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SCIENTIFIC AMERICAN

JUNE
1938

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The SCIENTIFIC AMERICAN DIGEST

SCIENTIFIC AMERICAN

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NINETY-FOURTH YEAR • ORSON D. MUNN, Editor

CONTENTS • JUNE • 1938

IT may be that the oil flowing through the "Christmas tree" illustrated on our cover will soon be doing its part in the operation of your motor car. The valves shown are used to control the flow of oil from the well to several different lines. The oil is being forced up by natural gas pressure, sometimes as high as ten thousand pounds to the square inch. After this gas pressure fails, the walking beam shown in the background is placed in service and the oil is pumped from the well for distribution.

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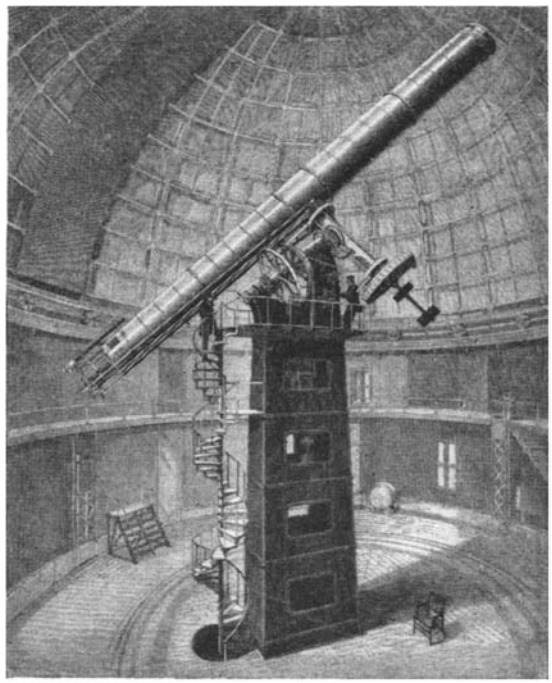
50 YEARS AGO IN . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of June, 1888)

SAFETY—"A block signal system, so arranged that a train entering a section of track will set a signal at the end of the section toward which it is moving to 'danger,' and set to 'safety' a similar signal by the same movement, on the section it is leaving, has been patented by Mr. George W. Peterson."

LICK—"The great telescope of the Lick Observatory was mounted in the south dome on Mt. Hamilton in the early part of the present year, and is now . . . practically completed. . . . The pier of the telescope is a rectangular cast iron column weighing 20 tons, built up of four sections rigidly bolted together. . . . The lower section, which at the floor level is 9 by 5 feet, expands into a broad base, 16 feet long and 10 feet wide, resting upon the solid masonry foundation which forms the tomb of James Lick. . . . On top of the pier is a balcony, surrounding the massive head piece which forms the support for the polar axis, a finely finished shaft of steel, 12 inches in diameter and 10 feet long, weighing 2,800 lbs. It is pierced centrally by a 6-inch hole, through which passes a shaft for communicating the motions in declination to the telescope from the balcony."



NIAGARA—"There have been so many false alarms about utilizing the wasted water power of Niagara Falls that one hesitates to accept rumors of new propositions as likely to be carried out. The latest one which appears to have any backing, though not altogether an original idea, is to tap the Niagara River at some distance above the falls by means of a tunnel driven along the side of the river. The water would be distributed by means of lateral underground conduits to turbines placed on the bank below the falls."

CRIME—"Photography is gaining prominence in the criminal courts. With its help a Berlin merchant was lately convicted of crooked ways in keeping his accounts. The slightest differences in color and shade of inks are made manifest in the photographic copy. Blue inks appear nearly white; brown inks, on the contrary, almost black. A contemporary states that the books of the accused were submitted to a photographer, who took off the pages concerned and brought into court the most undoubted ocular proofs of the illegitimate after-entry of some of the accounts. A subsequent chemical test substantiated this evidence."

PSYCHOLOGY—"Too many men make their boys feel that they are of little or no account while they are boys. Lay a responsibility on a boy, and he will meet it in a manful spirit. On no account ignore their disposition to investigate. Help them to understand things. Encourage them to understand what they are about. We are too apt to treat a boy's seeking after knowledge as mere idle curiosity."

AIR CONDITIONING—"An apparatus has been introduced in the Standard Theater, of this city, which in a very simple way is designed to solve the problem of securing a cool auditorium in summer. A fan is placed in the basement which draws air from outside the building and delivers it through the furnace pipes and registers to various parts of the auditorium. The air before it reaches the fan is drawn over ice arranged on shelves. This cools it so that a temperature of 70 degrees is easily attainable. . . . For a single evening's work about ten tons of ice are expended."

TORPEDO BOAT—"Torpedo gunboats and torpedo cruisers are the order of the day everywhere. It is now a long time since our naval authorities first came to the conclusion that, though we must be possessed of some big ships with heavy armament, both offensive and defensive, at the same time a large number of smaller light and swift craft were absolutely indispensable. Not a few critics of distinction have again and again urged that the larger vessels were too costly, and that a million sterling spent on one of these might be much more advantageously laid out on several second or third rate vessels of greater speed. Swiftness is everything as regards torpedo warfare."

LIGHT—"The electric light is getting to play an important part in medical investigations. With a little 'pea light' attached to the end of a slender rod, Sir Morell Mackenzie examines the throat of the German Emperor. The little battery that supplies the electricity hangs around the surgeon's neck."

FIRE—"The *Chemist and Druggist* (London) records the fact that show bottles in the windows of a chemist shop, just opened at 16 High Street, acted as burning glasses and set fire to the store."

PHONOGRAPH—"According to the New York *Herald*, Thomas A. Edison, the inventor, has been interesting himself with his new baby and a phonograph at his home. When the baby crowed with glee, the crow was registered on the phonograph; when it got mad and yelled, its piercing screams were irrevocably recorded on the machine. That phonograph is now a receptacle of every known noise peculiar to babyhood. It is Mr. Edison's intention to make a record every three months."

AND NOW FOR THE FUTURE

¶Naval strength—a pictorial survey of the present status of the Japanese Navy.

¶Plant breeding—an art and a science, by Keith C. Barrons.

¶Helium—the gas that makes dirigibles safe, by Paul H. Wilkinson.

¶Floods—escaping their wrath by a coördinated reporting system, by Alexander Maxwell.

¶X-particles—where they fit into the picture of modern physics, by Jean Harrington.

"Suppose I get sick? After all, I'm only human. And if I do get a touch of colic . . . or have a nervous breakdown . . . do you know what'll bring it on? Worry! Yes, sir, worrying about how long it would take us to get the doctor if anything should happen.

"Or suppose a pipe bursts in the bathroom? Or a burglar comes along? When something like that happens you don't write a letter, or go after help on horseback. No, sir. You hop to a telephone!

"And what about my mother? She's got marketing to do. Sometimes she needs to get in touch with Dad during the day. And there are errands to be run. Well, she can't do all those things without a telephone . . . and at the same time give me the attention I expect.

"All Dad needs to do to have a telephone is get in touch with the Business Office. I'd do it myself if I could just get out. But I can't. So is it any wonder that worry is keeping me awake half the day?"

BELL TELEPHONE SYSTEM

MEN IN WHITE UNDER ULTRA-VIOLET

EVEN in the far corners of this operating room, 80 to 90 percent of all bacteria are killed by the newly developed, tubular, ultra-violet ray lamps surrounding the main source of illumination. At the surgical wound, the germicidal effect is practically 100 percent. As reported in the article on page 344, these new lamps are rapidly being adopted by restaurants, food stores, bakeries, butcher shops, and the like.

Through pine forests and jungle-like growth, the dredge *Tampa* moves slowly, improving the Caloosahatchee River

FARMS FOR THE EVERGLADES

Levees, Drainage Canals Permit Reclamation of Mysterious Everglades . . . Soil is Black and Rich . . . Thousands of Acres for New Farms

By R. G. SKERRETT

STILL more fruits, still more fresh vegetables, will soon be shipped from Florida's sunny lands for the winter table. Millions will be benefited; for that reason, if for no other, special interest is attached to what the Government has been doing of late to put agriculture in the mysterious Everglades of that state upon a far firmer footing than heretofore.

