovered has been accepted by a majority of authorities as positive proof that man has inhabited America for as long as 20,000 years. On the other hand, it is probably true that most of the scholars in this field of research incline to the belief that man has been here at least that long.

During the past Christmas holiday period the rumor reached me that workmen excavating a road cut had dug up some shiny, black arrow-points. Taking with me a research worker who was attached to my office, I drove immediately to the site. I found that the workmen were excavating in sand and gravel underlying from eight to ten feet of undisturbed glacial till made up of fine clay and rock. The situation was on top of a hill. Mr. Oscar B. Larson, who had general oversight of the road project, gave valuable voluntary co-operation leading to the examination and photographing of the artifacts carried away by the workmen.



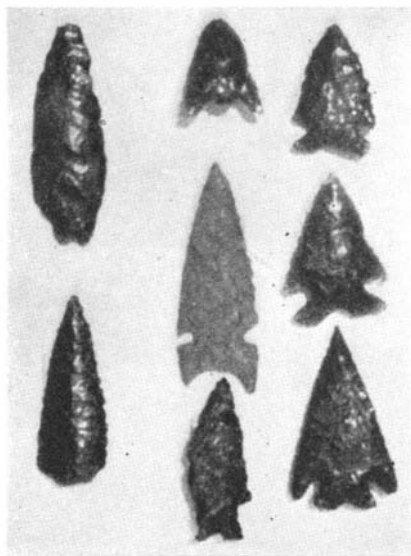
A 4½-inch spear point taken from the site described in the article

The first artifacts to be found had been shoveled up at a depth of two or three feet below the lower limit of the glacial clay, in medium coarse sand. There followed an immediate scramble for possession of the points as souvenirs, which presently led to the point in the excavation from which the shovelful of sand came. There a dozen or more artifacts were dug out and appropriated within the next few hours. As the overlying glacial clay was extremely solid the men dug back under it two or three feet. In this way a number of the artifacts were taken from under the shelf of overhanging glacial till, without disturbing the proof that the eight or nine feet of soil above the artifacts had not been broken through in making a "deep" burial.

THE sand from which the artifacts were taken was somewhat coarser than that of the cross-bedded, water-lain strata by which it was surrounded, immediately underlying the slightly reddish-gray glacial clay. We arrived in time to examine this coarse sand before it had been entirely removed by the workmen in their treasure hunt. Mr. Hill, my research worker, and I, are convinced that the coarser sand represented the filling material of a burial in the stratified sand, at a date before the last glacial period—which will undoubtedly be found to have been the Wisconsin stage, on this site.

Affidavits have been secured from all the workmen who actually picked up artifacts "in place" under the undisturbed glacial till. I arranged for Mr. Hill to remain on the site and check further developments. He excavated the small remaining amount of coarse sand and found one additional artifact, in place and under the overhanging clay shelf (central one in the photograph). This was a broken drill point of milky white quartzite. A few days later the temperature dropped to 30 and 40 degrees below zero, heavy snows followed and the field work had to be discontinued until spring advanced.

With the exception of the drill point, all artifacts (22 now known to have been found) were made from black obsidian and black, fine-textured basalt. Eleven of these are now in the possession of the museum of the Aurora, Minnesota, High School. From a scientific point of view they may represent the most valuable prehistoric artifacts on the continent. If cultures can be expressed in terms of a type of stone flaking, as some apparently imply, these could be classified as transition Yuma. All of them show some evidence of the diagonal flaking from side to side across the face in parallel ridges. Several of them carry out this feature in a very perfect way, while others show it only in slight degree and very imperfectly.



A few of the finds made at the site of the Minnesota discovery

Professor A. E. Jenks, anthropologist, of the University of Minnesota, who is a leading authority on ancient man in America, visited the site, noted the glacial till in place and undisturbed, and remarked: "It looks too good to be true". When the circumstances have been fully verified by the leading authorities in the field of geology the find will have pushed the dating of man's sojourn in America to more than 20,000 years ago.

[*Editor's Note:* Only time and detailed investigation will permit the exact significance of the finds described above to be assessed.]

Erosion Control

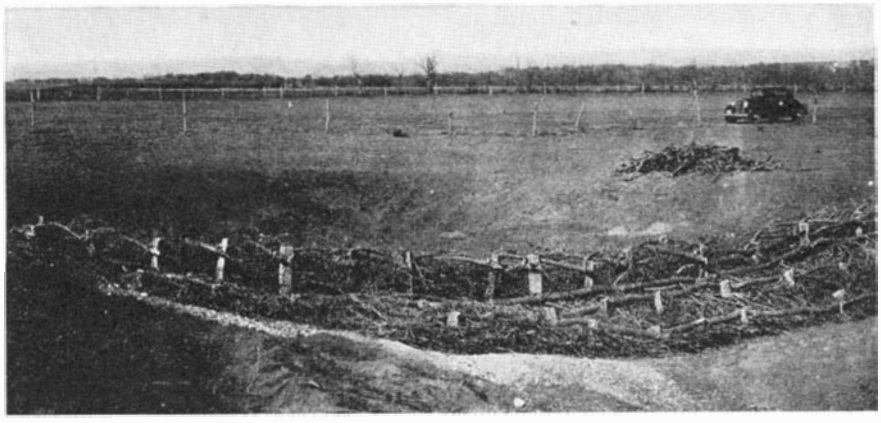
FLOODS during the late winter and early spring of this year have brought to the fore once again the necessity for thorough consideration of the flood control program in many sections of this country. In working out the solution, it is not enough to build levees, dykes, and flood-ways immediately adjacent to the rivers; it is necessary to go back to flood sources. This means primarily a study of the retarding effects which forests and plant growth have upon run-off, and of soil erosion which has lost to American agriculture billions of tons of arable earth.

Through the work of the Civilian Conservation Corps, many areas have been reforested recently. The new forest cover on formerly barren hills and slopes has done much to retard the melting of snow and prevent a rapid run-off of water. Other control measures taken under the supervision of the Soil Conservation Service, Department of Agriculture, have aided further. Mr. H. H. Bennett, Chief of that Service, says that: "Our work the last two years in 141 watersheds throughout the country indicates that the volume of run-off water can be

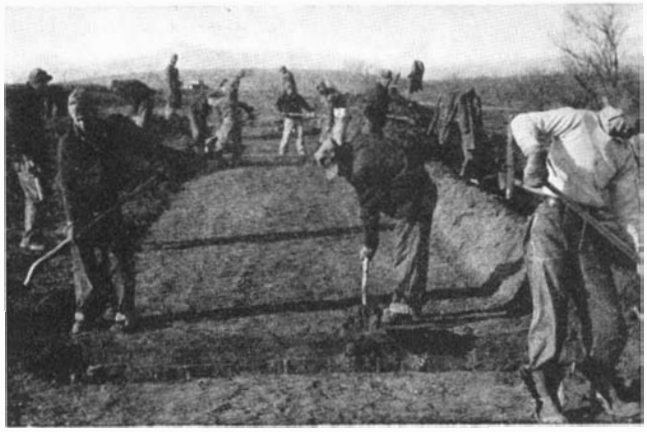
An eroded area typical of many such spots vation, this field has been so badly washed for

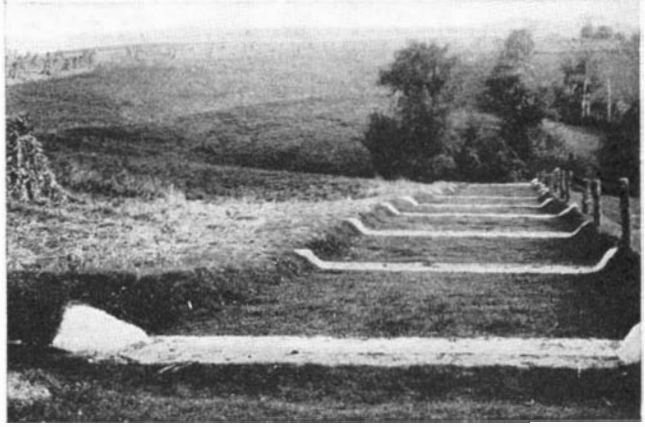
Terracing of cultivated fields along contour lines is of first importance in soil erosion control. It is very effective in holding and diverting run-off water, thus preventing loss of the rich and arable soil

In washes of the type shown below, simple brush dams and aprons provide a check against the further loss of soil, and, in fact, rebuild the land with soil and debris



The two photographs below illustrate construction of, and completed, concrete spreaders. These "sluiceways" are designed as outlets for the run-off from terraces, spreading the water into a thin, cascading sheet which will not gouge out a gully





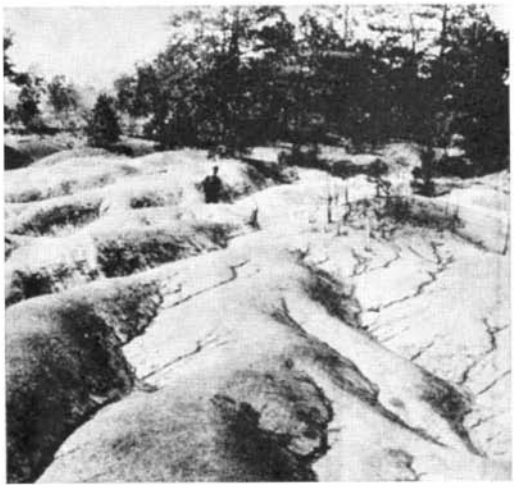
Checks Floods

reduced 20 to 25 percent through the use of erosion control methods. This is the margin, in most cases, between mere high water and destructive floods."

Detention dams, dykes, and similar engineering measures are essential to complete flood control in localities where the hazard is unusually severe. This control starts with the proper preparation of the cultivated field, and terracing is being resorted to in many localities where, formerly, heavy rainfall has scoured out entire hillsides.

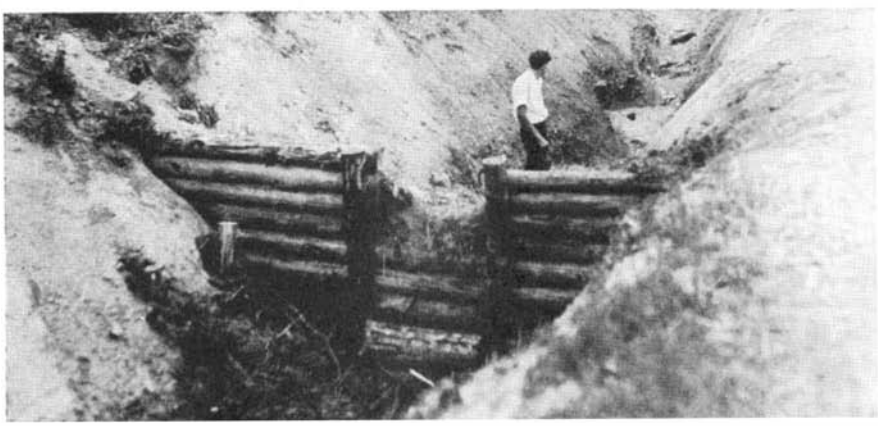
On these pages are illustrated a variety of dams and other structures which have been designed not only to prevent the flash runoff of water and scouring, but also to provide settling basins for the soil which otherwise would be washed away. In many cases, such barriers have served to rebuild land where great gullies were being formed.

There can be no permanent control of floods, according to Mr. Bennett, until we have control over erosion of entire watersheds. To gain such complete control means that in the future there must be full co-ordination of efforts in cultivation methods, in reforestation, and in the design of control structures.



requiring control measures. Formerly under culti- 25 years that no vegetation could get started

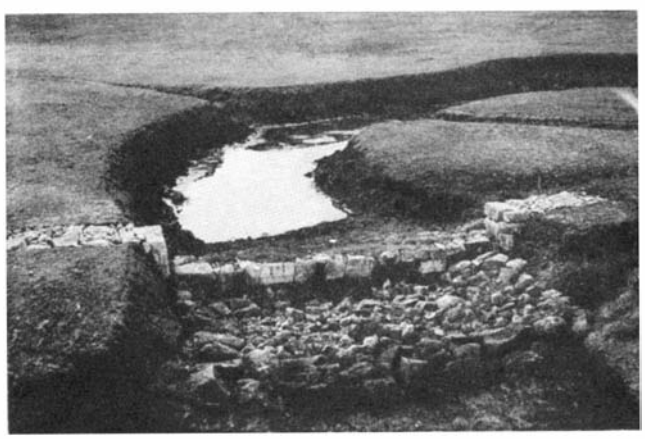
Another simple rebuilder of land is a staunch log dam, shown below, across a gully. Any land-owner could build this easily with materials from his own farm



Above: **A series of cemented rock dams is necessary in some cases where the gradient is steep and the erosion is fast**

Lower left: **A weir-type, low dam of field stones against low posts, with an overflow apron of stones, has been found satisfactory for retarding flow and loss of soil**

Below: **An apron of loose, heavy stones, overlaid with hog wire to hold the stones in place, prevents the scouring of a hillside where run-off of storm water is heavy**

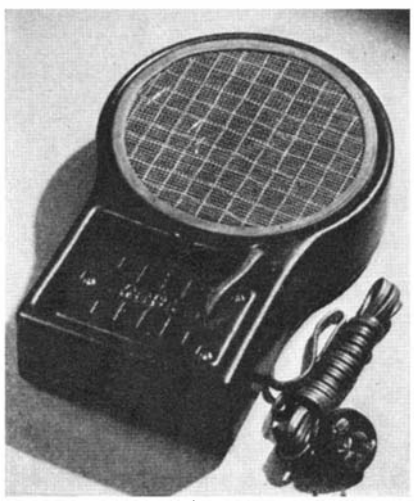


THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Electric Fly Killer

A NEW low cost, electric, insect destroyer, especially designed for use in food and dairy plants, as well as in the home, has been brought out by Edelman Company of Chicago. This device consists of a container for pyrethrum extract and an electrical atomizer built into one case.



Death to flies

The container holds one half pint of the extract or a sufficient amount to clear out a space of about 18,000 cubic feet. The extract is harmless to humans and pets, does not taint foods, and is non-injurious to furnishings, fixtures, or tableware.

The pyrethrum liquid is supplied as a fluid emulsion, and in use the active pyrethrum oil floats to the surface, from which it is driven at about 160 degrees, Fahrenheit, as a finely dispersed vapor mist. The device is entirely automatic, it being only necessary to plug the apparatus into a convenient light socket. There are no moving parts in the device and it is said to consume only 0.125 kilowatt hours of electricity in treating a space of 18,000 cubic feet.

Bright Nickel Plate

A NICKEL plating process which deposits a film so bright that it needs no polishing has been perfected by Weisberg & Greenwald, New York City. A number of installations are already in operation: plating on brass, steel, and zinc die castings. Deposits produced from this solution are said to have a mirror-like brightness; the brightness increases with the thickness of the deposit, sometimes resulting in covering up minor imperfections in the base metal to a considerable extent. This form of nickel plating is said to be remarkably ductile.

A similar process of producing "bright zinc" surfaces was perfected recently by the R. & H. Division of the du Pont company.—*A. E. B.*

WOOD CROPS

FOREST products are tenth in the big ten of farm crops, outranking 35 other major crops such as barley, beans, rice, peanuts, and sugar. Farm woodlands pay their owners nearly 63 million dollars a year.

Weight Saving in Diesel Construction

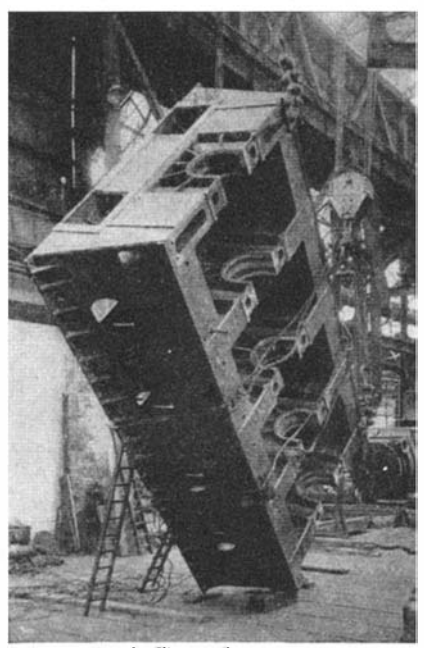
WHAT is probably one of the greatest forward steps in the Diesel engine since its invention was noted recently in England when a new engine, built to replace a unit in a motorship, doubled the power of the vessel yet required no more space than the original unit.

The new engine is rated 4000 brake horsepower at 109 revolutions per minute but actually develops 4400 brake horsepower. Of the double-acting, two-stroke, four-cylinder type, the new Diesel has a bore of 27½ inches and stroke of 47½ inches. It was built by Richardsons, Westgarth and Company for the motorship *Silverlarch* of the Silver Line. The *Silverlarch* is one of two vessels which the owners are having reconstructed by J. L. Thompson and Sons, Sunderland, England, to provide increased speed.

Construction of an engine having such a high ratio of power to size has been made possible by improved design employing steel and electric welding. Major parts, such as bedplate and columns, scavenging air main, crankcase covers, and plates and exhaust pipe, are all built of arc welded steel plate. The use of arc welded steel provided maximum strength and rigidity per minimum size of members and minimum pounds of weight. This advantage enabled the builder to obtain a structure double the capacity possible with a suitable form of cast-iron construction.

The bedplate is of special interest in view of the engine's power and its comparatively low speed. The length of the bedplate is 22 feet 6 inches, width 14 feet, and depth 5 feet 4 inches. It is of the tank-top type.

The bottom plate consists of two lengths of steel plate double butt-welded together longitudinally. To obtain maximum rigidity, the sump is welded integral with the bedplate. The columns consist of a mini-



Courtesy Lincoln Electric Company

Steel bed plate of new Diesel in which weight is saved by welding

mum number of pieces of steel plate fused into one unit by the electric arc. The cast-steel bearing housings are fixed in the bedplate by steel plates welded to them and to the sides and bottom of the bedplate. The welding was done with electrodes and welding machines supplied by The Lincoln Electric Company.

Although the aim of the builder was to obtain a structure of maximum rigidity at moderate cost without any particular emphasis on lightness, the saving in weight was large. The bedplate weighs approximately 33 percent less than would be possible with suitable cast-iron construction. Actual weight, arc welded, is 29½ tons. Weight, in cast iron, would have been 44 tons. Cost savings were also considerable due to elimination of patterns and pattern drawings and to simplified machining.

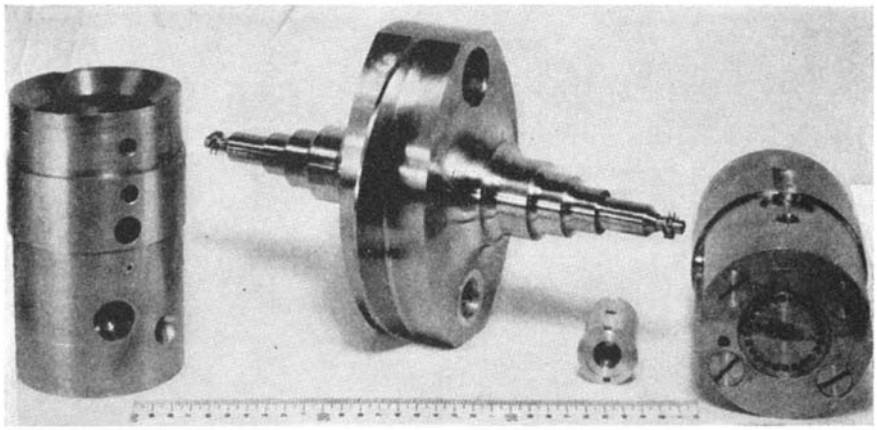
CELLOPHANE

A BAND 200 miles wide to wrap entirely around the earth!—that is the quantity of Cellophane that has been produced during the past 10 years.

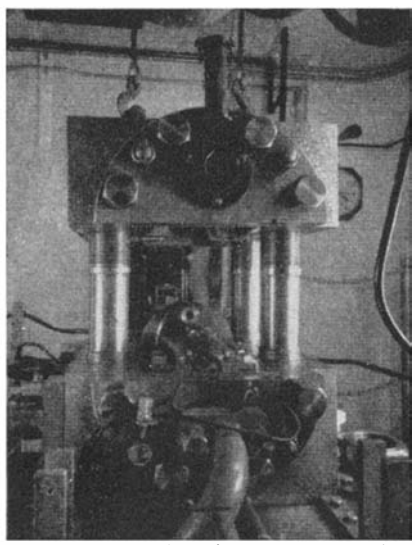
250,000 Times Gravity

FOR those people who revel in astronomical figures, a new ultracentrifuge at the du Pont Experimental Station, at Wilmington, Delaware, should hold much fascination. First of all, it is the second of its kind in the world, and the first in this country. It is the largest yet completed for this purpose. The rotor is designed to operate for prolonged periods at 60,000 revolutions a minute, thus creating a centrifugal force of 250,000 times that of gravity. Under such conditions a mass of one pound would weigh 125 tons. The rotor, of heavy steel, has a peripheral velocity of more than 20 miles per minute, or approximately one and one-half times the muzzle velocity of an ordinary 22-caliber bullet.

This machine is the invention of and was built by Dr. The Svedberg, professor of chemistry in Upsala University, Sweden, and Dr. J. B. Nichols, former student of Professor Svedberg, who is now on the du Pont research staff. It is the latest development of Dr. Svedberg's conception 13 years ago of a machine to attain "ultra" centrifugal forces. Since that time, Dr. Svedberg has made machines which have stepped up the attained centrifugal force from 500 times the force of gravity to 5000 times, to 100,000 times, to 200,000 times, and so on until the high point of 1,000,000 times gravity was attained at a rotor speed of 160,000 times a minute. The present machine is slower than that but its superiority lies in the fact that its 60,000 r.p.m. may be maintained indefinitely. It is driven by tiny oil turbines on each end of the rotor shaft, and requires an hour to accelerate to full speed and an hour to decelerate.



Centrifuge rotor showing the tiny oil turbines at each end of the shaft; and the two end bearings which house the turbines. Centimeter scale for comparison



Heavy centrifuge housing in raised position. Rotor is in the center

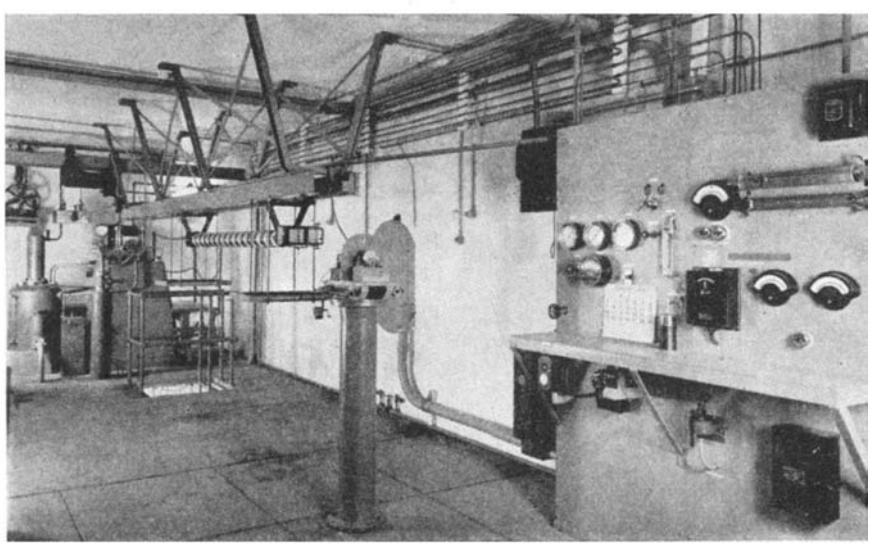
In using the ultracentrifuge, the liquid material to be studied is placed in a small cell inserted in the rotor. This cell has transparent quartz windows, and in the massive steel chamber which encloses the rotor are corresponding windows or peepholes. By directing a beam of light through the windows, the observer can note the effects of the centrifugal force.

If, for example, a solution of a colored substance in a colorless liquid is centrifuged, the observer may look through the windows and see the boundary of the colored dissolved substance move toward the bottom (outer) part of the cell. In order to obtain exact measurements, however, photographs are taken at suitable intervals, and from these photographs the rate of settling of the dissolved substance can be calculated. Knowing the rate of settling and other readily determined characteristics of the system, the size of the particles or molecules can be calculated. In taking the photographs, an image of true size is desired, and errors of parallax must be virtually eliminated; consequently the camera plate is 18 feet from the cell, the camera itself being nine feet long. On the photographs, distances as small as one twenty-five thousandths of an inch are readily measured.

When both the dissolved substance and the solvent are colorless, a beam of light passing through the cell is refracted or "bent," and the amount of the bending indicates the concentration of the invisible dissolved substance in that part of the cell as it settles to the bottom.

The speed of the rotor is measured by means of a stroboscope, which is simply a slotted disk driven at variable but known speeds through which the high-speed rotor is observed. When the rotor and the stroboscope are in step, flashes of light pass without interruption through both openings and the speed of the rotor is equal to the speed of the stroboscope disk times the number of slots it contains.

With the ultracentrifuge, Svedberg and his collaborators have determined the molecular weight (particle size) of various proteins, those substances so important in all living things. Quite unexpected results were found. Thus, contrary to all other kinds of giant molecules, many of the proteins were



The centrifugal research laboratory. Centrifuge is on heavy foundation in background, camera in striped tube, and control board and stroboscope in foreground

found to be homogeneous; that is, to consist of molecules all of the same size. No other molecular weight technique is capable of revealing this information.

Another important fact, the significance of which is not yet clearly understood, is that the molecular weights of the homogeneous proteins are simple multiples of a basic unit, 34,500. That is, for some curious reason, the protein molecule appears to consist normally of 1, 2, 3, 4, 6, 12, 24, 48, 96, or 192 "bricks," each weighing 34,500 times the weight of the hydrogen atom. No homogeneous proteins of intermediate size have been found.

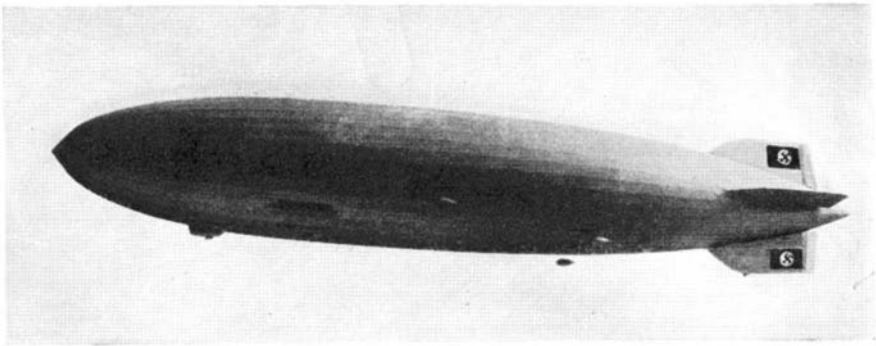
"Just what scientific advances will be achieved with the ultracentrifuge in the years to come is impossible to predict accurately," said Dr. Kraemer, du Pont research chemist. "But we do know that the pioneer work of Svedberg, Nichols, and their collaborators has provided a new tool having exciting potentialities in the field of colloid chemistry, which field includes the chemistry of giant molecules, of which such commercially important substances as cellulose, glue, resins, rubber, and starch are but a few examples."

THE "HINDENBURG"

THE new German Zeppelin, *LZ-129*, has been christened the *Hindenburg* and has passed its flying tests with perfect success. If the wonderful record of the *Graf Zeppelin* over the South Atlantic is borne in mind, there is little doubt that the same regularity and safety may be expected in the service of the new airship over the North Atlantic.

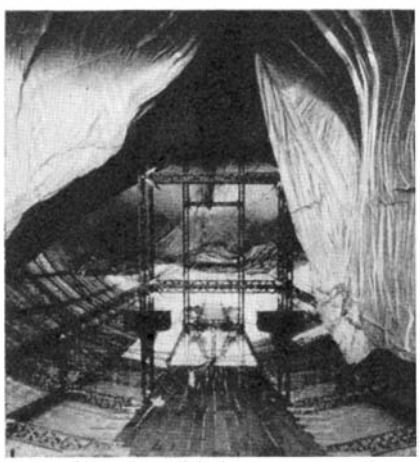
Thanks to the courtesy of W. E. Dörr, chief engineer of Luftschiffbau Zeppelin, the company that constructed the ship, we are able to give a brief description—it is impossible to give a detailed account of a craft of this complexity and size—of the *Hindenburg*.

The most remarkable fact that emerges from Mr. Dörr's statement is the divergence of American and German viewpoint in regard to airship construction. In the United States, the Airship Survey Committee is carefully and systematically investigating the subject of safety, and is carrying out a long program of research to provide a better basis for structural calculations and design. At Friedrichshafen, the Zeppelin company, with 35 years experience in the art and a marvelous record of safety in commercial operation, is perfectly content to build its latest ship on very much the same lines as its predecessors, although many improvements and refinements appear in the new design.



A wind-tunnel model of the *Hindenburg*

There is a striking difference between the *Hindenburg* and the *Graf Zeppelin*, but this is mainly in size. While the *LZ-129* is only a few feet longer than the *Graf Zeppelin*, it has a considerably larger diameter and holds 7,063,000 cubic feet of gas instead of the 3,708,000 cubic feet of the smaller vessel. This huge volume gives the *Hindenburg* the distinction of being the largest airship ever built, far exceeding in capacity the 5,000,000 cubic feet of the *Akron* and the *Macon*.



Looking forward along the catwalk; partly inflated gas bags at sides

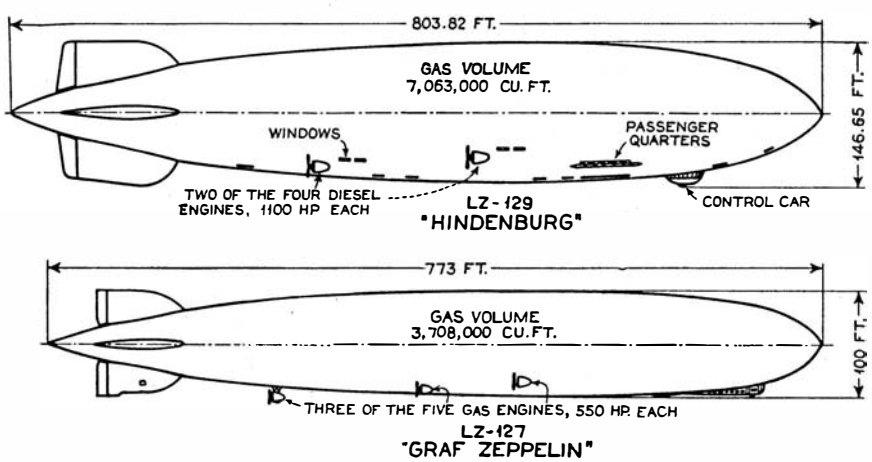
We do not propose to discuss here the almost tiresome question of whether the flying boat or the airship will be the more successful in transatlantic operation, but one thing is quite clear; the *Hindenburg* will be able to carry quite a respectable payload, at a moderate speed, and it will be perfectly capable of making a non-stop flight from Europe to the United States, with a range in miles which will be more than double that required. There will be no question of flying a southerly route via Bermuda and the Azores. The Captain will merely seek a great circle route, with due allowance for weather conditions, between the points of departure and arrival.

***Specification and Main Dimensions of the* Hindenburg:**

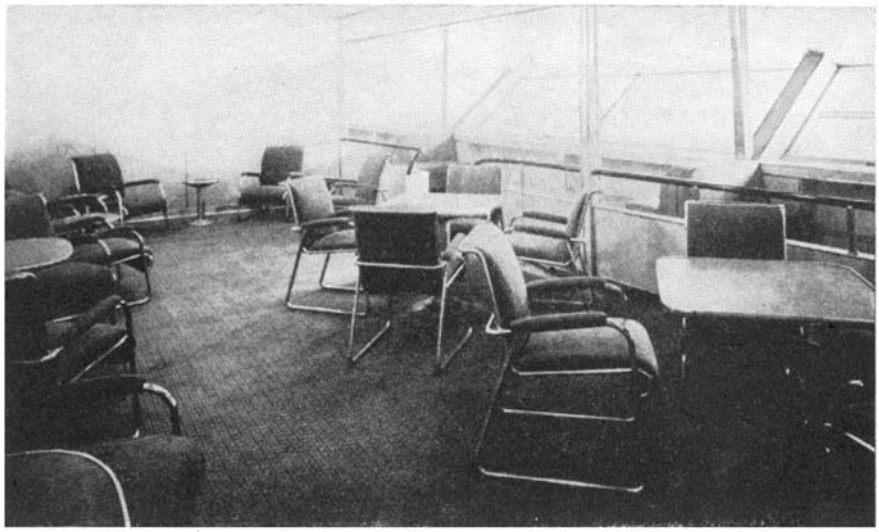
Length, 803.82 feet.
Height, 146.65 feet.
Largest diameter, 135.17 feet.
Fineness ratio (length divided by maximum diameter) 6 to 1.
Total lifting gas volume 7,063,000 cubic feet.
Number of gas cells, 16.
Gross weight with equipment and fuel, 430,950 pounds.
Payload (passengers), 15,470 pounds.
Payload (freight and mail), 26,520 pounds.
Total lift under standard conditions, 472,940 pounds.
Power Plant: 4 Mercedes-Benz Diesel engines of 1100 horsepower each.
Auxiliary Diesel-electric generator engines, two of 50 horsepower each.
Maximum Speed, 84.4 miles per hour.
Cruising Speed, 78.1 miles per hour.
Range at cruising speed, 8750 miles.
Maximum capacity, heavy fuel oil, 143,650 pounds.
Crew, 40 men.
Number of passengers, 40.

Why Was Fineness Ratio Reduced? In one of our illustrations, the wind tunnel model of the *LZ-129* is shown in fictitious flight. The model appears rather stumpy compared with the *Graf Zeppelin*, and it may be asked: Why was the fineness ratio decreased? It appears that, on the whole, the air resistance of the "fatter" airship is less in proportion to the volume displaced, and the shorter length also means less bending moments to be resisted by the girders. These are good and sufficient reasons for the change. But a long airship is apt to be more stable, a shorter one more controllable. There was some little doubt in the designer's mind as to whether there would be enough stability. From the flight tests, however, the conclusion was reached that just the right compromise between stability and maneuverability had been achieved.

Manual Control: The steering of a steamship is associated in our minds with a "donkey engine" or some similar contrivance for increasing the power of the helmsman. It has often been stated that with very



Comparison drawings of the *Graf Zeppelin* and the *Hindenburg*



The passenger lounge and promenade, starboard side, on the *Hindenburg*

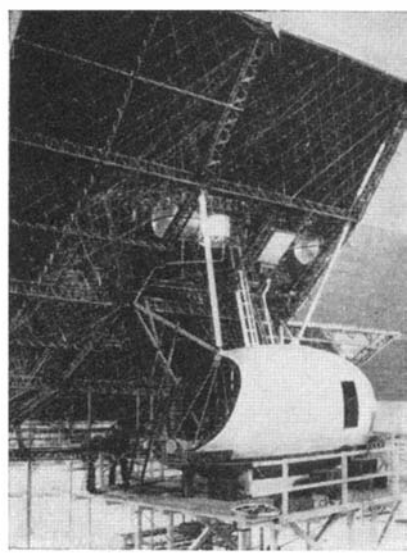
large airships a form of servo-control would become necessary. But the *Hindenburg* is still manually controlled from two large wheels in the steering room, with cables over pulleys going to the rear of the ship. The secret lies in the very delicate aerodynamic balancing which has been secured in both the rudder and elevator surfaces.

Fire Precautions: Americans interested in airship development have been somewhat disappointed by the length of time consumed in the construction of the *Hindenburg*, and the delays in final completion. Mr. Dörr explains that this was due to some important and fundamental changes in the design, related mainly to safety. In the original plans, which were for a model termed the *LZ-128*, gasoline engines were specified, with either hydrogen or "blaugas" for the gas cells, with the hydrogen or blaugas to be burned in the motors as loads became lighter and gas had to be valved out.

The present airship power plant uses Diesels, burning heavy fuel oil; also, while hydrogen is being used on the first flights, provision has been made for internal, relatively small cells of hydrogen, surrounded by helium gas. The fire hazard is thus greatly diminished and the hydrogen can be used for maneuvering, thus avoiding losses of the expensive helium. Other precautions against fire in the form of numerous and well placed fire extinguishers are employed. As a result, passengers will enjoy the privilege of a smoking room—a boon to restless persons on a long trip.

Certain additional precautions against fire have been taken in the smoking room. Its walls are covered with a veneer of pear tree wood, which is almost as non-inflammable as asbestos. The doors to this room can only be opened from outside, or by a push button at the sole command of the steward. This feature is counted upon to prevent passengers from leaving the smoking lounge while carrying lighted cigars or cigarettes. The door is also said to form an "air lock." The ash receivers are also of a special type. When a lighted cigarette is thrown into one of these receivers the burning stub is automatically extinguished!

Power Plant: The four Mercedes-Benz Diesels are the most powerful high-speed Diesels ever built. It took time and trouble to develop them, and therein also lay part of the delay. In American practice, reversible pitch and swiveling propellers have been employed. The swiveling enabled the crews of the *Akron* or *Macon* to place the propellers in a horizontal plane of rotation, to assist in up and down maneuvering. With the Diesels of the *Hindenburg*, no such complex mechanism is required. The engines can be reversed; the swiveling feature is a loss which is probably compensated for by the greater reliability of a simpler drive.



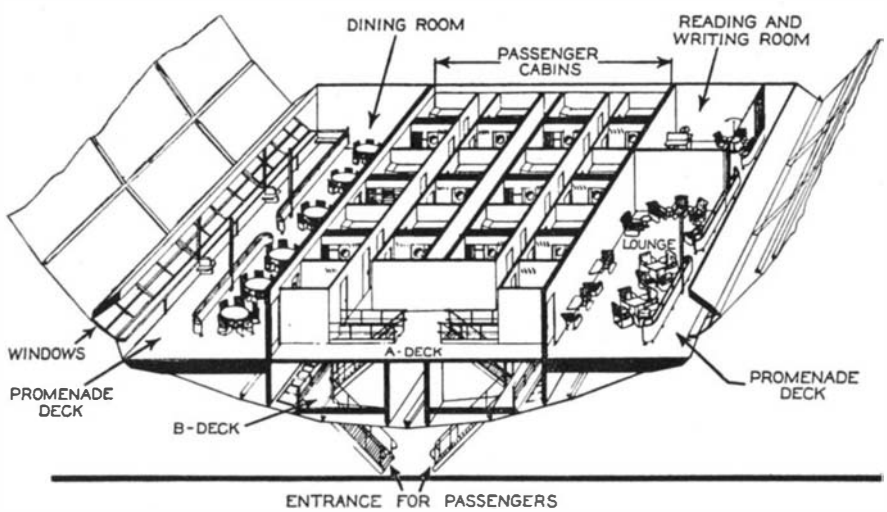
One of the power gondolas

On the *Graf Zeppelin* there were six power eggs or gondolas of 550 horsepower each. On the *Hindenburg* there are only four units, but of a greater total power. One of the photographs shows the mounting of these power gondolas, as well as some of the tanks mounted at the side of the lower keel which runs the entire length of the ship. Some 135,000 pounds of heavy fuel oil is stored in tanks along the keel, suspended on the sides of the cat walk and easily accessible. These tanks are connected to a distribution manifold.