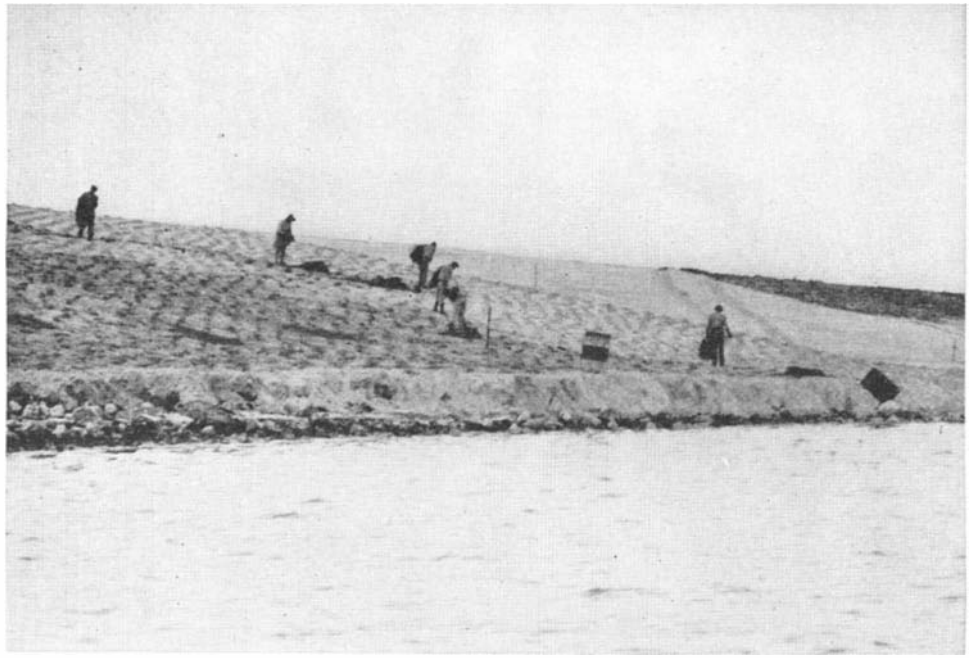
The measures taken by the Federal authorities are intended first to hold within bounds and then to guide seaward, in definite channels, the flood waters resulting from the heavy rainfall of the average wet season in Florida and, besides, to rear barriers that can be counted upon to lessen the ravages of the hurricanes that sweep with varying severity across the state practically every fall.

This truly gigantic problem was given the Corps of Engineers of the United States Army to solve seven years ago. The defenses that those experts have devised and directed in the construction are now approaching completion. When finished, they will represent outlays aggregating close to 17,500,000 dollars. The key feature of the entire undertaking is the control of Lake Okeechobee, the second largest body of fresh water lying wholly within our boundaries.

That lake, roughly circular in outline, has an average diameter of 30 miles. Its surface area, with the water at normal stage, is fully 725 square miles. Where the lake is deepest, the bottom is at sea level, and at that point the water is 15 feet deep when the surface of the lake is where the engineers would like to hold it. Large parts of the lake are very much shallower; even so, because of its immense expanse, the lake can retain a tremendous volume of water when the surface is raised only three feet.

BEFORE the state started the drainage of the Everglades, flood waters could flow over the lower lip of the lake. Such overflow recurrently submerged far-flung areas of the Everglades until the water could make its way slowly to the sea over the nearly level intervening territory. The rainfall in southern Florida in the course of a year may vary from 45 inches to 65 inches, mainly within a span of four or five months—a tremendous amount of water either to be absorbed by the soil or moved onward to the sea.

Lake Okeechobee is the natural catch-basin for the run-off of an area of 4200 square miles lying to the north of it; an area of several hundred miles, directly south of the lake, slopes sufficiently toward the lake to lead excess precipitation into the lake. The state engineers, and consulting engineers to whom Florida also turned for guidance, promptly recognized that the Everglades could not be reclaimed unless the water pouring into Lake Okeechobee in the wet season could be led away to the sea in definite channels that would serve the twofold purpose of controlling the flood stages of the lake and of providing outlets for the surplus rain falling on the low lands of the Everglades themselves. Up to 10 years ago, Florida had spent, all told, nearly 18,000,000 dollars in digging four main drainage canals running eastward from Lake Okeechobee to the Atlantic seaboard; in excavating the Saint Lucie



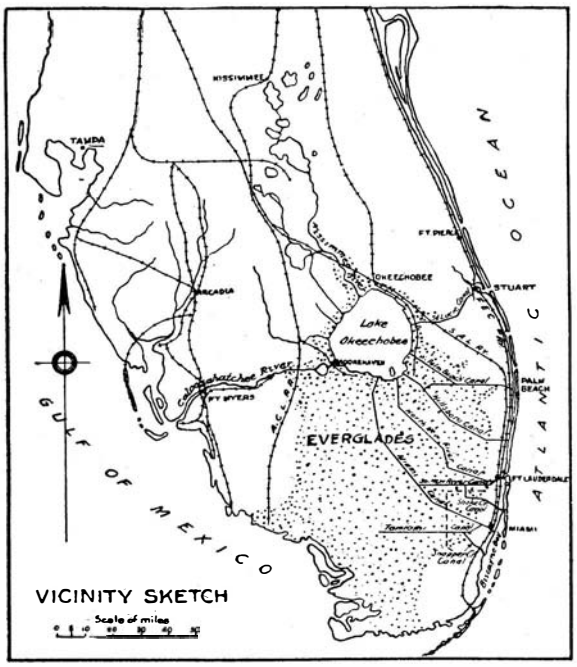
Canal, also reaching to the Atlantic; and in rearing levees along the southern rim of Lake Okeechobee to confine flood waters that would otherwise submerge extensive areas of reclaimed and cultivated land.

The Saint Lucie Canal has served as the main safety valve in carrying flood waters from the lake to the sea, while the four drainage canals have functioned principally to carry off the rain-water reaching them from the flanking Everglades—not the lake. In the dry season, they served as arteries to deliver to secondary canals water drawn from the lake to provide irrigation. As a further aid in getting rid of the waters pouring into Lake Okeechobee in especially wet seasons, the state dug a second flood-control canal leading from the southwest side of Lake Okeechobee to a connection with the Caloosahatchee River, and thence onward to the Gulf of Mexico. The situation seemed a promising one until September, 1926, when a hurricane swept across the southern section of Lake Okeechobee, from east to west. The high winds, with a velocity of more than 125 miles an hour, drove before them a wall of angry water seven feet higher than the lake surface had been just before the storm arrived. That surging, irresistible mass launched itself against the earthen levees standing in its path, battered and breached them, and spread the lake, swollen by the heavy rainfall, loose upon the outlying lands.

IN September, two years later, another hurricane hit Lake Okeechobee, traveling from southeast to northwest, the winds attaining a maximum velocity of more than 135 miles an hour. The north shore and the south shore, alternately, felt the full force of the cyclonic winds which blew before them a turbulent body of water 12 feet higher than the general level of the lake. That storm destroyed property to the value of more than 3,000,000 dollars and took the lives of 2000 persons. Again levees were overtopped by the pounding waves.

Such was the state of affairs when the Federal Government came to the rescue in 1930 and began to plan permanent relief measures that would keep Lake Okeechobee's waters confined even if a hurricane of record violence should again blow across the region. To achieve this, the Army engineers designed, and have since erected, levees considerably higher than previously built there, and so broad and firmly established that they can resist the pounding of hurricane waves and hold their crests safely above the storm-driven waters.

The levees rise to an average of 20 feet above the ground at the shore level; are more than 200 feet wide at the base; and slope thence to their crests where their flat tops are from 15 to 30 feet wide. Dredging and placing of material required in erecting the dikes has involved the handling of millions and millions of cubic yards of sand, gravel, shell, and rock—not to mention the job of clearing away immense quantities of overlying muck unfit for construction purposes.