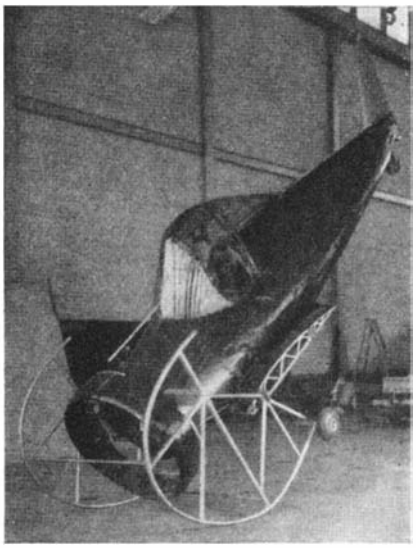
Landing Wheels: In the United States we have come to believe that mooring masts and other mechanical ground handling devices are absolutely indispensable for airship work. Experience with the *Graf Zeppelin* in out-of-the-way parts of the world has led the Germans to the conclusion that an airship must be capable of making "manual" landings; that is, without the aid of a mooring mast. To facilitate "manual" landings, the "buffer" or "bumper" bag commonly placed under the control car and the lower fin has been replaced with two large pneumatic tires, approximately four feet in diameter, mounted on swivels so that they may be swung into any desired direction. These landing wheels can be retracted in flight to diminish head resistance.

Structure: Mr. Dörr emphasizes the fact that the structural design has remained substantially unchanged. The girders have been merely enlarged in section and an aluminum alloy of even higher strength than formerly has been put into use. The girders are of the now familiar triangular trussed type. There are 15 main transverse rings, to house the 16 gas bags, with subsidiary rings placed halfway between the main rings which have 32 angles. The main rings are braced by a transverse wiring system, the wires being connected to a central girder, and by a cat walk which passes through the gas cells.

At the bottom of the ship there is provided a large main girder, which also serves as the main corridor or cat walk, providing accessibility to all parts of the ship and communication between the navigating quarters forward and the passenger quarters farther aft. Another of our photographs gives a view looking along the cat-walk keel towards the nose. The gas bags, shown partly inflated in the photograph, are held in position by wire meshing. Goldbeater's skin is no longer employed for the gas bags;



Drawing of the *Hindenburg's* passenger quarters



An airplane fuselage used in experiments in deliberate nosing over

it has been replaced by a special synthetic material which has no greater permeability to gases and is very much cheaper and easier to obtain. The outer covering or envelope is a cotton fabric coated with cellulose dope, and so pigmented as to be least affected by the sun's rays. Each of the gas bags is provided with its own safety valve, and all the bags can be simultaneously or separately controlled from the navigation cabin. A diagram of the gas bags and their valve controls is mounted in the pilot's car, with numbering corresponding to the various control handles.

A Central Electric Station: Amidships, inside the outer envelope or structure, is located a central electric station, a very important part of the airship. In two separate compartments, there are housed two Diesels of 50 horsepower each, with electric generators of equal capacity; transformers; batteries; and appurtenant equipment. The central station provides power for the motors used to wind up the radio antennas, the motor of the refrigerating system, the elevator used to haul up food, power for the kitchen, and so on. The complexity and completeness of the electrical installation is equivalent to that which would be found in a completely equipped and air-conditioned office building.

Control Car and Passenger Accommodations: The control car is located forward and is completely separated from the passenger quarters. Its dimensions have been held down to a minimum. Rudder and elevator wheels, instrument board, central telephone station, and the valve control system are located in the control cabin.

Quarters are provided along the lower main corridor for a ship's crew of 46 men. These quarters are divided into three groups: the officers' quarters, with accommodations for 12 men, are located above the control car forward of the passenger quarters; deck force quarters with accommodations for 22 are just aft of the passenger quarters; the machinists' quarters with 12 bunks are placed farther aft near the Diesel power plants.

The passenger quarters, located aft of the control cabin, are laid out to accommodate 50 passengers. The quarters are confined to one bay of the airship (that is, between two main rings), are entirely within the ship's hull, and are constructed on two levels. There are 25 staterooms, each of which contains two berths; four public rooms—dining room, lounge, writing room, and smoking room; promenades; kitchen; officers' and crew's mess rooms; bar; bath; toilets; and showers.

An Exciting Experiment: From the above description it will be seen that in the design of the *Hindenburg* everything possible has been done to secure safety, navigability, and comfort. The speed of the ship will be the highest ever attained by a commercial airship. It will be in the hands of the most experienced officers and crew. Therefore the proposed transatlantic service will be conducted under the very best conditions. Now we shall see a truly exciting experiment, the outcome of which will give the answer to the question: Is airship service across the North Atlantic a commercially practical undertaking? The experiment will be all the more interesting since the flying boat services across the Atlantic are also being organized so rapidly and should be in operation soon.—*A. K.*

Experiments in Nosing Over

THE Army Air Corps photograph shows a specially designed cradle which enables the pilot deliberately to nose over a mock-up of a single-seater pursuit fuselage.

Directly over head, a heavy beam reinforces the cabin from front to rear. A seat adjustment of eight inches range is provided so that pilots may raise themselves until their helmets are within one or two inches of a sponge-rubber padding at the top of the cabin. With this apparatus, a systematic investigation will be made of what happens in a nose-over airplane accident.—*A. K.*

REVIVED HEARTS

SIXTY-THREE human hearts have been made to beat again after being removed from the bodies of persons who have died. The object of these experiments, by Dr. William B. Kountz of St. Louis, was to learn more about human hearts and how they function, both in health and sickness—information which cannot be obtained by observation of animal or chicken hearts.

Tetrone B

A NEW industrial organic chemical which is notable for its strongly basic properties which enable it to dissolve wood pulp and cellulose as well as metals and their oxides, has been announced by Rohm and Haas, under the name "Tetrone B." Chemically speaking, it is a tetra-substituted ammonium hydroxide, non-volatile, and as strong a base as sodium hydroxide.

Tetrone B is of particular interest as a solvent for wood pulp and cellulose, and appears to be unique in its ability to dissolve cellulose without the intermediate formation of an ester or ether. It also acts as a solvent for dyestuffs, forming salts which have altered and modified solubilities in solvents or aqueous solutions.

Since Tetrone B is a strong organic base it is also of interest for the saponification of oils, fats, waxes, and gums. It is much more soluble in these products than the inorganic hydroxides. A number of new and interesting salts which have been prepared are the carbonates, phosphates, resinates, silicates, xanthates, and stearates. These salts show distinct properties, and for many applications have advantages over the corresponding alkali metal salts.

In synthetic work Tetrone B is of special value in the preparation of new accelerators, antioxidants, detergents, and pharmaceuticals.

Tetrone B is available in a 40 percent aqueous solution and may be supplied in various organic solvents for special problems.—*A. E. B.*

Angle Trisection

DUE to an error in proof-reading, the exponent 3 was omitted from the end of the tenth line in the second column of page 228 of the April number, containing an article on the trisection of angles. This exponent should be added by those who are using the article for instruction purposes or saving it for future reference. This will make the right-hand side of the equation read: $4\cos^3$.

Swordfish Stabs a Boat

THE Academy of Natural Sciences of Philadelphia makes public the accompanying remarkable snapshot of a swordfish puncturing a 14-foot dory with its "sword." So far as is known, this is the only photograph of the kind ever made.

The attack took place in the Atlantic ocean 120 miles southeast of Martha's Vineyard, Massachusetts, and is reported by Captain Ira Abbott, of Yarmouth, Nova Scotia, who at the time was sailing master of a yacht out of New York, as follows: "We harpooned the fish shortly after sighting it, and put the dory out with one man in it to bring the fish alongside the larger craft. I noticed he was having considerable trouble to get the fish alongside, so expected something like that to happen, so I was standing by with my Kodak ready to get a picture. I saw the flash of the fish in the water as it approached the dory and pressed the trigger

A swordfish turns aggressor

in time to get the picture as you see it. A few seconds after this picture was taken the fish made another savage lunge at the dory and ripped one plank entirely out, sinking the dory. We got the man all right, and shortly after landed the fish, weighing 350 pounds."

Railroad Inventions

EIGHT great inventions which stand out as mile-stones of railroad progress during the 19th Century, and which are familiar to everyone today, were not originated by railroad men; in fact, most of the inventors belonged to callings remote from transportation of any sort. This significant fact was brought out in a recent address by Dr. C. M. A. Stine, Vice President of E. I. du Pont de Nemours & Company. His citation of these will bear repetition.

The land telegraph, which found its widest use in railroading, was invented by Wheatstone, an English professor of philosophy, and by Morse, an American artist. Pullman, inventor of the sleeping car, was a street contractor in Chicago. Eli H. Janney, who patented the first automatic car coupler in 1868 (thereby eliminating the primitive link and pin method which maimed or cost the lives of many trainmen) was a clerk in a dry goods store. The automatic block signal system was originated by Thomas Seavey Hall, a retired textile manufacturer. Westinghouse was a youngster of 23 when he invented the airbrake, with no experience except in his father's carpenter and machine shop. The vestibule buffer was invented by Hosea W. Libbey, a physician and sanitarium proprietor. The first electric locomotive was designed in 1847 by Moses G. Farmer, a school teacher. Finally, the cinder deflector was invented and patented by the Reverend Adam Sox, a Lutheran minister.

PAPER

THE United States uses more paper than all the rest of the world combined, our total being an average of ten million tons per year.

Wrist Meter

JUST about the neatest trick of the year in men's watches is the Pierce-Chronograph, a combination wrist-watch, stop-watch, telemeter, and tachometer. These four different functions are combined in one compact, practical, and wearable unit.

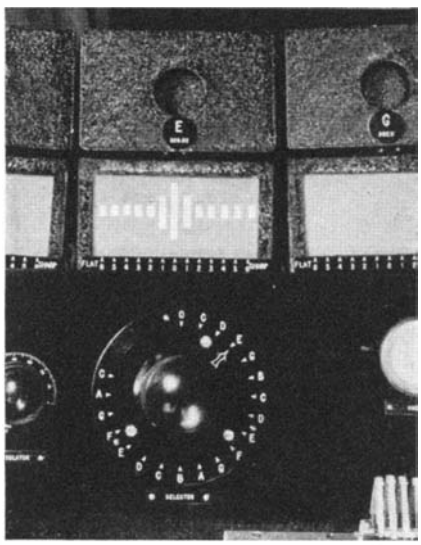
As a stop-watch, the Pierce-Chronograph will time in seconds and fifths of seconds. As a telemeter, it will indicate the distance away from the observer of light or sound. (For example: at the flash of lightning, press the button on the side of the watch, setting the sweep-second hand in motion. At the sound of thunder, press the button again. The number of *miles* away the storm is from the observer will be indicated.) As a tachometer, the Pierce-Chronograph will indicate the number of miles per hour an object is moving.

Versatile wrist stop-watch

Thus, this "watch-plus" is applicable to almost every known sport or sporting event besides its many specialized uses in radio work, navigation, scientific research, aviation, and so on.

New Visual Reed Tuner

THE entire musical industry will be interested in a new semi-automatic visual reed tuner developed by Victor H. Severy,



a well known engineer of Los Angeles, California. The National Dobro Corporation, manufacturers of fretted instruments and electrical guitars, will display the reed tuner in their Chicago offices.

The tuner tests accordion and harmonica reeds electrically, shows exactly how many vibrations they are out of tune, and makes it possible to bring them to within 1/20 of 1 percent of the accurate pitch. All tuning and adjusting on the tuner is done by sight, so that the operator's hearing ability for surrounding noises makes no difference to the result. The operator is seated at a small desk, with a series of light panels mounted perpendicularly facing him. On the table is a fine grinding machine so delicate that the operator can remove the smallest possible amount of metal from the reed. The reed is attached to a resonator chamber of the same actual dimensions as the instrument, so that it is tuned under the same conditions as it is later played.

In operation, the tuner dials in the number or frequency desired, and the reed is made to vibrate. The control which makes the reed sound also lights one of the perpendicular panels. A calibrated scale shows exactly how much the reed is too slow or too fast; in other words, too flat or too sharp. A slight touch of the operator's hands corrects the variation and a second test shows whether the reed is made perfect. Since the entire operation is almost automatic, all human equation is taken from one of the most delicate operations in the manufacture of reeds. In production, this tuner greatly increases efficiency and quality of product, so that it will mean more economical and better reeds.

Above: **An operator at the board of the new visual reed tuner for musical instruments.** ***Left:*** **Close-up of one of the lighted indicator panels**

What Is This New Oil Good For?

"VISCOUS oil," a new petroleum product, resembles clear, transparent honey, but is so thick and sticky that the liquid can scarcely be poured from a bottle. With substantial quantities available upon demand, petroleum engineers are speculating on possible uses for an oil which is so sluggish that it measures, at 100 degrees, Fahrenheit, as high as 144,000 on the Saybolt scale of viscosity.—*A. E. B.*

Fingerprint Differences

THE recent claim that fingerprints of two individuals have been found to be "almost identical" is refuted by John Edgar Hoover, director of the Federal Bureau of Investigation, United States Department of Justice.

A report from the state of Washington recently credited two men with having fingerprints "almost identical." "The fingerprints of the individuals in question have been examined by the identification experts of the FBI who have pronounced the impressions as readily distinguishable from one another," Mr. Hoover stated. "Such incorrect reports which may tend to shake public confidence in fingerprint identification as an accurate science, should be refuted as soon as possible."—*Science Service.*

The World's Poor Thanks

DEWAR'S earliest publication of the idea of a vacuum vessel dates so far back as 1874, and the suggestion that he was anticipated has no justification: Dewar gave his invention of the vacuum flask freely to the world, and never made a penny by

it, though he might have realized a fortune. If only, as Lord Rayleigh remarked, vacuum-jacketed vessels had come to be called Dewar flasks instead of Thermos flasks, their inventor's fame would doubtless have penetrated to a very wide public.—Douglas McKie, in *Nature* (London).

Lightest Metal

A METAL 10 percent lighter in weight than any previously known has been prepared by the Bartol Research Foundation. It is known as "Lithium Six," indicating that it is an isotope, or light form of lithium metal. While no immediate practical uses for such a metal are evident, the discovery is considered important by scientists who predict numerous potential fields of use.—*A. E. B.*

Water to Burn

OCCASIONALLY conditions occur which reverse the usual practice of generating electricity by steam and make economical the generation of steam by electricity. This practice has not been unusual in certain districts in the Alps and Canada and on the Scandinavian peninsula, where water power has been abundant and cheap.

Less well known is the fact that for the past two years this same practice, on a large scale, has been carried on in our own country by Puget Sound Power & Light Company. This company furnishes electric power, generated largely in its hydroelectric plants, to the major part of western Washington, and also supplies a central steam heating service in the downtown area of Seattle.

The company's electric generating capacity was supplemented a few years ago by the construction of the Rock Island power development on the Columbia River which is essentially a run-of-river plant with little storage capacity. In order to utilize power which could not be absorbed at certain times and would otherwise be lost as water over the dam, an electric steam generating unit was installed in one of the boilers at the steam plant. This initial unit for the generation of steam by electricity proved so successful that a year later a second one was installed.

Since the installation of these two units, which cost 29,000 dollars, more than 180,000,000 kilowatt hours of dump power have been used, thereby saving 100,000 dollars which would otherwise have been spent for coal.—Stone & Webster *Bulletin.*

AUTO PAINT

IN 1913 it took six weeks to apply the 22 distinct coats of old-style paint and varnish to the automobile body. Now the motor car body can be finished from the raw metal out in a single day.

Mechanical Innovations on "Queen Mary"

BESIDES being one of the two greatest liners in the world, the Cunard White Star superliner, *Queen Mary*, shortly to arrive in the United States, has many modern features. While the most striking exterior mode adopted by the *Queen Mary* is her cruiser stern, within the ship are a number of innovations.

The colored lighting system in the main ballroom and the veranda grill is based on a new invention, hitherto used only on land, whereby the orchestral tone will automatically control the color tones of illumination. By use of this, the color and volume of the lighting will be automatically varied in harmony with the pitch and volume of the music.

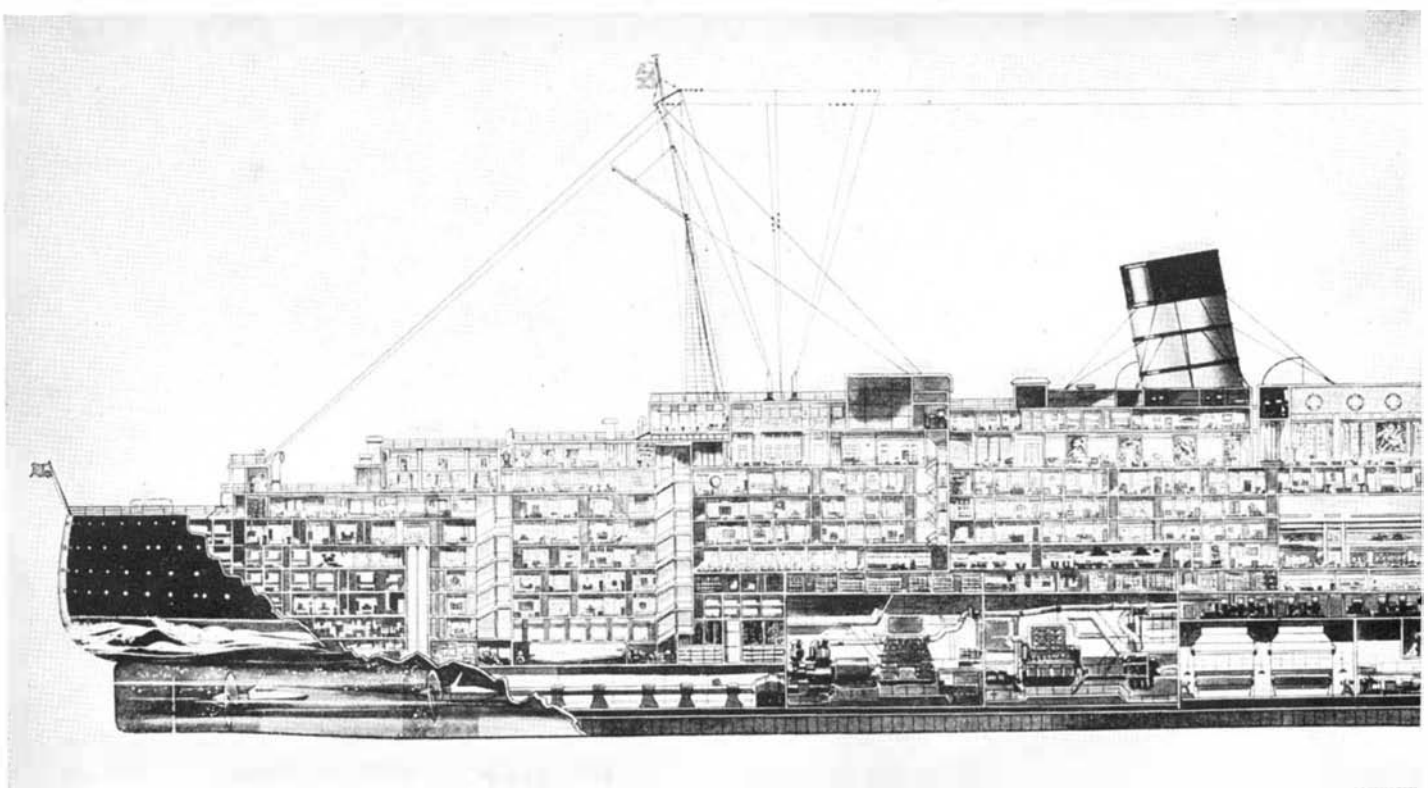
A special kind of vacuum tube, similar to a radio tube, governs this relation of light and sound, and remarkably smooth flexibility of control is obtained. By simply operating a "sound" push button connected with the dimmer, microphones and amplifiers are automatically brought into action. The microphones transmit the music as an audio-frequency impulse to the amplifiers, then an electric filter divides the current into three channels, so that the low-, middle-, and high-frequency notes picked up by the microphones govern the individual banks of colored lamps.