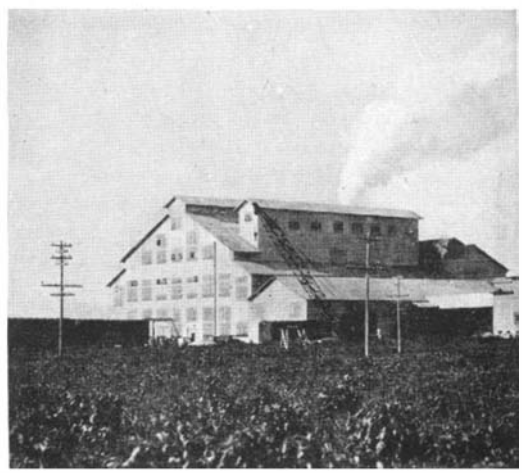


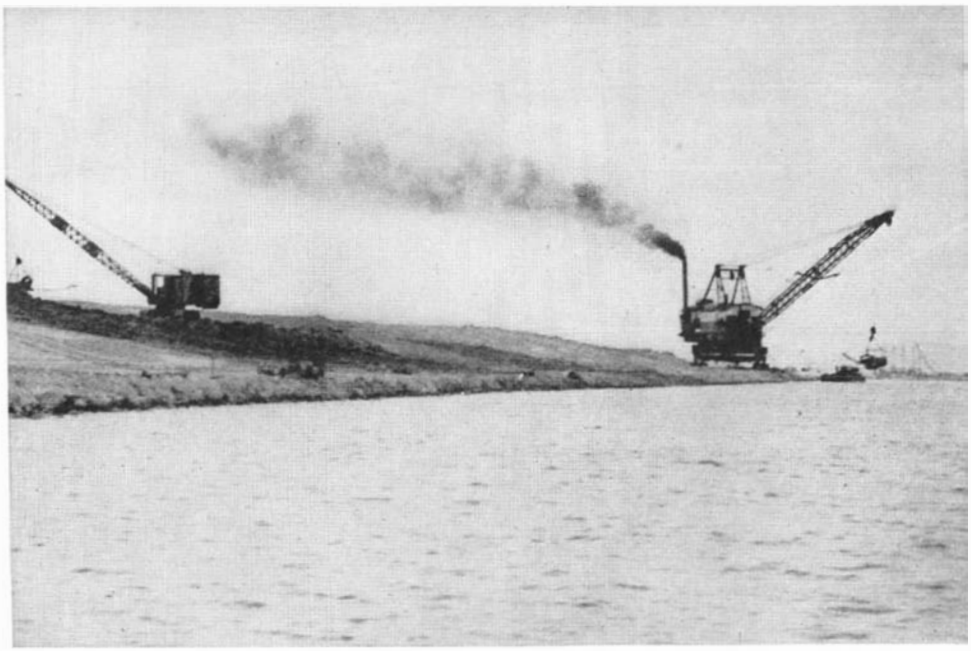
The tip of the state of Florida, showing the vast area of the low-lying, swampy Everglades

In digging or otherwise excavating the materials used in rearing the 80-odd miles of levees—68 of which encompass the southern half of the lake—the dredges have incidentally cleared a navigation channel paralleling the southern line of levees. This channel has a controlling depth of eight feet and a surface width of 80 feet at the normal stage of the lake. The channel is protected on its lake side by a dike formed of some of the material excavated during the progress of the work. This sheltered waterway gives access to the drainage canals that tap the lake and to the communities that have grown up on the land side of the southern levees.

Where each drainage canal meets the lake, the Army engineers have provided hurricane gates of steel which can be opened and closed either by electric motors or by hand. They are of a type that can be operated against a considerable head of water. In time of storm, they will be closed, and at other times they will be operated as required for the regulation of water or the passage of light-draft craft. At the lake entrance to the Saint Lucie Canal and at the corresponding entrance to the Caloosahatchee Canal have been built new navigation locks capable of accommodating larger vessels than in the past. Improved channels have been dug in the lake; and deeper water and a broader channel now link Lake Okeechobee with the Gulf of Mexico, via the Caloosahatchee River. The Saint Lucie Canal is likewise in process of being made fit for heavier traffic throughout its entire length of 24 miles. In short, Florida has nearly com-

Reclaimed Everglades land will feed sugar cane to mills such as this one, located at Clewiston, Florida

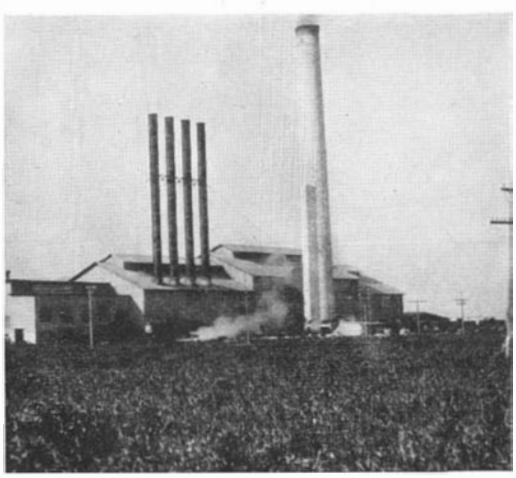




The great size of the levees on Lake Okeechobee may be noted here during finishing and dressing work

pleted a canal directly across its peninsula, between its Atlantic and Gulf coasts; and that waterway promises to be a boon to yachtsmen and a material aid in promoting further agricultural and industrial development of the whole adjacent territory.

IN its improved condition, the Saint Lucie Canal will be able to receive from Lake Okeechobee, at flood stages, 5000 cubic feet of water per second and lead that water to the canal's junction with the Saint Lucie River, that discharges into the Atlantic. By dredging, straightening, and deepening the channel of the Caloosahatchee River, that stream will be counted upon to transport 2500 cubic feet of water per second from Lake Okeechobee to the Gulf of Mexico whenever that relief is needed. Lake Okeechobee, with 68 miles of new levees on its south shore and 15 miles of improved levees on its north shore, together with its more capacious control canals and better defended drainage canals, is now a skilfully balanced project and is equipped, as it was not before, to meet all probable conditions and to contribute to the safe and steadily widening reclamation of the Everglades.



The Everglades, which mainly lie below Lake Okeechobee, have an average east-and-west width of 40 miles and extend southward for 90 miles before reaching tidewater. They have an area of nearly 2,860,000 acres, of which something like 80 percent is said to be susceptible of drainage. The Everglades occupy a shallow limestone basin in which has been deposited, during untold thousands of years, an immense accumulation of rotted vegetal matter. That muck has a vertical thickness of two feet near its southern limits and is 12 feet deep adjacent to Lake Okeechobee. Where that black soil rises above the water in the form of low-lying humps or "hammocks," it has usually evidenced its natural fertility by the character and kind of its luxuriant plant life.

But there are vaster low-lying and almost dead-flat expanses that are covered with saw-grass, which is both difficult and painful to penetrate. The boggy soil from which saw-grass springs, even when drained, has generally required a number of years of cultivating to make it yield a marketable crop of any kind. The agricultural chemist discovered an answer to the puzzle: he found that a small quantity of copper sulfate and some other chemicals, when spread over each acre, would work an astonishing transformation. The soil so treated becomes almost immediately fit for planting and capable of producing abundant and profitable yields.

With a favoring climate, a wealth of sunshine, and the soil suitably drained, lands in the Everglades speed up germination and induce unusually rapid growth. Palm nuts, which ordinarily require from two to three months before sprouting, will, in the favoring soil of the Everglades, send their shoots above ground in two weeks. Beans and peanuts will break through the surface within two days after their seeds are planted; and it is said that cotton will ripen its bolls two months sooner than elsewhere in this country.

THERE are now thousands of acres of land in the Everglades upon which sugar cane is grown, and during the months of ripening as many as six harvests may be reaped. These cane fields yield as much as three tons of sugar per acre annually—an extraordinary production. This has been achieved through the sustained collaboration of experts of the United States Department of Agriculture and the leading cane growers and sugar producers in Florida.

About 30 years ago, when the state of Florida first began the systematic drainage of the Everglades, she sold the earlier of those lands for as little as $1.25 an acre. Since the great richness of the reclaimed lands has been proved by men skilled in agriculture, the value per acre has increased nearly a hundredfold in many sections. This fact is mentioned merely to illustrate that the lands of the Everglades, virtually unexplored to any comprehensive extent for generations and even until within the last three decades commonly classed as well-nigh worthless, are now coming into their own because of their inherent fertility and the betterments brought about by the engineer and modern mechanical aids.

With Lake Okeechobee held within bounds by the defenses reared by the Army engineers, and with ampler channels provided for the prompt escape seaward of the very heavy seasonal rainfalls, the Everglades assume a new economic position in the nation, and from now on can be counted upon increasingly to supply tens of millions of us with luscious fruits and fresh vegetables when such commodities are most needed and not to be had from nearer sources.

"WITHAL it [the Everglades] is a strange country, a land of anomalies and the grotesque. Here fish sing (on the reef small fish attach themselves to the hull of a boat after dark and give off their plaintive notes all night long); snakes often live in trees; epiphytes grow as terrestrials; terrestrials grow as epiphytes; giant oak trees are arbours for aerial plants and ferns; cacti grow in water; oysters grow on trees that dip into the creeks; large pine trees and broad-leaved trees grow on rocks lacking soil; fig-trees grow as petriphytes trying to strangle the rocks; giant palms more than a hundred feet tall and cactus trees 30 feet tall grow as humus-plants; strangler figs kill other trees, and often turn upon themselves and commit suicide."—From "The Proposed Everglades National Park," by Dr. John Kunkel Small, New York Botanical Garden, in *Nature* (London).

ESP

What Precautions are Being Taken to Forefend Against Error in the Extra-Sensory Perception Research as Conducted at the Duke University?

By PROF. J. B. RHINE
Parapsychology Laboratory, Duke University

ONE of the leading problems in the scientific news at the moment is ESP, or extra-sensory perception, the current technical name for telepathy and clairvoyance. This work was given some of its present impetus by the publication in 1934 of my book, "Extra-Sensory Perception." So misleading, however, have been some of the recent references to this research that I am compelled to accept this opportunity to clarify certain essential points.