British engineers say that the *Queen Mary's* radio equipment is more powerful than that in any other ship. Concerts, speeches, and interviews, it is expected, will be broadcast regularly from the ship's public rooms.

The complete radio system will employ 11 short, seven long, and five medium wavelengths, besides nine for radio-telephony. By means of radio-telephone, passengers may hold private conversations from their staterooms with any person in any part of the world where telephone links exist. Speech scrambling will insure privacy.

There will be no interference with these telephone conversations while the various radio telegraph channels are in operation. The *Queen Mary* is equipped with nine separate aerial systems tied in with a main aerial 600 feet long; there are also an auxiliary wire with a 150-foot span, three short wave aerials, three receiving antennas, and one emergency aerial. A power plant having an output of 70 kilowatts will supply electric energy for the equipment.

To permit simultaneous transmission and reception of signals without mutual interference, the transmitting station is located 350 feet farther aft than the receiving station. The transmitting station contains four large transmitters, each of which will be capable of maintaining continuous communication with both sides of the Atlantic throughout the voyage. The ship's lifeboats are all equipped with radio.



A sectional drawing of the *Queen Mary*, showing many of the

If the duplicate generating plants for the radio plant should ever be put out of action, a complete emergency station, operated entirely from the ship's emergency lighting supply or from storage batteries, will be available.

The *Queen Mary* also has made advances in air-conditioning over systems prevailing in any other ship. By means of an immense plant, the ship will manufacture her own weather below decks, and passengers may control the temperature of their own staterooms. The air in dining rooms will be kept constant at any desired temperature and humidity, irrespective of weather conditions outside, and thus passengers will be able to dine, dance, read, rest or sleep in cleansed air.

For the first time on any ship, all elevator winding engines on the *Queen Mary* are identical, with interchangeable parts; thus carriage of spare parts is reduced to a minimum. The Otis Elevator Company has installed 21 elevators on the ship as follows: seven for use of cabin class passengers, two for tourist passengers, two for third class passengers, two for baggage, three for service, three for stores, one for engineers, and one for engine room stores. The speed of these elevators will be 200 feet per minute. Openings will be protected by center opening, self-closing, metal doors, which have the advantage of allowing the maximum width of entrance.

The *Queen Mary* will sail from Southampton on May 27 on her maiden voyage to New York, arriving June 1.—*Freeman Cleave.*

Blood From The Dead

BLOOD from the bodies of those who die suddenly—in automobile accidents, by electrocution or by drowning, for example—is being used in Russia for transfusion in human beings. Almost 1000 transfusions of blood from the newly dead have been made at the surgical clinic of the Institute Sklyfasovsky, Central Emergency Hospital, Moscow.

S. S. Yudin, surgeon-in-chief, describes the striking results obtained in these cases and the technique employed in transfusion in *The Journal of the American Medical Association.* Blood must be obtained from six to eight hours after death. The recipient of the blood is safeguarded by serologic tests of the blood, a bacteriologic check-up and a careful autopsy.

In those who die suddenly, the blood remains fluid and can be preserved at low temperatures for more than three weeks, the Russians have found. In its healing effects, this blood does not differ from the blood of living donors. As sources of supply, Dr. Yudin suggests victims of traffic accidents as well as hospital patients who die from coronary thrombosis and angina pectoris. The blood is warmed to body temperature by placing a flask of it in warm water. It is then passed through a gauze filter into the vessel from which it is to be transfused.

The advantage of the method is that there is no loss of time in acute emergencies, for it is unnecessary to call in a blood donor. Another valuable feature is that blood from the same cadaver can be used for repeated transfusions in the same patient. Sometimes several transfusions are necessary during a single operation.—*Science Service.*

Rubber Lined Pipe

A 300-foot unit of 16-inch rubber-lined pipe has recently been installed by the B. F. Goodrich Co., in a large southern pulp mill for handling cellulose material in the presence of chlorine in water solution at normal temperatures. This material was previously conveyed by means of 24-inch wooden troughs which were subject to continual repairs and had to be completely replaced every three years. The 16-inch rubber-lined pipe has required no repairs during its eight months of operation and it has increased production over the 24-inch troughs. In view of the fact that similar installations are still in operation after more than 10 years' service, the life of this equipment is indefinite.—*A. E. B.*

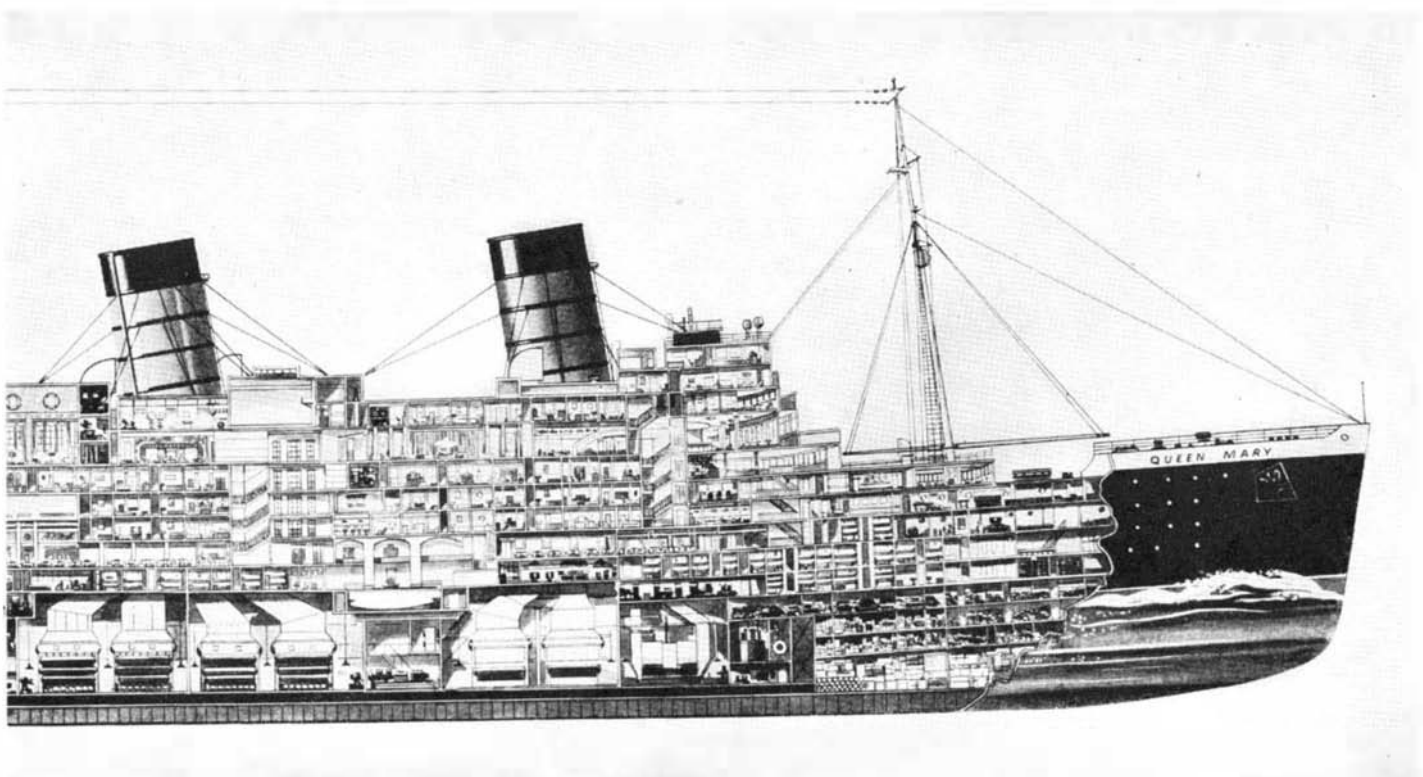
GAS SIEVE

SOLID metal, strange as it may seem, is used as a sieve for hydrogen. The metal is heated to cause it to expand and open the spaces between the atoms; then the tiny hydrogen atoms rush through like water through a basket.

Useful Paraffin

OF the many waxes that are finding more and more application in industry, none is more versatile than paraffin. It has a convenient melting point, will bend, is tenacious at ordinary temperatures, does not deteriorate, is impervious to water at atmospheric temperatures, and has a high dielectric strength.

Bureau of Mines Bulletin 388 reveals that it is used extensively in the manufacture of candles; the impregnation of waxed papers; the coating of paper cartons (butter, cheese, ice cream), drinking cups, milk bottles, and milk bottle tops; electrical insulation; waterproofing; the impregnation of match tips; floor and furniture polishes; laundering; the protection of preserves and jams from fermentation; coating for cheeses to improve their appearance and to prevent mold, evaporation, and shrinkage; the lining of butter tubs; coatings for beer vats and barrels (vinegar, cider, alcohol, whiskey, molasses, and sauerkraut); coatings for meats, sausages, and other products which must be prevented from drying; protective

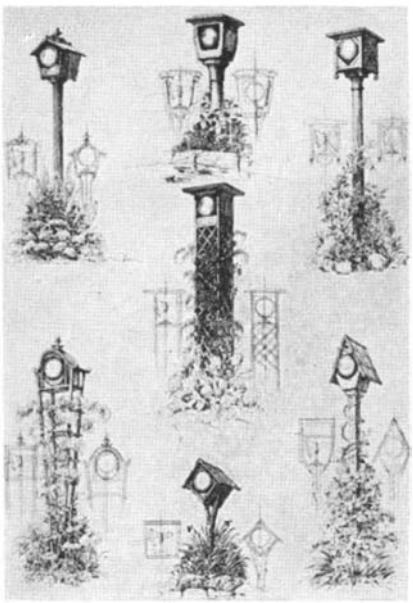


interesting details of her equipment discussed in the text

wax dressings for burns; the manufacture of artificial flowers; etching glass; miners' lamps and marine bunker lights; waxing yarns in the textile industry; stuffing or loading for leather in tanneries; and for numerous other materials and purposes.—*A. E. B.*

Garden Lighting Sources Beautified

THE artistry of garden illumination, now bringing out the depth and color of a blue spruce, now painting the delicate de-



Seven forms of decorative housings for garden illumination equipment

tails of a rock garden, or shimmering into rose and azure in a fountain spray, has met with the enthusiastic approval of landscape architects.

But the manner in which some lighting equipment is located in the garden to obtain these effects tends, architects believe, to destroy the appearance of an otherwise beautiful garden because the source of light is so much in evidence.

With this architectural criticism in mind, J. W. Gosling, designer at the General Electric illuminating laboratory, set out to further the idea of artistic lighting for the small or modest garden. He has designed little houses for the luminaires which by day appear to be bird houses mounted atop or hung from rustic poles, trellises, and other garden architecture. At night they shed light on flowers, trees, the bird bath, or fountain. A few of his numerous attractive designs are shown in an accompanying illustration.

Cold and Hot

THE sun shines hottest on high mountain tops where explorers shiver with the intense cold.

Observations of solar radiation from the summit of Mount Aunconquilcha, Chile—nearly four miles above sea level—where its intensity is nearly one sixth again as great, have just been reported to the Smithsonian Institution. Delicate radiation-measuring devices were carried to this crest in the highest Andes by C. P. Butler.

The instrument used in the measurements was set up on a cake of ice. Although, of course, the result was to be expected, it seemed a little incongruous to be suffering from the cold and at the same time measuring solar intensity far greater than that which would have been recorded in the hot desert far below.

"The results of the instrumental data," says Butler, "were not apparent to the senses. At the mine (a sulfur mine on the mountain top) even during the middle of the day the temperature hardly rose above freezing, even though Aunconquilcha is nearly 200 miles north of the Tropic of Capricon toward the Equator. We all wore heavy clothing, stocking caps, mittens, and heavy shoes. Despite the cold, one burned severely in a few hours unless protected by a sunshade. The men who worked in the mine were burned almost black. Although the data show that the amount of solar radiation here is greater than ever experienced at sea level, the only way this could be felt was in a feverish feeling about the nose, cheeks, and neck."

Storm-Testing Concrete

ROARING wind and drenching rainstorms are produced artificially by research engineers of the Portland Cement Association to test weather-tightness of concrete masonry walls. Wind tunnels equipped with a series of water jets are part of the apparatus in their field experimental laboratory at Elmhurst, Illinois.

Water in a volume equivalent to 2½ inches of rainfall per hour is driven against the test walls at a wind velocity of 25 miles per hour. The wind is produced by an airplane type propeller moving at 1750 revolutions per minute. This wind speed is more than twice the average wind velocity of 11 miles per hour recorded by the United States Weather Bureau even in the "Windy City" of Chicago.

The test walls are wired with electrodes. When current at known intensity is passed between pairs of these electrodes, any change in resistance due to penetration of moisture is shown by a delicate electric meter. Forty-seven walls, of different types of concrete masonry units, are included in the series of tests now under way.

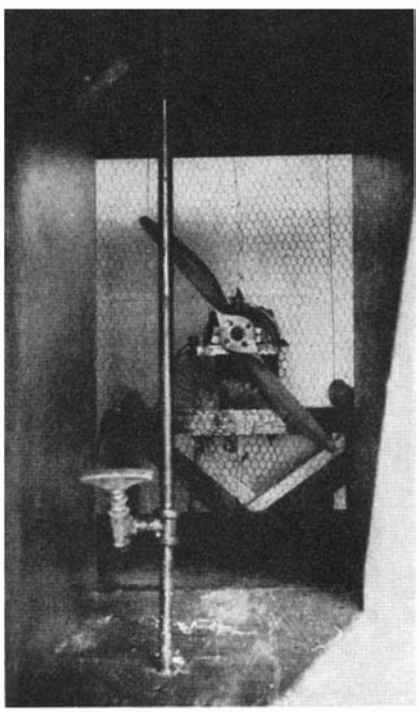
According to R. E. Copeland, engineer in charge of the tests, all of the walls are given many times more severe exposure to wind driven rain than they would undergo in years of actual service. "Only under hurricane conditions, for very short periods, would walls ever be subjected to such rigorous treatment.

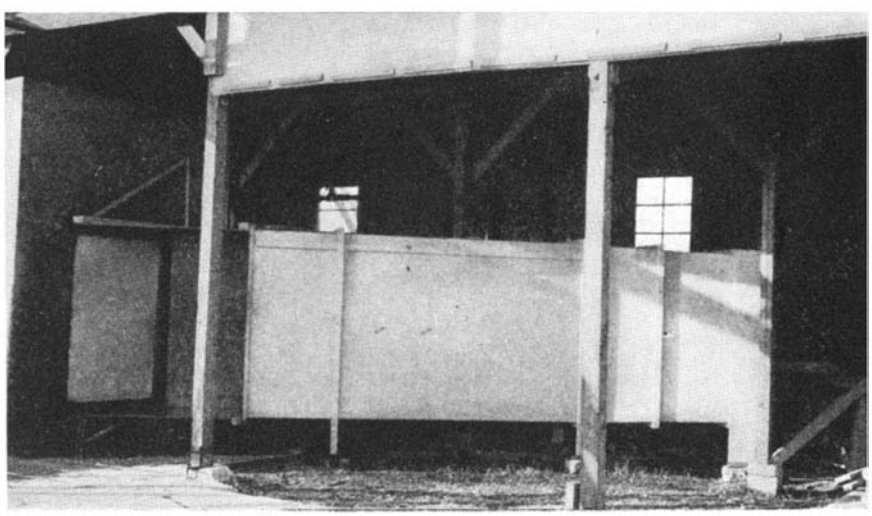
"The testing methods are planned, and the apparatus so designed," Mr. Copeland explains, "that the results can be translated directly into terms of the performance of walls in actual service. Water-tight walls have long been a problem common to all types of masonry construction. No tests with any structural material have been previously reported in which natural conditions have been so closely imitated."

Platinum Flute—Best in World

THE phrases "golden" and "silvery tones" have long been stock descriptions used by poets and critics to describe beauty in music. Now, it appears, science and art have co-operated to add a new term to the musical writer's dictionary — "platinum tones."

Such, at any rate, is one of the possible results of the introduction by George Bar-





***Above:* Propeller and water sprays used for testing concrete. *Below:* Exterior of the wind tunnel with section of a wall under test at the left**

rere, world famous flutist, of a solid platinum flute. Made at a cost of 3000 dollars, this instrument is said by musicians and scientists who have heard it to possess tonal qualities superior to those of any other flute ever made.

The discovery of the qualities of the flute was not an accident nor was its construction prompted by vanity, according to Mr. Barrere. Science had arrived at theories which indicated that platinum was the ideal material for the instrument. Therefore, just as a violinist seeks a Stradivarius violin when he reaches the top of his profession, Mr. Barrere, who had previously owned a gold flute, turned to platinum.

The theory to which Mr. Barrere referred was developed by Professor Dayton C. Miller, an expert on tonal dynamics and also a flutist, at the Case School of Applied Science, Cleveland, Ohio. Professor Miller, after numerous experiments with flutes of various materials, declared that the denser the material used in the instrument, the better the tone produced. He rated gold the best material he tested, but suggested that, since platinum is even denser than gold, it should be better still.

Actual tests made of the tones of gold, silver, and platinum flutes at the Bell Telephone Laboratories in New York tended to substantiate the theory.

RUST

ONE billion dollars is our average yearly loss due to rust, it is estimated by Dr. R. M. Burns of the Bell Telephone Laboratories. This equals the interest on the public debt of the United States.

RHYTHM LESSENS FATIGUE

WHEN soldiers are marching to the rhythm of band music, less fatigue is felt than when they are merely walking along without cadence, says Dean F. W. Shumard of the National School of Time Study, Norwalk, Connecticut. Laborers who sing or chant during their working movements, he continues, are not always manifesting the feeling of pleasure in their endeavors, but they are creating a rhythm for their movements which makes their work easier.

One reason for the efficacy of this rhythm in lessening fatigue is that it keeps the worker's mind away from the contemplation of his tiredness. Everyone knows from experience that a person not conscious of his growing fatigue is less tired at the end of the day than one whose introspection constantly centers on the likely effects of the work. Therefore, points out Dean Shumard, one of the chief aims of time study as applied to industry is to make the manual operations of each worker as regular and rhythmic as possible. Even if a slight slowing-down of a particular operation is necessary in order to secure rhythm, the day's production is increased through the steady pace that the workman maintains.

Rapidity of motion is not necessarily more energy-consuming than slowness of movement. Usually those operations which lend themselves to rapid movements are of the light type of work, and the worker can

quickly set a rhythmic pace for himself, thus saving considerable fatigue. On the other hand, slow tasks are often of the heavy type wherein rhythmic movements are nearly impossible, and therefore these slow tasks are much more tiring than the faster but lighter ones. The matter of rhythm plays an important part in the work of the time-study engineer.

Dry Ice as Rat Killer

HARDLY a month goes by without someone discovering a new use for solid carbon-dioxide. One of the latest additions records the effectiveness of dry ice as a rat-killer. Although non-poisonous, the gas from a chunk of dry ice as large as the rat hole will accommodate, will neatly suffocate the rodents as they sleep, provided all holes are stopped up after inserting the solid gas. In order to catch 'em while they sleep, the treatment should be applied in the morning. —*A. E. B.*

Haze Meter for Forest Fire Lookouts

ANNOUNCEMENT has been made by the Pacific Northwest Forest Experiment Station of the Forest Service, United States Department of Agriculture, of a new instrument called the Byram haze meter. Because of the important rôle which visibility conditions play in the detection of forest fires, the discovery of a simple and accurate means to measure the effect of haze on the distance fires can be seen marks a real advance. This instrument is used by forest fire lookouts to determine the distance at which they can see a wisp of smoke from one of the incipient forest fires for which they are ever on the watch. It will no longer be necessary to rely on makeshift estimates and guesses on taking action to meet changing conditions. In clear weather one lookout can keep watch over a wide territory, but when the air becomes filled with haze it is necessary to man more points in order to cover the same ground, thereby adding to the cost and difficulty of providing adequate protection.

The haze meter is based on the discovery that a smoke column is just barely visible to lookouts with good eyesight against a background about 60 percent as bright as the sky at the horizon. It provides a mechanical means for finding a point on the background or landscape that is 60 percent as bright as the horizon. By sighting through an arrangement of filters and bringing up by means of one stationary and one movable mirror first one and then another part of the landscape, the observer is able to find some ridge or other recognizable point that is just 60 percent as bright as the sky at the horizon. The distance to that part of the landscape is scaled off on the map and becomes the visibility distance or the maximum distance that he can expect to detect a smoke column of a certain size in that direction at that particular time.

Foresters will use the haze meter to measure haze in terms of the visibility distance of small smokes in order to deploy their fire lookouts on towers and peaks so as to meet current changes in atmospheric conditions. However, since the haze meter is based on fundamental principles it is thought that others may find use for the instrument to measure the optical density

of the atmosphere. This can be done in several ways, the simplest being to consider the measurements of visibility distance to the standard size of smoke column for which the instrument is calibrated as indicating the relative quantity of haze present.

Improved Silver Plating

A NON-TARNISHING silver plate has been developed by chemists of Washington University. The secret that spells bad news to the manufacturer of silver polish but relief to the lady of the house who likes to keep her silver bright, is the incorporation of tin into the silver during plating. A silver-tin alloy containing 20 to 40 percent silver produces a plate that has the appearance of pure silver, takes a high polish, and wears better than conventional silver plate. —*A. E. B.*

Photographing Burned Documents

BY making written or printed words on burned documents easily read, a new application of the process of taking photographs by infra-red instead of by visible light places a powerful new weapon in the hands of the law in its fight on crime, and supplies new evidence in settling disputes arising from the burning of essential papers, according to Gustavus J. Esselen, Boston chemical consultant.

Ashes of written or printed papers reveal essential facts when photographed by infra-

Above: **A charred note photographed by ordinary white light—undecipherable.** ***Below:*** **The note is revealed by photography with infra-red rays**

red rays invisible to the human eye, Dr. Esselen said, for although the whole document appears black in visible light, in infra-red rays (or the so-called "black light") the tiny residue left of the ink has a different "color" from the ash of the paper.

"While the reading of charred documents is spectacular and important," said Dr. Esselen, "the same technique reveals important facts about unburned documents without injuring them. Alterations invisible in ordinary light often are clearly revealed by infra-red. Differences in reflective power for visible light give us our sensation of color but similar differences in reflective power exist both in infra-red and ultra-violet regions of the spectrum. Two ink marks that are equally black in visible light may be totally different in infra-red because their reflective powers are different. Forgers who change documents and use an ink different from the original can be caught by infra-red photography if the inks are different enough. The same is true of ultra-violet. Neither infra-red nor ultra-violet alone will detect all such alterations but between the two the forger has a much narrower margin of safety. Differences in papers as well as inks are detectable by these means to establish the authenticity of questioned documents.

"No method except this new photographic process is known for making infra-red visible. Ultra-violet causes certain materials to fluoresce and thus its effects are made visible. No corresponding effect of infra-red has yet been discovered."

Our Calendar About Three Hours in Error

WHEN Pope Gregory XIII reformed the calendar in 1582, with the advice of the astronomer Christopher Clavius, he corrected an error that had existed in the earlier Julian calendar of nearly 10 minutes a year, but even his calendar is not perfect. The average length of the year according to the Gregorian calendar is about 24 seconds longer than it should be—the time that the earth takes for a complete trip in its orbit around the sun. But this remaining error is so small that it will not be until about the year 4600 that our calendar will be as much as a day in error. At present the difference that has accumulated since Pope Gregory's time is only about three hours—not enough to bother anyone.

The whole difficulty in making a satisfactory calendar comes from the fact that the earth does not turn an even number of times while it is making a trip around the sun. Instead, it turns almost 365¼ times. More accurately the number can be expressed as 365.24219, but even that is not exact. The two periods of time are incommensurable—one cannot be expressed precisely in terms of the other, no matter how many figures are used after the decimal point. Consequently, the best calendar is the one that most closely approximates this relation.

The Julian calendar, named after Julius Caesar, by whose decree it was introduced in 45 B.C., was due to the Roman astronomer Sosigines, who had placed the length of the year at 365¼ days. As the extra fraction of a day amounted to one day every four years, the leap year was invented. By having a 366-day year every fourth year, the difference was mostly accounted for. But because the actual year is about 10 minutes shorter than Sosigines assumed, by 1582 the calendar was 13 days out of step, and the beginning of spring came on March 12, instead of March 25, where Caesar had placed it. If this had been allowed to continue, it would eventually have come in the middle of winter, and as this would have put Easter and other religious festivals in the wrong time of year, Pope Gregory ordered the reform that bears his name.

Instead of restoring the beginning of spring to the 25th, however, he made it the same as in the year 325 A.D., the date of the Council of Nicaea, which had set the rules for determining the date of Easter. Ten days were dropped bodily from the calendar, which made the necessary correction. Then, in order to prevent a recurrence of the error, he ordered that, in the future, years marking the beginning of a century should not be leap years unless they were divisible by 400.

Other years would have the extra day if their number was divisible by four. Thus, in the Gregorian calendar there are 97 leap years every four centuries, instead of a hundred, as Caesar had it. For this reason, the year 1900 was not a leap year, but 2000 will be one.

But this difference of three days every 400 years is a little too much of a correction, by about 24 seconds a year. This amounts to a day in 3000 years, so by the year 4600, spring will start on March 22, unless some other change is made in the meantime. By that time the Eastern Orthodox Church will have a more accurate calendar than ours. They adhered to the Julian calendar until 1923. Then they adopted the Gregorian but with a slightly different leap year rule. This is that century years shall be leap years only when their numbers divided by nine give a remainder of two or six. This will not be out of step with ours until the year 2800 which, in the Gregorian calendar, will be a leap year, but in the Eastern reckoning it will be an ordinary one.—Copyright 1936, *Science Service.*

AIR CONDITIONING

MORE than 6000 air conditioned railway cars are now in use, and about 1000 more are under order.

Spinach Loses Standing as Health Food

GOOD news for spinach-haters! The leafy vegetable, obnoxious to many and unwillingly eaten because of widely-heralded health value, is losing its high standing. Spinach has been considered a valuable food because it has a high content of blood-and-bone-building iron and calcium. Less than half of the iron content of spinach, however, and less than a third of its calcium are in a form that can be used by the body, it appears from a report by Drs. M. K. Horwitt and G. R. Cowgill of research made by them at Yale University with the late Prof. L. B. Mendel.

Similarly, the amount of protein available for human nutrition is not what would be thought from the amount found in spinach by chemical analysis.

In their research, the Yale investigators devised a method which in the future can be used for determining in other foods besides spinach the amount of nourishing substances actually available to the body, as compared with the amount theoretically available as judged by the total content of these substances found in foods by chemical analysis.—*Science Service.*

Sandy Soil Solidified by Injection of Chemicals

TURNING porous sandy soil into solid rock-like material with the texture of medium hard sandstone is the latest technique by which European chemists are now strengthening subway tunnels, improving hazardous foundations of buildings, plugging leaks in the beds of streams of valuable mineral springs, and restoring underwater dams.

The system, known as the Joosten process of soil solidification, consists of injecting

into the soil two chemical solutions which combine to form a gel-like material. The gel material has a high surface tension and acts to draw the sand particles closely together. Loads of 1100 pounds to the square inch are successfully withstood by the artificially solidified sandy soil.

Applications of the new method are many. The Cathedral Church of Ribe in Jutland rested on closely packed chunks of rock lying on a bed of fine sand. In the course of years and due in part to increasing nearby motor truck traffic, the foundations subsided and cracks appeared in the masonry. Underpinning the walls with girders was deemed inadequate. It was decided to widen the foundation by means of chemical solidification in the underlying sand layer. The operation was so successful that the menace to the cathedral structure no longer exists.

In connection with recent construction on London's subway system the method was also tried successfully. Injection pipes for the chemicals were driven through the planking used to line the finished part of the tunnel. A chemically solidified arch of smooth gravel was formed in the tunnel's roof. When it came time to cut away parts of the roof which projected into the tunnel profile, pneumatic chisels had to be used because of the strength of the material.

The two solidifying chemicals are reported to be silicic acid, which is put into the sandy soil first, and an unnamed salt solution that immediately reacts with the silicic acid to form an insoluble colloidal silicic acid gel. For successful operation, a careful study must be made of the soil type and use confined to sandy layers. The technique will not work for clay or mud.

The process may find usefulness in the movement for improvement of the secondary, "farm-to-market" roads of the United States, officials of the Highway Research Board here indicated when they were told of the German experiments.—Copyright, *Science Service.*

Encourage New Uses for Cotton in Highway Construction

SECRETARY of Agriculture Henry A. Wallace, has approved the use of funds for the purpose of stimulating field tests of new uses of cotton in highway construction. The project provides for the diversion of manufactured cotton fabric for use as a reinforcement membrane in bituminous surface treated highways and for cotton mats for use in curing concrete highways. These materials will be furnished upon request to state highway departments so that they may be tested in widespread use under all climatic conditions. If the results of these tests are as favorable as certain preliminary trials along these lines have indicated, these new fields of use would require large quantities of cotton in the future.

Eggs Stay Fresh if Dipped in Oil

MANY poultrymen beat the heat in summer by dipping eggs in a thin, white mineral oil. This seals the pores of the shell and helps the egg retain its fresh quality.

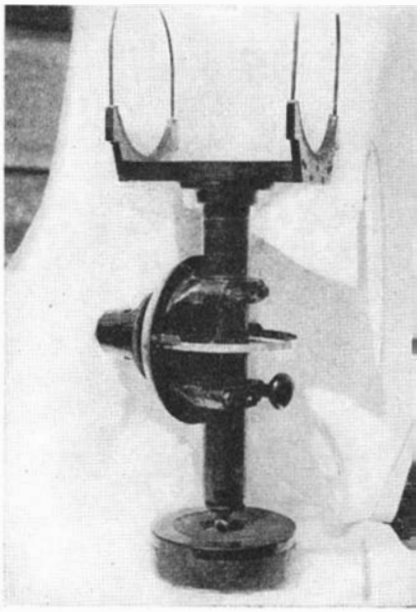
Recent tests by the United States Department of Agriculture show that oiled

(*Please turn to page* 352)

THE AMATEUR TELESCOPE MAKER

Conducted by ALBERT G. INGALLS

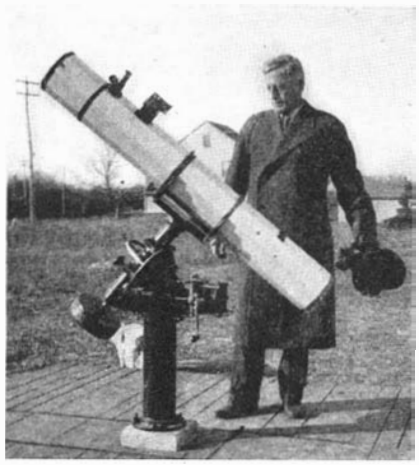
RIGIDITY and then more rigidity in the design of telescope mountings is a quality which Russell W. Porter strongly stresses in the latest (fourth) edition of "Amateur Telescope Making," and your scribe now keeps a weather eye peeled for really rigid mountings having good heavy cross-sections in the right places. A mounting known as the "Hempstead Hydrant," and shown in several accompanying illustrations, makes an excellent impression in this regard, and



The main works of the Hydrant

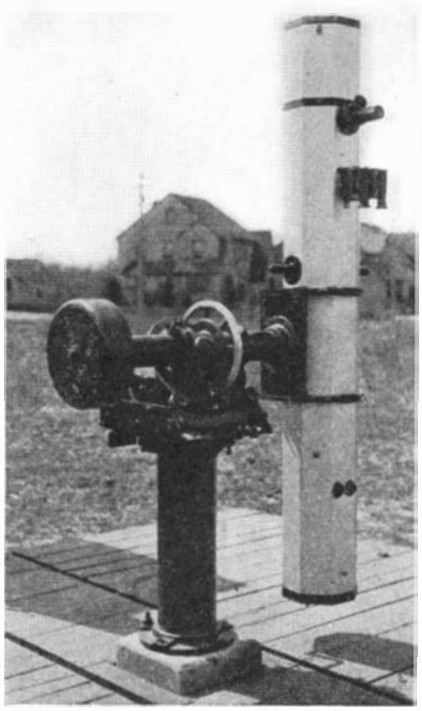
in other ways as well. At the place which Porter calls the "bottleneck" ("A. T. M.," page 130) its declination axis has a diameter of 3". We have asked the maker of this telescope, E. B. McCartney, proprietor of the Long Island Toro Co., golf course and lawn equipment, 76 Roslyn Road., Mineola, N. Y., to describe it, and this is what he writes.

"The mounting is of the Everest 'Town Pump' type, described in Scientific American, May 1935. I saw the 'Town Pump' when it was shown at *Stellafane*, and copied a good many features of it, although mine starts with a rear axle differential carrier for a polar axis. This automobile part is ideal for the purpose, as it has two axes at right angles and the declination axis can be large. Only a few makes of cars have suitable carriers, as most of them have oval or square rims, and some have the pinion shaft out of center with respect to the rim. I wonder that this auto part hasn't cropped up before as a mounting, but I know of only one other—Leuchinger's. [A. R. Leuchinger, Wantagh, N. Y. —*Ed.*] The old Chevrolet carriers are dandies for the purpose and can be had in any auto graveyard. This Chevrolet carrier is riveted to a torque tube, and Porter could make an elegant mounting design by running this tube through bearings in a concrete pier and dispensing with the rollers under the rim. This would make a simple mounting for those who are not equipped to do considerable machine work.



The Hempstead Hydrant with phonograph drive, on 5" pipe pedestal

"The telescope, a 6", has an octagonal tube of wood, $\frac{7}{16}$" thick, which rotates in rings made of brass channels rolled circular. It has a phonograph motor drive [This part will be described in the 'A. T. M. Supplement,'—or 'A. T. M.,' Vol. II, as it may now be called—some time later.—*Ed.*] No vibration from the motor is apparent, even when using a magnification of 425 diameters, and the motor can be wound without disturbing the field of view of a ½" eyepiece. I paid a dollar for the differential carrier and, excepting eyepiece and finder, the whole telescope cost about 25 dollars. In general, the mounting is about the same size as Everest's, with still larger bottleneck. The declination axis could be shortened 2 or 3 inches to make it more compact. The counterweight rod slides into the hollow declination axis."



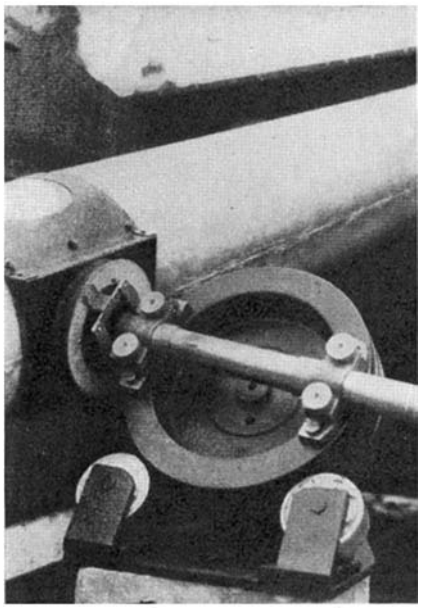
Its maker says the H-H mounting owes tribute to Bell, p. 51, Fig. 35

McCartney concludes, "Yours for bigger and better bottlenecks," and he is right—we are for them. So let's hope that more "Town Pump" and "Hempstead Hydrant" mountings will be created, in the interests of solidity.

While McCartney's bottleneck with 3" diameter, isn't quite so chunky as the real bullneck shown in Porter's drawing in "A. T. M.," few are equipped to go literally quite that far, though it would be desirable. Someone thought Porter's other sketch—the right hand one in Figure 2, page 131, "A. T. M."—was perhaps a caricature and a bit skinnier than any that have actually been made, so we reproduce a photograph of one that is mounted on real "pipe stems" of the kind that Ellison in a letter we published some time ago, called "whippy."

Anonymous. Axes far too "whippy"

ANOTHER solid mounting of the "Town Pump" type is shown on the opposite page. E. R. Richardson, San Gabriel, California, is the maker and the telescope is a 12½" Pyrex (looks as if this one were almost the thirteenth member of the "Twelve Inch Club,"—but it turned up after that page had already been made up). "This mounting is built around a 14", 120-pound fly wheel which I salvaged from the scrap pile of a local foundry," the owner writes. "The axes are from an auto wrecking yard—truck rear axles 2" diameter and of finest steel, and the rollers are truck ball bearings with double rows of balls.

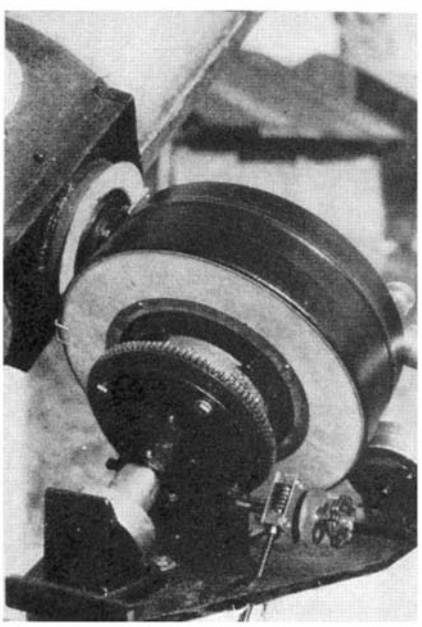


Richardson's massive polar axis

The moving parts weigh over 400 pounds, yet there is very little friction and a 1/25 H.P. synchronous motor drives it."