The ESP research [July 1934 and July 1935, Scientific American.—Editor.] was started to test the assumption that nothing can enter the mind except through the channels of sense (that is, vision, hearing, taste, and so on). In order to investigate this assumption, my associates and I, as well as many other university experimenters, have tested many hundreds of normal people to discover whether they can perceive things (that is, know about them) without any sensory contact via the known senses.

The tests are simple, consisting of naming cards in an inverted pack. In the more advanced tests in use for some time the cards are held out of sight and beyond the reach of the person calling them. If the subject can get more cards right than chance allows, this would give evidence of a way of perceiving which is beyond the senses—extra-sensory—in short, ESP. And according to the now numerous published reports from well beyond a dozen college laboratories, that is what happens in most of the ESP experiments to date. The results are better than chance by tremendous odds.

AS a natural result of such unorthodox results, the work in ESP has brought about a great deal of discussion, pro and con. The first battle line on this scientific front formed on the question of whether the results were really due to an extra-chance factor—whether the mathematical basis of the results is secure. Several of my fellow-psychologists (Drs. R. R. Willoughby of Brown, C. E. Kellogg of McGill, Dael Wolfle and H. O. Gulliksen of Chicago, and C. P. and J. H. Heinlein of Florida State College for Women) have criticized the mathematical methods used in the ESP work.

Leading authorities in the field of mathematics, however, have approved the statistics and its application. In the English edition of "Extra-Sensory Perception" I quote a letter from Prof. R. A. Fisher of London University approving the mathematics used, and a pronouncement made within recent months by the President of the Institute of Mathematical Statistics, Prof. Burton H. Camp of Wesleyan University, stated:

"Dr. Rhine's investigations have two aspects: experimental and statistical. On the experimental side, mathematicians of course have nothing to say. On the statistical side, however, recent mathematical work has established the fact that, assuming that the experiments have been properly performed, the statistical analysis is essentially valid. If the Rhine investigation is to be fairly attacked, it must be on other than mathematical grounds."

Prof. E. V. Huntington, of the Harvard Department of Mathematics, has submitted tables for evaluating the results of the card tests which still agree closely with those previously in use. It appears clear, then, that the mathematical and statistical verdict is in favor of the ESP investigators.

But the critics, failing in their attack on the mathematics, are already looking for another possible point of attack. If the results are not due to chance, they are saying, then "sensory cues" from the cards may account for the success. The person calling the cards, it is charged, may get cues from the back of the card, from shiny table tops, or from the feel of the cards as he handles them. Perhaps even the experimenter involuntarily makes faint noises that guide the calling.

What do the people investigating ESP say to these criticisms? That obviously these have been the very dangers which from the outset the research was planned to avoid. How the investigators did it has been repeatedly described in articles in the *Journal of Parapsychology*, the publication reporting current experimental work in this field.

From the very beginning, precautions against sensory cues were carefully used. Shiny table tops were avoided, cards were hand-stamped and inspected. They were called before being touched or even right down through the pack, and in the main block of the research not even the experimenter knew the card to be called and hence could give no involuntary cues to the subject.

Even so, in the articles referred to above, all tests where the subject could as much as see the backs or edges of the cards, or even touch the unseen cards, were set aside. The survey includes only those trials in which there was no sensory contact with the cards, and all of these trials, high or low in score, are included in the report.

Thus narrowed down, the evidence for ESP consisted of tests either at a distance with walls between subject and cards, or of tests with opaque screens set up which shielded the cards from the subject's sight and touch, or of tests with each card sealed in an opaque envelope. These last were used even with blind subjects.

BUT even when restricted to such cue-proof conditions, there remain 142,825 trials by 118 subjects working under the observation of ten different experimenters, six of whom are or have been college instructors in psychology. Four laboratories—Columbia University, University of Colorado, Tarkio College, and Duke University—contributed to the results involved in this survey.

These 142,825 trials (which include all the work, good and bad scores alike, which was done under the rigid testing conditions described) gave an average of 5.8 hits per 25 calls as against a mean chance expectation of 5.0. The odds are 10^{195} to 1 that so large an average score for so many trials would occur by mere chance—odds so great that it would take 196 digits to write out the figure! Thus the most rigidly guarded conditions yield results that incontestably indicate that something more than chance occurs in the ESP tests.

If the senses are barred, as the conditions would appear to require, either there is some error yet to be uncovered in this pioneer research now being conducted in more than a score of American colleges or else extra-sensory perception must be added to the range of known mental abilities. One should not and need not believe or disbelieve in ESP, as it stands today; he should, if he is able, undertake to assist in finding out more about the question, preferably through laboratory research itself. The research, its worst critics will concede, deserves careful consideration and repetition.—*Science Service.*

OUR POINT OF VIEW

Five-Year Patents?

INVENTION has its birth in a number of stimuli. The desire for glory, for prestige, for the satisfaction of the ego, are rather important causes of invention, but by far the greatest incentive to progress through invention is that of profit. Except for a few seekers after knowledge in the abstract, a few others urged on by scientific curiosity, and a few accidental discoverers of a new principle or device, inventors are impelled primarily by the profit motive. And progress, for the general good of all, is the worthwhile result.

Now Congressman McFarlane would make the inventor the loser by reducing the possibility of profit. He recently submitted a bill to make compulsory the licensing of any patent after three years instead of giving the inventor an exclusive right to his brain-child for the traditional 17 years. He has since withdrawn that bill and substituted one which would make the licensing of a new invention compulsory after five years if the patent has not been developed in that time, if the patent owner cannot meet the demand for his product, or if he charges an "excessive price."

The thought behind this tinkering with the present highly successful patent law is to force immediate commercial production of every new invention, whether or not the time is propitious. An individual or a company may spend hundreds or even thousands of dollars in the development of, for example, a new machine. Having patented several "editions" of that machine, the inventor finally starts production with his last, most efficient machine. His preceding patents are undeveloped, unused. After five years, a competitor steps in, demands a license to commercialize the unused patents, and starts production. It is conceivable that the competitor comes into the market at the "propitious time" to build a competing business that may drive the owner of the patents out of production entirely (though paying royalty to the owner). Again, since values of an invention are often intangible, a competitor may show that the original patentee is charging an excessive price for his product and thus obtain a license to compete with him, using his own invention.

The comment which Dr. Charles L. Parsons, secretary of the American Chemical Society, made in regard to the three-year bill—that three-year patents would be valueless—applies equally to the five-year bill. Indeed, that conclusion is inescapable when one examines the facts with an unbiased mind. Such a patent law would exert little control over "monopolistic trusts" (as so many corporations are now dubbed by spellbinders, and against which the bill is aimed) but would definitely slow up the larger progress which is now being made by scientists, engineers, researchers who hope to have a patent to sell in return for their labors.—*F. D. M.*

Scientific Method versus Prejudice

WHEN Prof. J. B. Rhine at Duke University set out to reduce the previous looseness of the so-called psychic "science" of earlier periods to a laboratory procedure under controlled and reproducible conditions, he at first limited himself to two special aspects of it—telepathy, the perception of the mental activities of another person by other means than the normal senses, and clairvoyance, the perception of objective events by similar means.

Now, for the first time, Prof. Rhine reveals the preliminary findings of a third and allied kind of research which it appears has quietly been undergoing tests at Duke since 1933: precognition or foreknowledge. How can this question be tested scientifically?

Certainly we cannot test it by citing striking experiences such as most of us have had. No matter how strongly those experiences convince the individual, they cannot be switched to others in the form of proof. They are too indefinite, too intangible, too vaguely bounded to reduce to anything like a common denominator between minds; and they may be nothing but beautiful coincidences, anyway. Therefore Rhine tests precognition by the same ESP cards used before in testing telepathy and clairvoyance, but with an added kink. With clairvoyance it has proved possible to "call" or name more cards than probability calls for, when a pack of 25 cards is laid face down and the subject is asked to identify each card down through the pack, without removing any. Suppose now there were such a thing as precognition. Then, if the subject were asked to do the same thing, but to name the cards in the sequence they would take *after being shuffled* at the end, precognition of future events would seem to be shown if the subject was able to name more cards than probability called for. This is what has happened. In an extended series involving 113,075 trials and 49 subjects the scores were better than probability in the ratio of 400,000 to one. Coincidence, or what?