It begins to look as though Porter's heavy emphasis on mass in the design of telescope mountings were bearing fruit.

In his most recent letter Ellison again reverts to "whippy" mountings—the term, an apt one, was in an earlier letter of his which was published here: "Just a remark on whippy mounts and slide-off observatories. The run-off roof—or run-off shed—is doubtless the easiest to construct. But when you come to work with it, you may well regret that you took the easiest way. The advantages of the revolving roof are that it keeps off (a) wind, and (b) radiation. Even the most rigid mount will vibrate in a breeze, and as for a whippy one, the images execute such a war dance that observation is hopeless. And, if your telescope tube is of sheet metal, as it is three times out of four, you will find the images play the most extraordinary pranks. Often they are like hairy caterpillars. On a clear night, especially if windless, the upper side of



Richardson's mounting, from north

the tube gets cooled by radiation, probably several degrees below the lower, and the upper half of the mirror gets cooled below the lower half. Well, anyone who knows mirrors and their little ways can tell you what that will mean. The remedy is either a wooden tube, or a roof over the instrument. No amount of swathing in felt and so on, will mend matters."

From this subject Ellison shifts to bees-

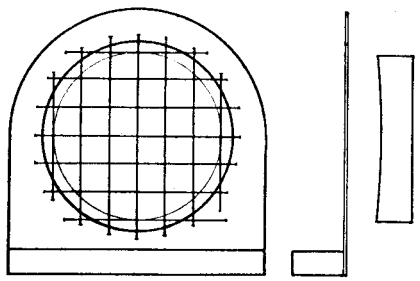


FIG. 1
The Sholes grid for locating 'em

wax, and gives us the history of its recommendation in his treatise in "A.T.M.," along with the "Swedish pitch" ("A.T.M.," p. 75) which no Yankee has ever been able to find; telling how, in his own mirror making, the two of them have now given way to coal tar pitch, as is also happening in the U. S. A.

"About that coal tar pitch. The whole trouble began with the old masters of the art in the seventies and eighties of the last century. These old fellows, like all their Victorian generation, were saturated in pedantry, and gave whole pages of directions which I gradually found to be so much 'bunkum,' and scrapped bit by bit. One of these directions was that the pitch must be only the best, and the best meant Swedish pitch. Now Swedish pitch is vile stuff, is full of dirt, and has to be strained; also is desperately sticky. It was in trying to devise some way of mitigating its stickiness that I adopted the plan of mixing in a percentage of beeswax.

"But one time I was in a benighted place where Swedish pitch could not be obtained, and had to put up with what I could get, which was coal tar pitch. And, to my surprise, the stuff figured far better and more certainly than the Swedish. I sometimes mix resin with it. That is good stuff too, but needs a lot of softening with turps."

Ellison then comments on the HCF lap: "I gave the HCF dodge a good try-out, and I find as Everest does. It is unnecessarily complicated for figuring, but for quick polishing it is the goods. I merely pour the hot pitch on the glass tool as usual, but immediately lay a sheet of HCF on it, and press the mirror on, previously covered with a paint of rouge and water. [See A.T.M., p. 367.—*Ed.*] The heat of the pitch softens the HCF, and it takes the curve very completely. The sheet of HCF need not be the full size of the tool, as it flows under pressure, and spreads to 25 percent or more wider than it was. After this I cut out facets just as usual, only the HCF plus pitch is far easier to cut than plain pitch. This too is fine for polishing. When it comes to parabolizing I make an ordinary tool of the coal-tar stuff."

Never having observed HCF flow or spread under pressure Ellison's mention of a 25 percent spread causes one to wonder whether Irish HCF and the Yank variety are quite the same thing. They might differ.

Ellison next comments on the rubber "Door Mat" for tired lap makers: "The very latest stunt seems to be casting the tool by means of a rubber honeycomb mat made expressly for the purpose. I have no doubt that it will work; also that it will be a godsend to many. But I can tell you a story of the same idea, which I tried out in 1890, in collaboration with a friend and former pupil, Dr. Nathaniel H. Alcock; one time Professor of Physiology in McGill University, Montreal. We made a sort of honeycomb mould by cutting out 1″ squares in a sheet of plywood. The cutting was done with a fret saw, and the thing when finished was just like the rubber mold, except that it was not pliable. The squares were smoothed with a sharp knife to an angle of 45° inside, and the whole thing dipped in water, and laid on a wet surface. The pitch was ladled into the squares with a teaspoon, and when hard was pushed out, and each facet cemented to the face of the glass tool by holding the back of the pitch square to a flame for an instant. When all the squares were in place, the tool was held in a basin of hot water till soft, and the facets moulded into contact, by pressing the mirror on in the usual way. The method had the advantage that, if any facet were damaged or detached, it was easy to make and attach a new one. I soon got tired of the tedious job, and found my own way did all that was required, and did it in far shorter time."

This resembles the method described a little later by Ritchey. Everest no longer spoons the pitch into the "Door Mat," but pours a regulation lap and then pushes the "Door Mat" down into it by means of the mirror, using plenty of warm soap-suds.

MAKING his own drawings, which are reproduced here, Raymond A. Sholes, 10004 Regent St., Los Angeles, California, describes a bit of his technique, as follows:

"In the February number, Nicholas M. Smith's method of testing was described; also Ellsworth L. Martinelli's technique for using HCF. The success of both depends upon knowing the diameter, or radius of zones, which must be measured while the eye is at the knife-edge. Both Everest's and Mason's methods of measuring are O.K., but I hit upon the idea shown in Figure 1

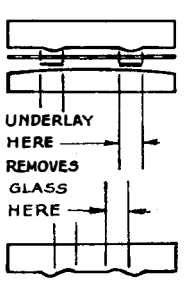


FIG. 2

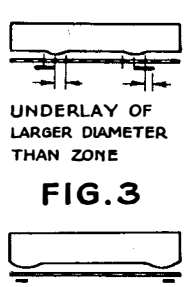


FIG. 3

FIG. 4

Details of the Sholes technique

of the accompanying drawing, which has the advantage that it allows the operator to view the whole mirror and yet measure any zone as accurately as is necessary.

"A piece of stiff cardboard was marked off in 1″ squares, and a hole cut in it, somewhat larger than the mirror, the center of the hole being located where two of the lines cross. Silk threads were strung across the opening both ways, located on the pen-

cil marks. The card was tacked to a block of wood and stood in front of the mirror, as shown, while testing. It must be so located that the center cross is directly in line with the center of the mirror. The threads make black lines where the mirror is light, and bright lines over the dark areas. These do not interfere with viewing the shadows as shadows, but are always there to refer to when wanted.

"The crests can be measured and checked both on the vertical centerline where the shadows reverse and on the horizontal centerline where one would normally place a mask. Checking one against the other leads to greater accuracy. For a large mirror, the cardboard would have to be replaced by a piece of plywood or a wooden frame.

"While using underlays and HCF, as described by Mr. Martinelli, my experience was that the work done on the glass is always a little toward the center from the underlay. A typical set-up is shown in the upper part of Figure 2. The lower part shows the result—a depressed zone just inside the raised zone that was being attacked. I found that, if the inner diameter of the underlay is made the same as the highest part of the zone, and the outer diameter a little larger than the zone diameter, as shown in Figure 3, there was no tendency to create new zones. Even when a raised zone was near the edge, the underlay, as shown in Figure 4, brought it down—believe it or not—without causing a turned down edge."

STELLAFANE convention this year, Saturday, August 8. Porter probably coming.

WE learn that the 41¾" x 6½" Saint-Gobain low-expansion glass flat, also the machine, with which Ritchey made the 40" Ritchey-Chrètien a year or so ago, are lying idle in Washington. If some amateur club would pick up these items an interesting club project of some sort might be worked out.

IF you feel you need more materials, in order to swing the telescope making hobby, listen to this, from Bre'r Fred Ferson of Biloxi, Mississippi—just one of us TNs. "I am going to start the Ferson Plan for the redistribution of telescope materials, and call it 'The Share the Wealth of Telescope Materials'. Every man who joins, by paying Ingalls and Ferson six bits, might receive one brick building, 20' x 100' with tower and dome, one large and one small lathe, a milling machine, drill press, shaper, planer, a forge, optical spindle, grinding machine and motor, and small tools and sundries too numerous to mention. Also one Pyrex disk, and tool per month—prism blanks, rouge, pitch and 'Door Mat'. Last but not least, $200 per month per TN."

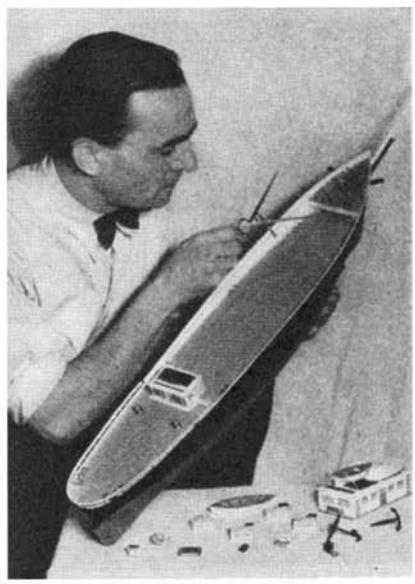
To this great plan for spending our way into vast wealth Ingalls adds a compromise arrangement by which the work is to be divided between Ferson and himself. Ferson is to provide the materials and Ingalls will get the six bit dues. All of the benefactors must agree to drop and break the mirrors before the last day of each month, thus adding to the wealth of the community by making the remainder of its members work that much harder, as well as "putting money into circulation." Local organizers' salaries will be limited to nominal sums—say $12,000.

CAMERA ANGLES

Conducted by JACOB DESCHIN

Hobby Photography

ALMOST any hobby can be doubled in interest if seen through photographic eyes, even though photography itself be your particular avocation. Whether you lean toward stamp or coin collecting, woodworking or model boat building, or some such activity as fishing or hunting or "collecting" bird and animal tracks, you will find camera opportunities galore. The objective attitude which you will assume in photographing the various phases of your hobby will develop a sort of romantic feeling about the hobby that will do wonders in helping you over



The Model Builder

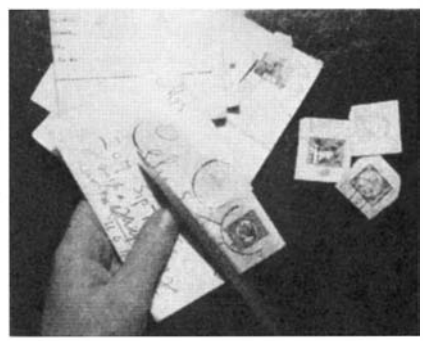
some of the obstacles which now and then you meet in trying to work out some particularly tough problem.

Generally speaking, a camera equipped for ground glass focusing is best for hobby photography, although any camera can be made to do for most of the pictures you will want to make. On a ground glass one can compose carefully, focus accurately in order to get sharpness over the entire area or to limit definition to the subject matter alone, which in certain instances, as when it is desired to subordinate the background, is a considerable advantage from the pictorial point of view. A tripod or other firm support is necessary for almost all ground glass work. Filters will also be required in certain instances where contrast cannot otherwise be achieved.

Hobby pictures may be divided into two categories—the record type and the pictorial. One of the chief uses for the former would be for chronicling the step-by-step history of a particular project, the story of a fishing trip, pictures of specimens for the collector of eggs, stamps, or whatnot. In this connection, the collector can use photography to obtain pictures of objects he does not possess and for one reason and another, usually financial, he cannot afford to purchase. Thus, he can take a picture of some desired object that catches his attention in a store window or in the collection of a fellow-hobbyist. The result is not the same as actually owning the item himself, but is certainly a good second-best.

The pictorial phase of hobby photography would include shots having an atmospheric quality about them. Some record pictures lend themselves to this treatment, but usually it will involve a special arrangement of subject-matter to achieve a generalized impression of certain phases of your hobby or something epitomizing the hobby as a whole. Such a picture can be enlarged and displayed in some appropriate manner in one's den or in some other part of the home.

Composition is important whether the picture is a record or imaginative impression. There is no reason why a record picture, merely because it is utilitarian, should not be as well arranged as an artistic one. An attractive and careful disposition of the various components of the picture will make each photograph not only pleasant to look



Stamps

at but in many instances will give a better idea of the subject-matter photographed.

Hobby photography will sometimes involve having someone's hands in the picture and this can, of course, best be done by having a friend release the shutter while your hands are busily engaged within the picture area—or the other way about. When you are alone, as will probably be the case in many instances, a delayed exposure device, which may be attached to any camera having a cable release, can be relied upon to do about the same service. While this is not feasible with the fishing hobby, for ex-

ample, your companion, if he is not too absorbed himself and if he also be of a photographic turn of mind, can be pressed into service. In this field, incidentally, some interesting pictorial shots can be made of the fishing paraphernalia, your companion silhouetted against a lowering sky, or the boat on the shore when the light is particularly attractive.

A pictorial diary or album can be made of the record type of pictures that can be used for reference or display to friends. Individual pictures may be filed in a box reserved for the purpose and properly indexed so as to be easily accessible when needed.

Picture your hobby. In time you will find the results invaluable not only to yourself but to other hobbyists as well.

Photographic Nightmare

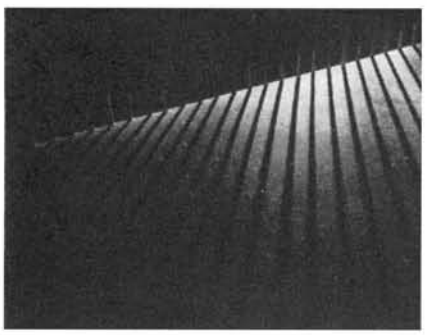
ORDINARILY, a cigarette is a fairly harmless creature. It has elegance, a certain beauty and grace, is pleasant to handle, and comes as something of a benefactor in times of stress. All these things the writer appreciates and when recently the assignment was handed him to do the apparently simple thing of photographing a row of cigarettes to fit in with a certain definite layout, he fairly beamed. Agreeable jobs like this came one's way very seldom, he thought.

The specifications were that the cigarettes had to stand on end, that they were to be varied in type, cork-tipped and plain, round and flat, that shadows were to be long and clearly defined in the photograph and that the cigarette in the immediate foreground was to be taller, much taller, than the last one at the extreme end. Also, the background had to be plain and unobtrusive and the general quality of the finished product was to be pictorial.

Next to the purchase of the required cigarettes, the easiest part of the undertaking was to stand the cigarettes on end. This was accomplished by pushing thumb tacks into a card at a uniform distance apart and placing a cigarette on each point. So far, so good. From then on the troubles never ceased. For the shadows a spotlight was obviously needed. When general lighting also was introduced in order to show up the front part of the cigarettes more clearly, the shadows seemed to suffer somewhat and more detail got into the picture than was wanted. Also, something had to be done about the background, and it seemed that the only way to get an even tone was to shoot down for an angle picture. But this would not do. The horizontal arrangement that was wanted was not to be had in this way, even though the first cigarettes did look larger than the ones farthest from the camera.

An arrangement of 40 cigarettes was tried first but without success, then 70 and still no luck. Laboring under the strange notion that the solution lay in numbers, the writer drafted 50 more and lined up his 120 "men" for the final dash to a victory that, alas, still proved elusive.

The evening ran on and crept into the morning, when the idea occurred to the harassed photographer that perhaps, after all, he had too many cigarettes, too much light, too much of an angle, too much cardboard—in short, too much of everything. So down came the surpluses, one after another. The 120 cigarettes were reduced to 24 in a single row, the general light was shut off, leaving only the spotlight, the angle was eliminated and foreshortening resorted to by having the camera lens on a dead level with the cigarettes, giving a giant of a cigarette in the immediate foreground and a third this size to the last cigarette. The cigarettes were arranged in a row along an edge of the cardboard by the thumb-tack procedure, the spotlight lowered to give a long shadow almost twice the length of each cigarette and the cardboard so adjusted that a black curtain served as a background.



Cigarettes and Shadows

The result, which finally gave satisfaction all around, was a row of cigarettes against a void, giving, with the long shadows cast by the cigarettes, a rectangular composition.

The aftermath, for the photographer, was the photographic nightmare impression shown in the illustration.

(The final satisfactory cigarette picture appears on page 310 of this issue.—*Editor.*)

Camera Hunting in the U.S.S.R.

MISS CELIA SPALTER, a recently returned traveler from Soviet Russia, contributes to this month's department a brief summary of her photographic experiences in that country during the course of a three months' visit. She writes as follows:

"After a week or so of futile endeavor, photographically speaking, due to the countless warnings about what not to photograph and what happens to your camera if you do, I discovered that no one really knew what you could or could not photograph. Questioning invariably elicited such informative replies as 'I don't know'—'You had better ask the Director'—and so on. One answer, however, I could always count on, whether I was inquiring about taking pictures in

schools, theaters, or nurseries, was: 'You can't photograph the Kremlin or the Red Square.'

"Once I had overcome my fear of taking pictures, I found the camera an indispensable ally whenever in search not only of pictures but of adventure; for no sooner would I aim at my subject when some social-minded citizen would inquire why I was taking pictures—or some camera-minded citizen would inquire about the make and cost of the camera. In either case, the result was identical—an avalanche of questions from an ever-increasing group of curious citizens, eager to learn about America and what America thinks about them, until the snapping of pictures had developed into a sort of informal discussion meeting."

Empty Boxes

IN the course of the camera hobbyist's activities he empties quite a number of paper and tin containers and, seemingly having no further use for them, throws them away. A little thought and ingenuity will discover many uses for some of these containers. Cut film boxes and the black paper which separates the individual films may be used for storing exposed films when it is desired to reload film holders before developing the exposed films. Larger boxes may be used for storing black paper, pieces of cardboard, string, and so on—those odds and ends for which a use may be found on certain occasions, such as for masking negatives, for making test strips in printing and enlarging, and so forth. Boxes also come in handy for holding a batch of negatives which have been selected for an evening's printing, the box itself being used to hold the batch and the cover for placing the negatives when you are finished with them. One man uses the round paper container which once held a pound of hypo crystals as a measure for dealing out the "loose" crystals which he now purchases in bulk of five pounds or more—at half the cost per pound of the pound box. Thus tins and bottles which formerly held chemicals may be used over again for another purpose if we take the precaution of storing them away to await the moment when they become the solution to some disconcerting darkroom storage or other utilitarian problem of the photographer.

"Shooting" Sports

TAKE your camera to the game the next time you go and try shooting action. Understanding the game as you do—or you wouldn't be there—you will watch for significant situations, spectacular plays, and other telling incidents that occur during the course of the game's progress. And at the finish you will, if you have been industrious and agile—as well as fairly accurate as to exposure—come away with a batch of potential pictures that will vividly recall the game to you long after the action itself is over.

Generally, a lens of longer than ordinary focal length, though not necessarily a full telephoto, is needed for the majority of games, particularly those that are played outdoors. Indoors, with such games as basketball, bowling, badminton, and billiards, the lens of normal focal length will be adequate if the worker can find a place

to sit or stand that is near enough to the action to fill or almost fill the size film being used.