As yet Prof. Rhine regards these findings as tentative; far more work remains to be done. Unfortunately, many persons are judging the tests at Duke on the basis of inclination, preconception, or what-not, when open-mindedness—neither incredulity nor credulity—seems to be called for. Nothing short of such an attitude is scientific.—*A. G. I.*

Training

TRAFFIC court is an excellent place to find out various things about the competence of automobile drivers. In a recent survey by Dr. Lowell S. Selling, Director of the Psychopathic Clinic of the Recorder's Court in Detroit, it was found that not one out of a hundred drivers who had been brought into court for various traffic violations had learned how to drive his car with confidence, tactfulness, and a thought for the other driver. Such investigations as this are of great value in guiding the thoughts of those who are directly and indirectly responsible for safety on the highway. Dr. Selling has found, for example, that many of the drivers involved in traffic offenses are insane; many are feeble-minded; many are illiterate; many, of course, are relatively normal but have never been properly trained in motor-car driving.

More and more is going to be heard in the future about adequate training of drivers. Such training will eventually and automatically weed out the insane, the feeble-minded, and the dangerous illiterate; it will make possible a revision of the thought processes of those normal human beings who aspire to safe driving, rendering them competent to drive a motor car with a maximum of safety to themselves and to others.

Such training must be carried out on a grand scale and must be thought of as a permanent institution that will eventually—within not less than a generation—make every motor-car driver aware of his responsibilities and fully able to cope with them under all ordinary as well as emergency circumstances.

Driver training is undoubtedly the only answer to the most important phase of the motor vehicle safety problem. What form it will eventually take we cannot venture to say here. But everyone concerned with highway safety is going to hear a lot about it in the very near future; thoughts will eventually crystallize into action and then something definite will be done about the whole pressing question.—*A. P. P.*

But Can You Eat Onions?

Non-Allergic Food Sensitivities . . . How to Trace Down Dietary Idiosyncrasies Scientifically . . . A Lady Who was Suffering Mainly from Fox's Disease

By T. SWANN HARDING

THE scene is a doctor's office. The patient under examination complains of periodic headaches with a general feeling of exhaustion and muddle-headedness between. The doctor asks:

"Is there any food you can't eat?"

"No. I can eat absolutely anything eatable."

"How about cucumbers?"

"Well, I can't eat them. But then, most people can't."

"How about milk?"

"Never touch it."

"Why?"

"It used to make me sick when I was a kid."

"What about eggs?"

"O, they make me awful sick every time!"

"Can you eat an egg custard?"

"Yes, I can, and I can take eggnog, and I can eat hard-boiled eggs all right. But it always makes me sick to see any soft, uncooked egg white."

Naturally the patient had trouble with onions, too.

This scene is characteristic. Certain more alert doctors are going at this diet business in a new way. The old way was to pick out the things the patient liked, tell him not to eat them, and call the rest a diet. The old way was to tell the patient what to eat. The new way is to find out experimentally what foods he can eat with comfort and safety.

FOR many long years certain individuals have known they could not eat shellfish or strawberries without getting hives, or eggs without getting headache, asthma, or hay fever. It is now known that these troubles are often due first to some peculiar sensitiveness of the individual, and second, to the entrance of a little undigested food, and particularly protein, into the blood. Medical men call these disturbances "allergic" in nature, the type due to foods being called "food allergy." An entire medical specialty is now devoted to finding allergic causes for asthma, hay fever, indigestion, flatulence, sick headaches, certain skin eruptions, and other troubles.

The medical specialists so concerned are called allergists. They first tried to identify offending foods by means of skin tests. A little scratch was made on the skin and a droplet of a solution of the food to be tested was put on it. In cases of sensitivity a big hive soon appeared at the spot. While these tests often helped in finding the cause of asthma or hay fever, they have not proved very useful in locating the causes of indigestion, flatulence, and general malaise. It seems that the skin is more closely related to the inside of the nose and lungs than to the digestive tract.

Too much deduction has been made from the diet of laboratory rats

Today many allergists admit that skin tests are of little value when it comes to finding foods that cause indigestion. Dr. Walter C. Alvarez, of the Mayo Clinic, goes so far as to say that often they are a nuisance because when once patients find that their skin is sensitive to certain foods they are forever after afraid to eat them, and sometimes they are reduced to skin and bones as a result of unnecessary starvation. No one should ever go without a food simply because his skin reacts to it. He should test it and see whether eating it actually causes distress.

Among the leading pioneers who have been waking up the medical profession to the importance of sensitiveness may be mentioned Dr. Alvarez, Dr. Albert Rowe, and Dr. Warren Vaughan.

Incidentally, not all food-sensitiveness is allergic. As Alvarez has pointed out, such things as pepper, mustard, and alcohol may simply irritate the digestive tract, and onions, cucumbers, melons, dried beans, and tomatoes probably contain small quantities of drug-like substances which produce regurgitation, belching, and flatulence. This may well account for the fact that many of the annoying disturbances produced by eating certain foods are not diagnosable by skin tests.

THERE is the case of a doctor who could eat onions without difficulty if they were first soaked in vinegar, but who had an attack of asthma every time he ate them otherwise, raw or cooked. This suggested that some chemical irritant was washed out or altered by the acid vinegar. Another person maintained that cucumbers with the rind on were harmless to him, whereas peeled cucumbers gave him distress. Still another found that the harmful part of an apple was in its peelings.

Many cases were found in which symptoms suggesting gastric ulcer were caused by eating banana, apple, cabbage, turnips, or meat, or drinking milk, alone or in combination. In one instance appendicitis was simulated when onions were eaten. Many persons complained of canker sores in their mouths after eating certain foods.

A certain man who each morning fought off an almost irresistible tendency to go to sleep found with his doctor's help that this was due to the cream in his coffee. Severe hunger pains, usually considered typical of stomach ulcer, have also disappeared in a few cases when milk, chocolate, or orange juice was banished from the diet.

An interesting case was that of a young man who suffered from a sort of mental cloudiness that prevented him from working. In spite of treatment by many doctors the condition persisted. He was dull, listless, apathetic, and bothered by a variety of abdominal pains and distresses. Yet, when he was given a diet composed only of foods that rarely distress anyone, his head cleared and his ambition returned in 48 hours. Subsequently he gained in weight on a somewhat more extensive diet and returned to work.

Often two factors combine to cause the trouble. Thus a certain woman could eat wheat in winter but had to avoid it in summer in order to avoid hay fever. Another individual became wheezy on exercising only if he was eating wheat. Fatigue, nervousness, mental strain, worry, and so forth may make an individual sensitive to certain foods that he can eat freely without difficulty when at his best.

The symptoms caused by this non-allergic food sensitivity are most often the following: A hay-fever type of stuffy nose; indigestion; flatulence; abdominal pain; and, occasionally, diarrhea, hives, headache, stupid feelings in the head, canker sores, but much more rarely irritations of the joints and bladder.

STUDENTS of nutrition and even doctors have long concerned themselves with the mineral, vitamin, and caloric content of foods and the biological value of their proteins. But the digestibility of various foods has been neglected. Doctors have tended to follow dietitians in this neglect. Yet the digestibility of a food is extremely important. It may bulk larger at times than its content of vitamin A, calcium, iron, or complete protein.

So far, most of the books on dietetics either ignore the subject of digestibility or else dismiss it with a few words as of minor importance. Unless a dietitian has been especially trained under an allergist she is likely to have little patience with those who claim they cannot take milk, eggs, orange juice, or spinach. Patients in and outside of hospitals are often forced to eat so-called "health foods" even after they have explained that they could not tolerate them after childhood.

The average physician, when asked for advice on diet, warns usually against fried, greasy, or "rich" foods, or against those foods which he himself finds it difficult to handle. He may recommend others he likes. He may give the patient a printed diet list that will fit that individual's needs about as well as the key to one safety deposit box fits the lock of another. If the patient protests against eating foods that are considered good for him he gets scant sympathy. He may be told he is unco-operative, or that the trouble is in his head. He may be impatiently ordered to do as directed. Yet the doctor's dietary advice, like that of the hospital dietitian, is built around the big idea of the nutrition scientist; that is, to supply all patients every day a diet complete enough to ensure good growth and ultimate reproduction in a baby rat.

Of all the fruits and vegetables, onions appear to be a common offender

For this reason the physicians above-mentioned began a while back to query patients about what foods they could safely eat. As was indicated by the dialog at the beginning of this article, this inquiry must be carried on with skill, for many of us think we can eat anything, until we are questioned closely or our memories are refreshed by reading a list of foods. The results of these inquiries are interesting and of much importance.

Dr. Alvarez found that the following foods produced more or less distress in 10 to 28 percent of 500 persons questioned, the foods being listed in descending order of frequency: Onions (usually raw); milk, cream, or ice cream; apples (raw); cabbage (cooked); chocolate; radishes; tomatoes (more often raw); cucumbers; eggs; fats, greasy, and "rich" foods; cantaloup; meat or beef; strawberries; coffee. Among the foods that very seldom offended were: lamb, gelatine, butter, sugar, rice, barley, arrowroot, carrots, asparagus, turnips, peas, beets, squash and canned pears.