While any camera can be used in sports photography, only the type cameras equipped with focal plane shutters permitting speeds of 1/500th and 1/1000th of a second should be used when very fast action outdoors is to be recorded. If the fastest speed of which your shutter is capable is only 1/100th or 1/200th of a second you will do best to leave such subjects alone and thus avoid the darkroom disappointment that is sure to follow an attempt to stop 1/500th of a second action with a 1/100th of a second shutter speed. However, with some practice these relatively slower shutters can be made to stop moderately fast action if the two following precautions are taken: Shoot the action when it is diagonally opposite the camera, moving toward it or away from it—never when it is moving directly parallel to the lens. The other point applies to such sports as vaulting and similar activities involving a leap into the air. In such games the athlete comes to a momentary "dead stop" at the peak of his leap just before he descends. If you learn to make the exposure just as he reaches this peak, even a 1/100th of a second will stop him. But it will take some practice.

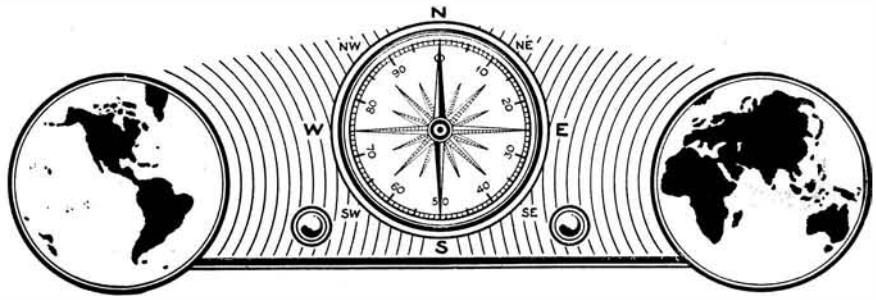
The fastest film available, the so-called supersensitive panchromatic, should be used for fast shooting. The camera should be of a type to permit quick changing of film so as to prevent missing "prize" shots, and for indoor sports it should be able to accommodate some photoflash synchronizing device, a number of which are now available.

Altogether, sports photography is exciting and profitable, but one must be properly equipped and learn to "size up" pictures quickly if success is to be gained.

VIEWING NEGATIVES

THE "printability" of a negative cannot be judged intelligently by holding it up to a naked light bulb. Besides being a strain on the eyes, the strong light has a tendency to wash out details and in general to kill tonal gradations, giving the impression that the negative will not print or enlarge acceptably. This is particularly true, of course, in the case of thin negatives. Now, we all know that a reasonably thin negative will make a better enlargement than a very dense one. There will be better tones in the enlargement, details will be clear and the printing time will be shorter, the latter a feature particularly desirable when enlarging on chloride or chloro-bromide papers. The best way to view a negative, therefore, is to interpose a sheet of white paper between the light and the negative, each of the three units—the light, the paper, and the negative—at a slight distance from the other. A better interposing medium is a frosted or ground glass. The regular printing box used for contact work is ideal for this purpose.

Incidentally, the miniature camera user, impatient to see his results, in the positive, has learned that when using the paraphenylene-diamine types of fine-grain developers he is able to view the film as a positive by holding the dried negative under the light against a dark background. A little experimental tilting this way and that will give the correct angle at which to hold the negative.



WORLD-WIDE RADIO

Conducted by M. L. MUHLEMAN*

Resonance Indicator

IT is extremely difficult to tune a highly selective receiver to exact resonance with a signal without some means of visual indication. Many receivers are equipped with tuning meters or "electron eyes" just for this purpose. A self-contained resonance indicator, made available by the Technical Appliance Corporation, may be easily connected to the average broadcast or all-wave receiver not equipped with a tuning indicator.

A self-powered resonance indicator for broadcast or all-wave receivers

The unit employs two 6H6 metal tubes in conjunction with a 6E5 electron-eye tube. One 6H6 is used in a voltage-doubling circuit to supply the necessary plate power for the 6E5. The other 6H6 operates as a linear diode detector, the rectified signal of which is amplified by the triode section of the 6E5 and applied to the electron-eye section of the same tube. Since the unit is completely self-powered, it does not place any drain on the receiver with which it is used.

Aside from indicating when the receiver is tuned to exact resonance with a desired signal, the resonance indicator will also show the presence of weak station carriers which ordinarily might not be heard. It is therefore of distinct assistance in tracking down weak DX stations.

The resonance indicator may also be used for aligning the r-f and i-f amplifier stages in a receiver, and as an output meter. It may also be employed for all-around servicing work on radio sets.

Radio's Political Aspect

RADIO engineers have unwittingly competed with the governmental agencies in thinking up new alphabetical combinations to characterize functions. The AAA's and the CCC's have much the same ring as many of the radio engineering abbreviations. Since some of these abbreviations are as confusing to the layman as are many of the New Deal appellations, it might be well to provide actual definitions. They are as follows:

ABC	Automatic Bass Compensation
AFC	Automatic Frequency Control
AGC	Automatic Gain Control
ASC	Automatic Selectivity Control
ATC	Automatic Tone Control
AVC	Automatic Volume Control
QAVC	Quiet Automatic Volume Control

The abbreviations AGC and AVC actually refer to the same function—gain or amplification—meaning much the same thing as volume.

Frequency Drift

PRECISE adjustments are required in a broadcast or all-wave receiver if all tuned circuits are to be in exact resonance or alignment. Heat alone can affect such adjustments and as a result, most receivers are aligned at the factory while they are in operation or "warm."

It is obvious, then, that when a receiver is first turned on it is out of alignment by an amount equal to the contraction of the metal in coils and condensers. The receiver is not "tuned up," in the same sense that an automobile engine is not "tuned up," until the correct operating temperature is reached. Therefore, during the first ten minutes or so signals to which the receiver is tuned may appear to drift or distort slightly.

If frequency drift or distortion is still apparent after the receiver has reached operating temperature, the difficulty is more than likely due to a change in frequency of the converter oscillator. It is not often that frequency drift can be attributed to the station to which the receiver is tuned as most modern transmitters are crystal controlled and the frequency is maintained at a high degree of accuracy.

Where to Listen

WITH the arrival of Spring, the wavelength bands below 30 meters are providing listeners with many new DX catches. The 25-meter short-wave broadcast band is particularly good now, while the 20-meter amateur band is active until midnight and after. Many of the English amateur 'phone stations can be picked up as late as 8 o'clock in the evening.

The 10-meter amateur band is "open" until early in the evening, and is practically

*Editor *All-Wave Radio*

free from station interference. This is a "super-distance" band and is crammed full of surprises. However, very careful tuning is required. If the vernier knob is not turned slowly, most of the stations will be passed by.

The new *Detroit News* short-wave station, W8XWJ, is just a ways off the high-frequency end of the 10-meter amateur band. It will be found at 31,000 kc (31 mc), but because of the skip distance, can be heard only in certain localities. This station is on in the early evening.

Many interesting conversations can be heard over station WOU, owned by the New England Telephone Company, and used for communication with fishing vessels. The station operates on a wavelength of 119.6 meters or 2506 kc.

Many short-wave listeners have enrolled as active students in a course on modern radio which is being broadcast over station W1XAL, Boston, on a wavelength of 49.6 meters or 6.4 megacycles, by the Massachusetts State Department of Education. This continuous course includes a series of lectures, now going on, by Mr. C. D. Belcher, radio engineer and formerly radio inspector with the United States Department of Commerce. These lectures are given on Mondays from 7 to 8 P.M., E.S.T.

The German short-wave station DJD is back on the air on 25.49 meters or 11.7 megacycles. Particularly good reception should be had from this station during the warm weather.

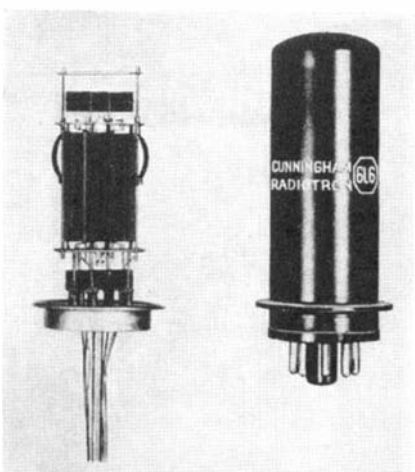
Beam Power Amplifier Tube

IT is a known fact that true reproduction of orchestral renditions through the medium of a radio receiver cannot be realized unless the output amplifier has sufficient power-handling ability to take care of the wide excursions in volume of the average musical selection. Reserve power is required to handle volume peaks without introducing distortion.

With the introduction of volume expansion in radio receivers [See page 223, April 1936.—*Ed.*], a demand has arisen for a tube having far greater power-handling ability than previous types of home-receiver output tubes. The requirements of a receiver having the volume-expansion feature are far more rigid than the requirements of the average receiver; to be truly effective, output powers in the vicinity of 20 watts and more are necessary in this particular type of work.

RCA has announced a new all-metal tube, known as the 6L6, that meets these requirements. This new power pentode has a number of distinctive features made possible by the application of new design principles involving the use of directed electron beams. The beams of high electron density are produced by constraining the electrons with potential fields set up by the tube electrodes arranged to give the desired effects in the assembled tube.

Because of the new design, this unique tube has extremely high power-handling ability, high efficiency, and high power sensitivity. With comparatively low driving power, a single tube, operated as a Class A amplifier, can supply an output of 11.5 watts to a loudspeaker. Two of the tubes operated as Class A push-pull amplifiers are capable of a maximum output of 14.5 watts. When used under Class AB conditions, a pair of the tubes in push-pull can supply as much as 40 to 60 watts output!



The 6L6 beam power amplifier

Tuning Indicators

AN electron-ray tuning indicator can be added to any type of broadcast or all-wave receiver equipped with automatic volume control, by the use of a special adapter placed on the market by a number of manufacturers. The installation is not at all difficult.

A tuning indicator has two advantages: First, it will show when the receiver is tuned to exact resonance with the desired signal, thus insuring the listener against distorted reception; second, the indicator permits "silent tuning" from station to station. Since the electron ray immediately indicates the presence of all but the weakest station carriers, one may tune with the volume control turned to its minimum volume position.

German Television Cable

SIEMENS and Halske coaxial cable, constructed with a newly invented insulation called "styroflex," has been placed in use for the piping of television impulses. The cable is constructed of an inner copper wire of 5 millimeters diameter following the longitudinal axis of the cable. This wire is kept in place by a "styroflex" spiral. Around both is a foil, then a linen sleeve, and finally a lead jacket. How "styroflex" is made is not definitely known. It is transparent, flexible, and as thin as paper, and is said to be highly efficient when applied to this particular purpose.

The coaxial cable will handle 4000 kilocycles, now occupied as follows: one hundred talking bands, up to 1000 kilocycles, and a television band from 1000 to 1500 kilocycles, now used to produce a 40,000 point picture, or the equivalent of 180 lines, 25 changes per second.

Authorities claim that this cable will later be used for a television band of 2000 to 4000 kilocycles, 380 to 400 lines, 25 changes per second.

Siemens and Halske also have a new cable called *symmetrische* which they claim is as good as or better than, but different from the coaxial cable, in that the "styroflex" makes possible two longitudinal wires in the core, one of which is used to handle the return circuit instead of the usual spiral-wound copper sleeve.

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 341)

eggs also stay fresh much better in cold storage than unoiled eggs. In an eight-month storage test the original grade was retained by 65.8 percent of the eggs oiled at a temperature of 60 degrees Fahrenheit, by 55 percent oiled at 80 degrees, but by only 32.5 percent unoiled.

Eggs given an oil and vacuum carbon dioxide treatment retained 88 percent of their original grade at the end of the storage test. This method, developed by T. L. Swenson of the Bureau of Chemistry and Soils, was 35 percent more efficient than plain oiling, and 173 percent more efficient than storage with no oil treatment.

In the vacuum process eggs are dipped in oil in an air-tight chamber. Enough air is pumped out to create a partial vacuum. Some air also escapes from the eggs. When carbon dioxide is turned into the chamber the eggs draw enough oil into the pores of the shell to form a complete seal. Carbon dioxide has a stabilizing effect on the egg white. If air is used eggs do not retain their freshness.

Tractor Smashes 23 Tons of Worthless Old Drugs

ELEVEN truck loads of old drugs and patent medicines weighing more than 23 tons were recently hauled to the city dumping ground at Dallas, Texas. There a 10-ton tractor ran over them until all were destroyed.

This was the largest quantity of such products ever destroyed by Texas food-and-drug officials, who are co-operating with the Federal Food and Drug Administration in trying to stop the activities of unscrupulous salvage drug dealers. It included drugs and medicines bearing Spanish-American war tax stamps. Some were made in Indian Territory before Oklahoma was admitted as a state in 1907. Labels on bottles of "Scientific Electric Fluid" guaranteed this product to cure 37 different diseases. "Recommended for all the chief ailments known to the human system" was printed on packages containing Dr. Gary's vegetable ointment.

Although better-class druggists keep old products from their shelves, the salvage drug business became unusually active last year in Texas and other southern states. Much of the old material picked up at auctions of bankrupt, fire-damaged, or distressed stocks found its way into interstate commerce. Co-operation of state authorities with the Federal Food and Drug Administration has made it possible to confiscate and destroy large quantities of these worthless drugs.

Microscopic Chemistry

IT is frequently necessary in medicine and biology to perform an analysis where no more than a few drops of secretion or a microscopic fragment of tissue are available. In such cases the usual methods of chemical analysis are of little avail, and the technique of microchemistry was born of this necessity. Old style test tubes, beakers, and flasks have been discarded for new equipment which is more nearly comparable in size with the samples of material analyzed. Beakers of 100 and 300 cubic-centimeter capacities are replaced with micro-beakers the size of a thimble. Test tubes as small as 1/50 of an inch in diameter find use in the more exacting investigations. The conventional measuring graduate is replaced with an accurately calibrated glass tube 4/1000 of an inch in diameter. A special micro burner, which gives a blue flame two or three millimeters in height, is used in working with these small capillary tubes. Small platinum crucibles, beakers, flasks, graduates, and hair-like platinum wire—every piece of equipment is at least as tiny as the kitchen furnishings of a small child's doll house.

Problems of industry which were previously practically impossible of solution are now being solved with accuracy. An unimposing streak, a tiny flake of rust, and the microchemist turns detective to ferret out some industrial crime that otherwise would have gone unsuspected. One example, that of a broken wire in a resistance unit in a steel plant, is described by E. G. Van-Brunt of the General Electric Co. At first the wire was suspected of being defective, but subsequent analysis of minute particles near the break showed the presence of sulfate. The trail finally led to a nearby blast furnace which admittedly gave off sulfurous fumes, thereby clearing the wire of blame.

The serious scaling of certain chromium-alloy heating units on test at red heat was traced, through the aid of microchemistry, to improper rinsing of the lubricant in the original manufacture. Traces of sodium, an extremely destructive agent when heated with chromium-alloy materials in air, were found in the surface of the heating units. It was finally learned that the lubricant used contained a form of combined sodium which had broken down chemically to form a powerful alkali when the units were rinsed to clean them. The trouble was remedied by a change of lubricant—a cause of difficulty that might not have been discovered without micro-chemistry.—*A. E. B.*

SHOES

THE use of a new cellulose cement is revolutionizing shoe manufacture. One half of the production of women's street and dress shoes, and a growing percentage of men's shoes, are neither sewed, nailed, nor pegged; the soles are cemented to the uppers.

Nervous Breakdown Termed State of Mind

SICKNESS in which the patient's mind and nerves are upset—a nervous breakdown, for example—is not an ailing condition like typhoid fever or tuberculosis but a state of mind, Dr. Louis Casamajor of New York City recently told members of the American College of Physicians.

Typhoid fever is something which has happened inside the patient's body. Nervous and emotional sickness, on the other hand, is something "which has happened to the relationship of the patient to the world in which he has to live," Dr. Casamajor explained. The patient suffering from such

nervous sickness is up against a situation or influence in his life which he cannot take in his stride. So he becomes ill just as he would if a disease "germ" got him down.

The conflict between his instinctive urge for security or satisfaction of personal wants and the demands of civilized society makes him sick. Some of the factors which may cause this kind of sickness are the stress of war, of modern business competition, of deciding whether to return to work after industrial injury or to stay home indefinitely on compensation, Dr. Casamajor said.

Another theory of the causes of such nervous sickness is that the patient is oversensitive to either emotion or physical sensation such as pain. This view was presented by Drs. Austen Fox Riggs and Horace K. Richardson of Stockbridge, Massachusetts. In treating such patients, these doctors try first to make the patient understand the cause of his nervous ailment—psycho-neurosis is the technical term—and then to help him use this understanding of himself in learning how to live more efficiently.—*Science Service.*

Dehydration of Turpentine

When the oleoresinous exudates of various species of pines are steam distilled, the condensed distillate consists of spirits of turpentine and water. Turpentine is lighter than water and, generally speaking, immiscible with it. The two portions of the distillate are separated by gravity, the water being removed from the bottom and the turpentine from the upper part of the receiving vessel or separator. This separation is often incomplete, a fraction of 1 percent of water remaining emulsified with the turpentine which will also contain a few thousandths of 1 percent of water dissolved in it, warm turpentine holding more water in solution than cold turpentine. A warm turpentine saturated with water will, when cooled sufficiently, become turbid and free water will separate. Furthermore, droplets of water are carried over with the turpentine and as a result turpentine as sold on the primary markets and in bulk usually contains small quantities of water. The presence of water in turpentine, especially separated or free water, is very objectionable. Free water dissolves the glue coating of turpentine barrels and causes leaking, and badly corrodes iron containers and discolors the turpentine. Dissolved water alone will slowly cause rusting of iron and discoloration of turpentine.

A number of substances are known which will remove water from or dehydrate certain other substances. The substance suitable for dehydrating turpentine must be cheap, effective, and one which will not contaminate or react with turpentine. It has been found that sodium chloride, possibly the cheapest of the dehydrating agents, does not contaminate or react with turpentine and when used in a properly designed apparatus removes from freshly separated turpentine all the free or suspended water and a sufficient quantity of the dissolved water to permit the turpentine to be cooled to 10 degrees, Fahrenheit, without separation of the trace of water remaining.

Although the dehydration is not perfect, it has been found that the turpentine which has been run slowly through the dehydrator no longer dissolves the glue or glued barrels and that turpentine can be shipped and stored in barrels, black iron, and galvanized drums much longer without leaking, discoloring, or becoming turbid, provided, of course, the barrel or drum is well glued, clean, and free from rust or loose zinc oxide when filled.