Chocolate is a very common and often a serious offender, yet how many avoid tea and coffee to drink chocolate or cocoa! Pie and pastry, which have such bad reputations, were rarely complained about. The commonly despised fat and greasy foods were blamed by many, but this, as was also true in case of onions, is often due to the fact that they happen to be tasted when belching. Hence they are blamed at times for the sins of other foods.

If the food is one that is rather rarely eaten—like crabs or strawberries—the patient easily spots its effects, but if it is one that is eaten at nearly every meal he may go on suffering mild distress for years without ever realizing that the offending food is wheat or milk. Hence, rarely used foods are doubtlessly more often cited in such lists as the above, though certain commoner foods may be more distressing. In some cases, of course, the aversion is purely psychic and due to some unfortunate association.

THERE is now pretty general agreement among a number of investigators that wheat, eggs, milk, chocolate, cabbage, onions, tomatoes, and oranges frequently offend. Yet these are such foods as are eaten daily by most of us. Moreover, it takes an unusual person to discover without expert assistance that his breakfast coffee or the toast that goes with it is responsible for such mild but efficiency-reducing symptoms as flatulence or a stuffy head.

As to the kind of symptoms produced —onions, cabbage, apples, radishes, dried beans, cucumbers, and milk were usually accused of causing gas, belching, or distention. Onions, radishes, cantaloups, cucumbers, lettuce, fats, and melons generally produced regurgitation, a lingering taste, or "repeating."

Migraine was most often caused by onions, milk, peanuts, cabbage, eggs, pork, apples, coffee, oranges, and cucumbers. Vomiting, severe pains, and diarrhea were most frequently caused by milk and its products, chocolate, raw apples, raw onions, eggs, tomatoes, cooked cabbage, and certain meats. So much for samplings made among people who are sick enough to see a doctor yet who do not complain of stomach or intestinal trouble.

Dr. Osee Hughes, on the other hand, interviewed about a thousand individuals in good health, at Ohio State University. Her results tended to confirm those of Dr. Alvarez. The symptoms mentioned by those who were queried were very similar to those already listed here. There were, however, some differences in the relative standings of individual

foods, as stated by the different persons.

The foods that most commonly disagreed with healthy young women were, in descending order of frequency: onions (raw), radishes, cabbage (cooked), beans, cucumbers, onions (cooked), tomatoes (raw), greasy or fried food, frankfurters, bananas, strawberries, eggs, and chocolate. Apples and milk, which stood high on the list of Dr. Alvarez, had rather a low standing.

THE foods that most commonly disagreed with healthy men and women between 30 and 65 years of age were, also in descending order of frequency: onions (raw), cabbage (cooked), beans, greasy foods, cucumbers, peppers (raw), sauerkraut, "sweets," pork, chocolate, milk, tomatoes (cooked), onions (cooked), bananas, radishes, and seafoods. In general, people did not avoid foods that mildly disagreed with them but often ate them regularly.

Raw onions and cooked cabbage stand high as offenders on all lists. Frankfurters probably assumed a prominent place in the lists derived from the young women because they were college girls who frequently went on picnics and wiener roasts. The older group of healthy people found milk more difficult to handle than did the young women.

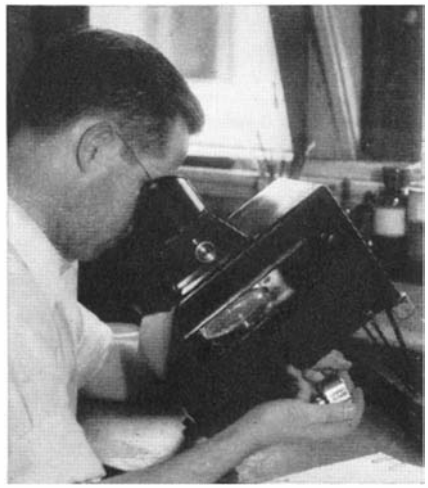
But what can be done about this? Is there no way out? As was mentioned earlier, there are certain foods which rarely offend. Therefore it is possible to devise a diet on which a person's nutrition can be maintained temporarily, using foods that rarely offend. This is called an elimination diet. Once one is found that works perfectly, other foods can gradually be added, one after the other, till all offenders have been spotted and the ultimate diet is as diverse and rich as the particular individual can stand.

Putting a person on an elimination diet may not only reveal that he or she is sensitive to one or more foods; in many cases it promptly demonstrates that he or she has neither sense nor intestinal fortitude. In other words, a fussbudget with too many strong likes and dislikes is unmasked.

For instance, a woman with a facial rash declared she had been all over the world seeking successful treatment but got no relief. She declared also that she would do anything to be cured. The doctor told her that the trouble was due to eating some food to which she was sensitive. In order to identify the food he told her to go for four or five days on an elimination diet of nothing but lamb, rice, potatoes, butter, sugar, and Jello.

Immediately she began to complain bitterly that she could not do without her morning coffee; that she didn't like rice and didn't like Jello; that she must have ice cream now and then and a cocktail before dinner. After much grumbling she said she would *try* to adhere to the diet, but the next day the doctor saw her getting outside of a large chocolate ice cream soda. His diagnosis of this case was Fox's disease.

To those who are unfamiliar with this technical term it should be explained that it was named after an interne who was himself named Fox. He was asked by his chief what he thought was the matter with a woman upon whose case he had been working. He replied to this



Counting the bacteria in seafood, but some are sensitive to seafood even when it contains no bacteria

effect: "Well, doctor, it looks to me as if she was just a plain damned fool!" Hence this condition, rather frequently met with, came to be known as Fox's disease.

Many people are quite familiar with one or two of their own dietary idiosyncrasies. But other such weaknesses must be unmasked by an expert. If the indigestion or pain or migraine occurs at intervals of weeks or months, the cause can often be found by making a written record of all unusual foods, not eaten every day, consumed in the 24 hours preceding the upset. Suspicion should rest heaviest upon foods eaten at the preceding meal, as distress usually follows quickly.

After three or four attacks an examination of the written list may enable the patient to identify the offending food. If relief is obtained upon letting it alone much will have been gained. But the food should be further tested by eating it again to make sure it is responsible for the attacks in question. If the result is positive the food should thereafter be avoided. Lists of foods eaten during periods when the patient is comfortable will aid in guiding him as to what to eat.

If the distress be present after almost every meal the problem of finding the offending food must be simplified, perhaps by actual fasting for a short time. Should the distress continue, food obviously could not be the cause. If it ceases, then the patient can be given a new food daily until the offenders are spotted. Good foods can then be kept on the dietary list and the bad ones discarded. Since some patients haven't the hardihood to fast the elimination diet often comes in handy.

The diet most commonly used by Alvarez consists of *nothing but* lamb, rice, butter, sugar, and canned pears. For breakfast the patient may have a lamb chop with puffed rice or rice flakes, or steamed rice with butter and sugar, or some syrup from the can of pears. Cooked rice can also be made into little cakes and fried in butter. No pepper and sauces; no onions—the meat being either roasted or else fried in butter, and no other fat. The only drink is water.

For luncheon the patient may have a chop or a piece of roast lamb, again with rice and canned pears. Dinner is a reproduction of luncheon—eaten backward if desired, or off the mantel shelf. Obviously no coffee or tea or soda fountain drinks, or candy or even chewing gum, is allowable. Any added substance put into the mouth complicates the problem. No laxatives or purgatives should be taken.

If the distress was due to a harmful food its symptoms usually are gone within 12 hours. Whether they clear up or remain, the elimination diet should be continued another day to make sure. If by then they have disappeared the patient can add a new food daily to his elimination diet, keeping a full record, and finally avoiding all foods that give distress.

In order to avoid upsets at the start, with discouragement and possible weight loss, foods not high in the list of trouble makers should be tested first, such as beef, potato, gelatin, carrots, turnips, asparagus, string beans, arrowroot cookies, thin toast, and oatmeal, possibly in that order. Later, when the patient has gained confidence and has found a fairly liberal diet that he can handle, he can try the more notorious trouble-makers. Then he can make a stab at eating onions.

IF trouble persists on the elimination diet, then either the patient's symptoms are not due to foods or else he is sensitive to one of the foods like lamb, rice, sugar, butter, and pears. By subsisting for a couple of days on pure maple sugar the latter possibility can be tested out. If the distress still persists it is unlikely that further dieting will help.