CURRENT BULLETIN BRIEFS

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

Research—An Eye to the Future is a thoroughly illustrated little pamphlet telling in picture and text how systematized research has made possible the motor car of today. *Write for Bulletin 636A to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

The College Man Weighs the Law is a short résumé of the various types of legal work which may be taken up by the college graduate. It is an endeavor to focus the attention of the various aspects of the profession and to serve as a general guide. Volume IV, Number 23, Northwestern University Information. *Northwestern University School of Law, McKinlock Campus, Chicago, Illinois.—Gratis.*

A Review of Railway Operations in 1935, by Julius H. Parmelee, gives facts and figures in tabular and graph form. *Bureau of Railway Economics of the Association of American Railroads, Washington, D. C.—Gratis.*

In the New Era of Motion Picture Entertainment is the annual report to the Motion Picture Producers and Distributors of America, Inc., by Will H. Hays, President. It surveys the pictures produced during the preceding 12 months, and indicates the progress and trends of the motion picture industry in general. *Motion Picture Producers and Distributors of America, Inc., 28 West 44th Street, New York City.—Gratis.*

Silent Motion Picture Films. This is a catalog of 16 mm. films, including dramas, comedies, cartoons, sports, travel, religion, education, and so on. It includes an application blank for membership in a film rental library. *Write for Bulletin 636C to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

If I Only Had That Book is the title of a technical book catalog listing over 1300 domestic and foreign books of all publishers. *Write for Bulletin 636B to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

Studies in Tree-Growth by the Dendrographic Method, by D. T. MacDougal. By means of apparatus which automatically draws graphs of wood growth, the author,

who is a noted plant biologist on the staff of the Carnegie Institution, reveals the continuous variations in the amount and quality of mature wood laid down in tree-trunks, and describes his basic researches. *Carnegie Institution of Washington, Washington, D. C.—Gratis.*

A STATEMENT in opposition to the establishment of a municipal power and light plant in New York City and to the creation of municipal power authorities should be of interest to those who are concerned with public utilities in any municipality. *Publicity Bureau, The Merchants' Association of New York, Woolworth Building, New York City.—Gratis.*

TEACHERS MANUAL FOR SCIENCE IN THE WORLD OF WORK, Volumes I and II, by Frank R. Deming and Joseph T. Nerden, is a summary of the methods of class room procedure which have been recommended for class room instructors in the Connecticut vocational schools, using the project method. *McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York City.—25 cents.*

AIR CONDITIONING, VENTILATION AND DUST COLLECTING is a compilation of selected special articles and pamphlets covering these three subjects, as well as the fire hazards in connection with them. This well illustrated booklet has been prepared to give insurance field forces and underwriters the information in a compact and convenient form. *Write for Bulletin 636D to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

DUST EXPLOSIONS DURING FIRE FIGHTING, Circular No. 385, U. S. Department of Agriculture, deals with the extent of dust explosion hazards, the causes of such explosions, and procedure recommended for combating them. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

EXPORTERS HANDBOOKS tell in detail how shipments of goods for export to Europe, Cuba, and Canada, should be handled in order to eliminate delays and unanticipated charges in passing through customs. "Preparing Shipments to Europe," Trade Promotion Series No. 158, 15 cents; "Preparing Shipments to Canada," Trade Promotion Series No. 91, 10 cents; "Preparing Shipments to Cuba," Trade Promotion Series No. 163, 10 cents. *Superintendent of Documents, Washington, D. C. (Coins only.)*

CHICAGO GRINDING WHEELS lists dozens of different types of grinding wheels for various purposes, and presents line drawings showing various special shapes that are available. Prices are given. *Write for Bulletin 636E to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

THE FUTURE OF ENGINEERING EDUCATION, by William Otis Hotchkiss, outlines the development of engineering education and from this background indicates the trend. *President, Rensselaer Polytechnic Institute, Troy, New York.—Gratis.*

SERVING LEGITIMATE BUSINESS is a 12-page pamphlet describing some of the recent work done in combating rackets, and telling how business men can protect themselves by making complaints to the proper parties. *National Better Business Bureau, Inc., 405 Lexington Avenue, New York City.—Gratis.*

SEALED JOINT GLASS CONSTRUCTION is an illustrated pamphlet describing a newly developed type of gripper which makes possible the rapid and economical construction of glass and tiling walls. These grippers are claimed to hold the tiles under all conditions of stress, vibration, and changes in temperature. *Write for Bulletin 636F to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

PRIMITIVE HUNTERS OF AUSTRALIA, by Wilfrid D. Hambly. A 50-page, general treatise on the Australian natives. *Field Museum of Natural History, Chicago, Illinois.—30 cents.*

HOW TO RUN A LATHE. A booklet of instructions on the care and operation of a back-geared, screw-cutting, engine lathe, which has gone through 32 editions and is now famous. *South Bend Lathe Works, South Bend, Ind.—25 cents.*

IF YOU SMOKE

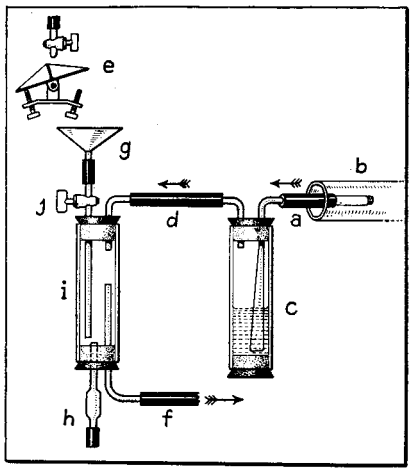
(*Continued from page* 313)

of di-ethylene glycol? Is the question not yet settled, or are the manufacturers too inert to make the indicated change? It is known that some of the manufacturers are studying this question, also that the existing "inertia" derives more from the consumer than the producer. Tobacco tastes are as sensitive as drinking water tastes. If the manufacturers were all definitely convinced tomorrow of a superiority, and made the change in a sudden manner, still Mr. John Public would set up an unearthly din. Re-educating John would be a costly task. The hesitation—if there is any—on the part of the manufacturers themselves is therefore understandable. "Any change in established tobacco tastes requires overcoming habit-changing resistance. A tobacco that tastes different must win its way gradually, even if it is easy on the throat, and such has been the case thus far."

Attempts to assess the various effects of smoking are so subject to the human equation that, in one experiment, Doctors Michael G. Mulinos and Raymond L. Osborne of the Department of Pharmacology at the College of Physicians and Surgeons, Columbia University, eliminated them by building a mechanical cigarette smoking or puffing machine and attaching to it a test tube containing a solution which became saturated with the smoke. Then they instilled two or three drops of this solution into the conjunctival sac in the corner of a rabbit's eye and noted the amount of swelling, redness, and objection by the animal. It was found that the swelling (edema) produced by the smoke-solution

from cigarettes which contained no hygroscopic agent lasted an average of 31 minutes, that from di-ethylene glycol treated cigarettes 8 minutes; and that from glycerine treated cigarettes 45 minutes. On increasing the percentage of glycerine the irritation was slightly increased, but a similar increase in the percentage of di-ethylene glycol caused it slightly to decrease.

The puffing machine is shown in the illustration. It was adjusted to take four-



The puffing machine, which eliminates the uncertain human factor

second puffs once each 15 seconds until the cigarette is consumed to the butt. The cigarette is inserted in the end of the horizontal tube *a*, and the large, loose tube *b* is placed around it in order to keep off drafts which would otherwise alter its normal speed of burning. From the cigarette, the tube *a* leads down close to the bottom of the water in *c*, and when suction from an air pump is applied at *d* the smoke is drawn into the water, which dissolves its contents as in the oriental *hookah*.

The remainder of the apparatus is for the purpose of giving the intermittent puffs. The suction pump is attached to *f* and, as long as nothing plugs the openings in *i* (at *g* and *h*) the suction at *f* merely draws in air at these openings. But if water is suddenly dumped into the funnel *g* this water not only prevents ingress of air there, but the water, running down into *i*, also plugs *h* until it runs out. The suction applied at *f* is then passed along to *d* and the cigarette.

Instead of having a man stand by the apparatus occasionally dumping water into the funnel, in order to make the cigarette puff, a tipping bucket shown at *e*, is used, as in standard laboratory practice. This is simply a square of metal bent along its diagonal into a curve, supplied with a transverse partition as shown, and pivoted at its bottom center. Water from a tiny stream above the bucket slowly fills one side until it overbalances, spilling the water out and into the funnel. Then the other side fills and tips into the sink; and so on and on, at intervals determined by adjustment of the incoming stream and of the stops beneath either side. The stopcock at *j*, if closed, would render the smoking steady instead of intermittent, provided *h* were also closed, but was not used in this experiment.

As stated by these Columbia University pharmacologists after their experiments, "it is obvious that the cigarettes which had been made with di-ethylene glycol as hygroscopic agent proved to be less irritating than those with no hygroscopic agent, and much less irritating than those with glycerine."

The amounts used were those ordinarily used in the manufacture of cigarettes, that is, 2.74 percent di-ethylene glycol and 3.65 percent glycerine.

Similar experiments were made by Wallace, Reinhard, and Osborne of the New York University College of Medicine, and the findings gave a close agreement with those just described. The duration of irritant effects from the glycerine treated cigarette was also found to be much longer than with the di-ethylene glycol cigarettes.

What about the acidity of tobacco? According to the *Journal of the American Medical Association* "there seems to be no evidence that the acidity of tobacco smoke is of the slightest importance to the health or to irritation of his throat by the tobacco." Perhaps the talk of acidity is a smoke-screen.

What, then, of smoking? Has science an answer to the question whether smoking is harmful? How much ought an individual to smoke?

SCIENCE need not answer these questions, for they have already been answered by tests on more than 100,000,000 guinea pigs —those of us who smoke. Most smokers—probably all smokers—are doubtless harmed to some extent, usually not great, by smoking. Likewise, most or nearly all smokers derive some pleasure and satisfaction from smoking. As Professor Mendenhall says, a packet of cigarettes is a "packet of rest," and the same is true of cigars and the pipe. That is, tobacco is a mild sedative—it quiets our nerves. Most of us contrive, generally without thinking, to adjust the extent of our smoking in such a way as to make a net gain of smoking satisfaction over smoking harm. The few who do not, do not employ their entire intelligence or else they are too weak to do so even when they sense its need. As it probably will do little or no good to preach to this minor fraction, we pass on. The average intelligent smoker senses when he is smoking too much, because he does not feel well, and he eases off, often unconsciously.

Scientific experiments, then, are interesting, and the findings derived from them provide us with something interesting to talk about with other smokers while we smoke. But the human race has already tried out the tobacco experiment and finds perhaps something like this: smoking does not do a great deal of good but it does not do a great deal of harm. Most members of the same race, smokers included, would also agree that smokers in general would be much more widely tolerated by other members of it if they would bury their butts six feet underground.

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One of the most provocative features of this review is the discussion of the present controversy over the relative merits of glycerine and di-ethylene glycol as hygroscopic agents. Doubtless this argument will continue for some time. Scientific American *will, therefore, keep in close touch with the situation and, when further findings of sufficient importance are reported, pass them along to its readers.*—THE EDITOR.

Books SELECTED BY THE EDITORS

HUTCHINSON'S TECHNICAL AND SCIENTIFIC ENCYCLOPAEDIA

Edited by C. F. Tweney and I. P. Shirshov

LOOK for anything you wish—vectors, germs, sewage, atoms, cinematography, exocoetidae, ballistics, furnaces, lycoperdon, insulation, gears, zymurgy, oxygen—and you'll find a discussion of the subject in one of these four volumes, if it is in the field of science, pure or applied. This remarkable work, comprising over 2400 pages thoroughly illustrated with numerous photographs, sketches, diagrams, cross-sections, working drawings, is the only one of its kind published for a quarter of a century. Being British, there are present some Briticisms, but there is usually a cross-reference to the American equivalent. If we had a monthly "must" for technical and scientific workers, this would be it for this month.—$25.00 f.o.b. New York City (weight, 18 pounds unpacked.)—*F. D. McH.*

WHY KEEP THEM ALIVE?

By Paul de Kruif

THE author of "Microbe Hunters" and other famous popular books crusades in this, his latest one, against the fact that the discoveries of medical science are not yet generally available to the poor. Many commentators appear to think that this book represents a break in de Kruif's unusually effective style of presentation—it is so frenzied and frantic and keyed up that this reviewer, at least, found it repellant. He scolds perhaps too much to give his appeal maximum effectiveness. Sometimes there is more light where there is less heat.—$3.20 postpaid.—*A. G. I.*

FARADAY

By Sir Robert A. Hadfield, Bt.

IT is quite possible that the average person thinks of Faraday in connection with some of the early experimental work with electricity; it is less well known that he devoted a considerable amount of study to the development of alloy steels during the years 1819-1824. Faraday's work in this field was certainly far in advance of the needs of his time. The present book has gone thoroughly into the subject and presented it in the light of modern knowledge. The author, a noted metallurgist and manufacturer, has collected and analyzed a large mass of material from the literature and documents of the past and has embodied facts of interest in his book. The material presented is in no sense a biography of Faraday but rather a running story, told from the technician's point of view, of the development of steels and alloys during the past century.—$6.25 postpaid.—*A. P. P.*

THE BATTLE OF JUTLAND

By Commander Holloway H. Frost

HERE at last is a complete study of the most important naval encounter during the World War, the battle which heartened the Germans and which was characterized by bad judgment on the part of the British commanders. Seven leading chapters give the background of the battle as they discuss the course of the War and the various campaigns which led up to the noted battle. From there on, the action is covered in minute detail, the movements of all ships being carefully traced and diagrams being included to show every bit of strategy. Commander Frost concludes his book with two chapters which discuss the effects of the battle on the course of the War. Admiral David Foote Sellers says in regard to this book: "I know of no one better fitted to write on the subject of this book than the late Commander Frost."—$4.70 postpaid.—*F. D. McH.*

THROUGH MY TELESCOPE

By W. T. Hay

A BOOK of textbook facts on the planets, and a few added aspects of elementary astronomy, "warmed over" in easy, chatty form for readers without previous knowledge of the science. The author is an English variety stage actor who, as an amateur astronomer, discovered the remarkable white spot on Saturn that attracted much attention in August, 1933.—$1.65 postpaid.—*A. G. I.*

ADVENTURE BOUND

Edited by Chester L. Persing and Bernice E. Leary

PREPARED expressly to "interest non-readers in reading," this book has been edited with the view of giving the high school freshman and upper grammar grade pupils sugar-coated knowledge. The various stories are told in simple narrative form tinged with adventure. The subjects covered include aviation, radio, exploration, invention, farming, motion picture photography—all told in a manner that makes for light, easy reading. Despite the audience at which this book is aimed, the present reviewer will wager that many a grown-up will pick up this book and read it from cover to cover. Not only will he read it with interest but he will take away from it bits of knowledge that otherwise have escaped his attention.—$1.15 postpaid.—*A. P. P.*

HIGHLIGHTS OF ASTRONOMY

By Walter Bartky, Assoc. Prof. Astron. Univ. Chicago

THOSE who wish to study astronomy from the student's angle may find aid in this book, which is the text used for the astronomical portion of the introductory course in the physical sciences at the University of Chicago. It stresses astronomical time reckoning, also exercises on the actual sky, but lays relatively little stress on the universe outside the solar system. It has 270 pages and is neatly produced.—$3.20 postpaid.—*A. G. I.*

THE ROMANCE OF CHEMISTRY

By William Foster, Ph.D.

ASIDE from its use of an extremely trite title, this book is a highly commendable study of the more interesting phases, from the layman's standpoint, of the whole subject of chemistry. Dr. Foster has a certain facility of expression which makes his story very readable for those who are interested in the general background of chemistry, its personalities, and its developments.—$3.20 postpaid.—*F. D. McH.*

NEW WORLD PICTURE

By George W. Gray

FROM the macrocosm to the microcosm—from the Universe down to the electron—George Gray, a widely known scientific writer, has dealt with the whole physical world in this outstanding book. Relativity, matter and energy, cosmology, expanding universe; electron, atom, waves and particles—these are the main entities dealt with. Every chapter in this book was worked out in collaboration with the ablest scientists—mainly those in different branches of the Carnegie Institution of Washington. Gray's style of presenta-

tion is readable and simple, and he interprets as he goes; in fact his whole book consists rather more of interpretation than mere exposition, and it is accurate interpretation at that. His book represents a vast amount of work and is a remarkable synthesis.—$3.70 postpaid.—*A. G. I.*

HEATING AND AIR CONDITIONING

By John R. Allen

PREVIOUSLY issued under the title "Heating and Ventilation," this book in a thoroughly revised form deals with its subject-matter from an engineering point of view. Details are given for installation of various types of units and sufficient information is presented to make possible a thorough analysis of buildings in which heating and air conditioning plants are to be installed. Numerous tables and comprehensive line drawings serve to make the whole subject clear to the reader with an engineering background.—$4.20 postpaid. —*A. P. P.*

STUDENT'S MANUAL OF MICROSCOPIC TECHNIQUE

By J. Carroll Tobias

THE author of this book started his own microscopical activities with a peculiar advantage over the authors of most manuals—he happened to live in a small town, isolated from help, and therefore knows just what it means not to be given definite, explicit, practical instructions and data on things in so-called "practical" books. Years later he prepared his book and it clearly shows "the special advantages of early poverty," in that it really comes to grips with the work it treats, instead of leaving the too-common gap between the perplexed and irritated reader and his subject. In scope, it covers the microscope itself, collecting microscopic objects from water, killing, fixing and preserving, dissociation, section cutting, staining, preparing and mounting hard objects, preparation and handling of animal material, preparing vegetable specimens, the polarizing microscope, accessories and, finally photomicography—all in 205 compact, illustrated pages that are to the point and don't "hold out" on the reader.—$2.65 postpaid.—*A. G. I.*

DIESEL AND OTHER INTERNAL-COMBUSTION ENGINES

By Howard E. Degler, M.E., M.S.

THIS critical survey of a vitally important phase of present-day industry and transportation gives enough of the background of the subject to enable the reader to grasp the thoroughly up-to-date descriptions of various types of engines. The book is presented as a practical text on the principles of operation and the performance of stationary, portable Diesel and gasoline engines. Well illustrated with photographs, detail cross sections, and line drawings of the various types discussed.—$2.65 postpaid.—*A. P. P.*

DIESEL ENGINES, OPERATION AND MAINTENANCE

By L. H. Morrison

THE editor of *Diesel Power* has done much to clear up, in this volume of just over 200 pages, many of the little problems in the operation, repair, and maintenance of Diesels. He gives information not only on the principles of Diesels but their installation, and on the technical aspects of the cylinders, valves, pistons, governors, fuel injection nozzles, air compressors, and other parts, which are so different in the Diesel from ordinary automotive practice. This is a practical text for heavy-duty engines.—$2.40 postpaid.—*F. D. McH.*

THE ANATOMY OF PERSONALITY

By Howard W. Haggard, M. D., and Clements C. Fry, M. D.

THE senior author of this new book was the author of a very widely read book called "Devils, Drugs and Doctors." The present book is on scientific character reading and should increase its reader's insight into other people as well as themselves. If you are frank with yourself, not an egoist, and can "take it," you will probably recognize yourself somewhere in this book—if not, you should place an order for a halo. Different types are discussed and concrete examples given, such as the egoist, the egocentric, the sensitive, the meek, the useful—people we all know—and the hidden motives and mechanisms of their actions are laid bare. Well written.—$3.20 postpaid.—*A. G. I.*

THE BOYS' BOOK OF MODEL AIRPLANES

By Francis A. Collins

THIS third edition of a well-known book has been brought thoroughly up-to-date and gives the latest information for the construction of all types of model airplanes. It describes various types from small paper gliders up to and including long distance flight planes. The book is thoroughly illustrated with both photographs and drawings which pertain to the text.—$2.15 postpaid.—*A. P. P.*

TELEVISION

By M. G. Scroggie, B.Sc., A.M.I.E.E.

ALTHOUGH written from a British point of view, this book surveys the entire field of television and presents explanations of the various systems in a non-technical manner. It will be of value to the layman who wants to find out what television is all about; a more technically-minded person will find that it gives a complete picture without obscuring the story with technicalities. Present results and future potentialities are covered.—$1.65 postpaid.—*A. P. P.*

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By Mayme I. Logsdon, Assoc. Prof. Math., Univ. Chicago

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