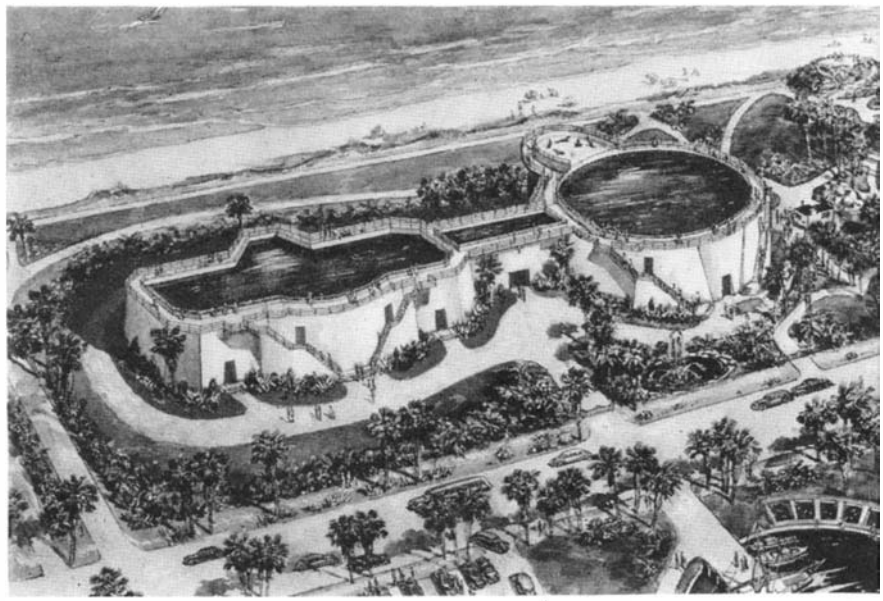
Sometimes the patient will find after a few months at home that he can safely eat certain foods which formerly upset him. He should therefore constantly experiment among the forbidden foods and broaden his diet if he can. He should strive ever to return to a normal diet. No one should ever remain for weeks or months on a highly restricted elimination diet, as this is used for diagnosis, not for extended treatment.

Unconventional Aquaria

ONE of the most ambitious efforts to reproduce ocean life is nearing completion at Marineland, Florida, which is located on the new Ocean Shore Boulevard 35 miles north of Daytona Beach and 18 miles south of St. Augustine. Consisting of the two largest aquaria ever built, which are also the world's only specially designed underwater motion picture studios, these Marine Studios will afford visitors and scientists an unusual opportunity to observe and photograph large and small fish and aquatic mammals much as they are found in their natural surroundings under conditions duplicated nowhere else in the world.

Conceived several years ago and representing an investment of approximately $500,000, Marine Studios has been developed by W. Douglas Burden, an associate of the American Museum of Natural History, Ilia A. Tolstoy, grandson of Count Leo Tolstoy the famous Russian writer, and Miss Lillian Koehler, an associate of Mr. Burden. After much patient pioneering work, they have developed a wholly new principle of presenting the strange, beautiful creatures of the sea. Instead of displaying each species in its own segregated compartment, a more natural presentation of submarine life is offered in both of the huge tanks where each species plays the same part that it does in the open ocean.

The unconventional features of the design, which afford visitors to Marine Studios a unique opportunity to study and photograph marine life, center around the construction of the tanks themselves.



Artist's conception of Marine Studios, the two largest aquaria in the world and the only ones ever to be designed as under-water motion picture studios

One is polygonal, and is 100 feet long, 40 feet wide, and 18 feet deep; the other is circular, 75 feet in diameter and 11 feet deep.

Enclosed galleries run at different levels around the entire perimeters of the two tanks. Each of the galleries faces inward upon a circle of glass portholes, of which there are over 200 in the sides and bottoms of the inner tanks where the marine life is displayed. The portholes are placed in such a way as to make it possible for observers to look into the tanks from four different levels.

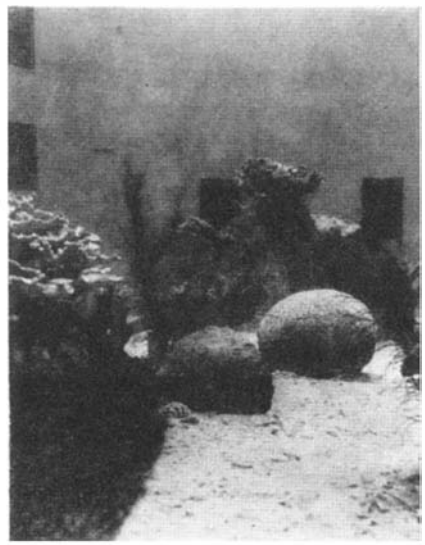
THE design of the tanks was recommended by Fred Waller, President of Courier Productions, Inc., and other technical motion picture experts who worked out in advance the various camera angles that would be necessary to afford producers the greatest latitude and leeway in the filming of scenes. These angles were the controlling factors that actually determined the shape and dimensions of the tanks and the location of the glass portholes.

This enterprise hopes to give the spectator a dramatic, vivid, fascinating cross-section of life in the sea. Already several porpoises, believed to be the only ones alive in captivity, sharks, loggerhead turtles, and penguins have been assembled, in addition to several tons of coral reefs around which some of the smaller and more beautiful creatures of the sea are making their home.

By extensive research, Mr. Tolstoy has developed, with the assistance of Dr. G. Kingsley Noble, of the American Museum of Natural History, a drug which, when injected into large sharks or similar creatures of the sea, puts them to sleep almost instantaneously, yet the effect is temporary, leaving no after effects. While under the influence of this drug, they can be transported and placed in the huge aquaria without injury to themselves or to anyone else.

"Our idea," says Mr. Burden, President of Marine Studios, "is to build something which is sound and of lasting value, of value to the public, of value to the community in which we are located, and of value to science."

A 235-pound loggerhead turtle as seen through one of the portholes 12 feet below the water surface. Amateurs may make such pictures



Coral gardens on the floor of the aquarium. The water is extremely clear. Sunlight entering from above shows portholes at different levels

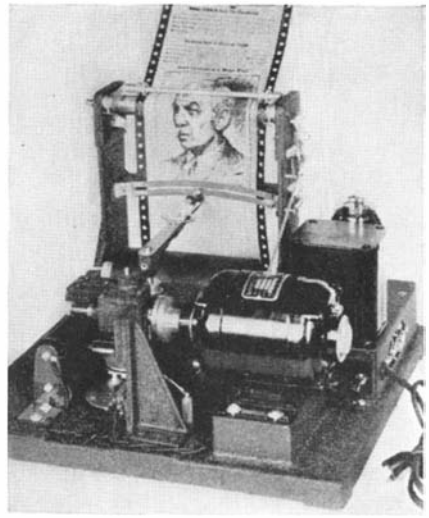
Home Newspapers by Radio

Your Home a Silent "Press Room" . . . Automatic Facsimile Reproduction . . . Latest News by Breakfast Time . . . Bulletins Are Now Being Broadcast

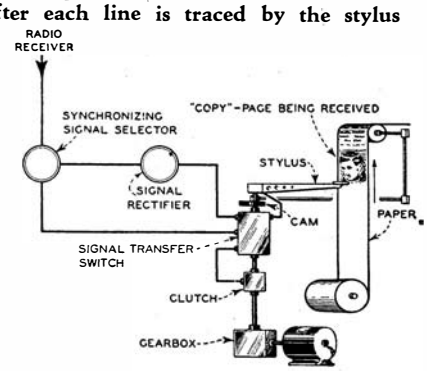
A PRIVATE newspaper with any spot in your home as the press room, the world's best editors and reporters on your staff, is available today to anyone in the United States possessing an ordinary radio receiving set. No thundering press will deafen you while your newspaper is being printed; instead, equipment contained in a small attractive box will silently print your "latest edition" while you sleep, completing it in time for reading at breakfast.

The name of this service now available is facsimile, first cousin of television since it shares with it some of the same basic principles. Unlike its more glamorous and well publicized relation, facsimile steps into broadcasting from other communication fields in which it already has proved its capabilities in a quiet but exceedingly effective manner. Facsimile has been in daily commercial use for several years, speeding newsphotographs back and forth across the country via the telephone circuits and across the Atlantic by short waves.

In spite of the rapid development and use of every-day wire and radio facsimile service, many are unaware of its greater capabilities as a mass communications medium in the broadcasting field. This is largely because facsimile transmissions have been employed almost entirely to handle press photos for subsequent newspaper reproduction; in the average layman's mind this is the limitation of the method. Many also confuse television with facsimile and ask why television ultimately will not perform the same duty.



Above: **The home "press room." *Right:* Interior of the facsimile recorder, showing the moving stylus. *Below:* Simplified diagram of the reproducer. The paper is moved upward by means of toothed wheels after each line is traced by the stylus**



FACSIMILE, in its electrical communications sense, involves the conversion of illustrations or other copy, such as printed matter, photographs, line drawings, sketches, and so on, into electrical signals which can be sent over radio or telephone circuits. At the receiver, the signal is automatically converted back into visible form, appearing as a recorded replica of the original copy. The received copy is permanent and, like a printed page, can be handled, observed, or read whenever desired.

Television also involves the conversion of visible aspects of subjects into electrical signals which can be sent to distant points. However, the frequencies required for this conversion are such that ordinary telephone circuits or conventional sound broadcasting equipment cannot handle the signal. Costly coaxial cables with associated high frequency signalling apparatus or ultra-high frequency radio transmitters and receivers are therefore required.

In addition, there is as much difference in the technique of the two mediums of communication as there is between making a newspaper and a motion picture. Where facsimile is concerned with the transmission and subsequent recording of copies of still subjects such as pictures and printed pages, television deals with moving objects or persons. The image on the screen of a television receiver has the basic qualities of a motion picture. The image moves, it is transitional, and when the show is over the screen is blank. Since nothing has been recorded, the images will not be seen unless someone watches the screen when they are to be received.

Facsimile and television thus perform widely different functions. Each will fit into the communications picture as separate services, having fundamental distinctions as widely divergent as those of the public press and the motion picture.

The Finch facsimile transmitter now employed by many broadcasters (see listing on page 335) in their experimental service, uses a scanning machine in which the copy to be sent over the air is inserted in what is termed the "copy head." This holds and advances the copy in front of the "scanning head," consisting of a small electric bulb, lens system, and photo-cell. Light from the bulb is focused as a small spot on the surface of the paper carrying the copy; the reflected light is picked up by the photo-cell. The scanning head is moved from side to side by an electric motor so that the spot of light traces a series of parallel paths across the copy which is moved upward through a distance equal to the diameter of the light spot at the end of each scanning stroke. In this manner, the entire surface of the

STATIONS LICENSED TO TRANSMIT "HOME NEWSPAPERS"

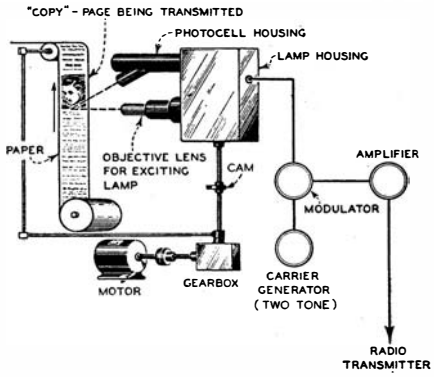
WLW	Cincinnati, Ohio
WOR	Newark, New Jersey
WGN	Chicago, Illinois
WSM	Nashville, Tennessee
WHO	Des Moines, Iowa
WSAI	Cincinnati, Ohio
WWJ	Detroit, Michigan
WHK	Cleveland, Ohio
KSTP	St. Paul, Minnesota
WCLE	Cleveland, Ohio
WGH	Newport News, Virginia
W8XAL	Cincinnati, Ohio
W8XNU	Cincinnati, Ohio

paper is scanned, line by line; the black, halftone, and white areas reflect to the photo-cell varying amounts of light ranging from minimum to maximum. These variations in reflected light effect a change in the amount of current flowing through the photo-cell. This current is fed to the radio transmitter in the same manner as sound broadcast signals are handled. Any conventional receiver tuned to the frequency of the transmitter will then pick up the signals which may be rendered audible by a loudspeaker, or used to operate a "home" facsimile recorder.

The recorders now in use are self-synchronizing. This is an important advantage; the recorder may be located in one state and the transmitter in another—the system does not depend upon local power lines for synchronization. Recorders are available for A.C. or D.C. operation, or for battery supply for farm use.

THE recording machine is similar in many ways to the scanning instrument. What is termed a "receiving copy head" holds the dry processed recording paper, which is fed as a continuous strip two newspaper columns wide from a roll carried in the lower part of the machine. A recording stylus is moved by a small electric motor from side to side across the surface of the paper, forming marks on the paper corresponding in position and shade to the elements of the copy at the transmitter. When the incoming signal is strongest the line traced by the passage of current is darkest; when it is weakest no mark is made. At the end of each of these recording strokes the paper is moved up by an amount equal to the width of each line element. By means of extremely short low-tone signal impulses sent out by the transmitter just before the start of each recording stroke, and by the use of a small motor turning over at a predetermined speed, the recording stylus moves across the paper in step with the scanning head of the transmitter, recording copy in its proper position. In this manner the recorded copy

Illustrations courtesy Finch Telecommunications Laboratories, Inc.



Above: **A photograph being scanned at the transmitter.** ***Left:*** **The diagram shows how light is reflected from "copy" to photo cell**

is built up line by line to appear as a duplicate of the original. One hundred lines will build an inch of reproduced copy; at the operating speed of the present machine, a two column newspaper will be "printed" at the rate of five feet per hour. It is not impractical to hope for a newspaper of five columns in the near future—tabloid size.

The actual home recording machine, which, it is claimed, can be made to sell for less than $50 in mass production, is small enough to be housed as a complete unit in a cabinet approximately a foot square. It may be connected without auxiliary amplifying equipment to the output circuit of any broadcast receiver having a power rating of three watts or more. In operation the broadcasting station from which facsimile signals are sent is tuned in with a receiver as would be the case if regular sound programs were to be received. The loudspeaker is switched off and the facsimile recorder is switched on; the volume control of the receiver is turned to the point where copy has the desired contrast. The resulting recording operation is wholly automatic and requires no attention. Paper costs will be about 15 cents per week.

Until the development of an automatic machine and inexpensive dry recording paper of wide latitude which requires no liquids for moistening or smudgy carbon transfers for printing, the adaptation of facsimile recording methods to home service seemed rather remote. Concentration on the automatic recording problem has resulted in the present-day home facsimile machine which safely operates without attention throughout long facsimile broadcasting periods.

During the present experimental period—and probably thereafter—facsimile broadcasts take place between midnight and 6 A.M. when sound broadcasting facilities are ordinarily idle. Time clocks will turn the radio receiver and recording motor on and off at specified hours. "Printing" of illustrated world events, bulletins with latest news flashes, photographs, market reports, weather maps, cartoons, recipes, and illustrated advertisements of all sorts, will thus be effected in homes while their occupants sleep, the machine being practically silent and entirely automatic in its operation.

THIS, to some who are not familiar with facsimile developments, may sound like one of H. G. Wells' prophecies. That it is not, is attested by the fact that at the present many of the leading major broadcasting stations in the country already have been granted FCC permits and have inaugurated such a service using regular broadcasting frequencies and full power in experimental transmissions to determine public reaction and to obtain basic engineering data for home facsimile services. In addition, other important stations have applied to the FCC and are considering the possibilities of facsimile service.

GIANT MOLECULES:

How Genetics, Youthful Science of Inheritance, Has produced Billions of Dollars of Wealth . . . Big Things that Boil Down to the Minutest Controls

THE remarkable discoveries in the youthful science of inheritance, genetics, have been applied to animal and plant breeding throughout civilization—and with almost incredible success. As regards the United States alone, during the past 30 years, even a conservative estimate of the cash value of the practical application of genetic findings would have to run into billions of dollars. Far greater yields of grains, fruits, vegetables, and cotton; far higher quality both in domestic plants and domestic animals of every description and their products, including milk, meat, eggs, and wool; increased and sometimes perfect resistance to disease; entirely new commercial varieties; and the lessening of the chances of famine: all these are in this story of science.

Thus, seemingly pure research into the machinery of inheritance has made possible stupendous progress in agriculture. This machinery works by controlling the development of the billions of cells, the tiny bits of living material or protoplasm which make up our bodies. Not only do certain cells develop into eye tissues or brain tissue under the influence of heredity's mechanism, but also each special group of cells submits to even more precise regulation: frequently so precise that you may inherit a startlingly exact copy of your father's nose, or mouth, or of your mother's brain, perhaps with its peculiar sort of "nervousness."

WE did not derive all our practically countless cells directly from our parents. Each parent provides only one cell. These two unite to form the first stage of our existence, the one-celled embryo. This tiny cell, multiplying by continued cell division, finally produces the fully mature body.

We are made up of billions of cells, and so, of course, as we recall, they are microscopic. Yet, small as they are, only a tiny fraction of each protoplasmic bit is involved in inheritance. If we could focus a fine microscope upon the single cell provided by one parent, and if this microscope were very powerful, we would discover, down near the limit of visibility, objects shaped like worms and called chromosomes. These chromosomes are made up of much smaller objects, the genes. At this point even the keenest microscope fails us—and scientists are not quite certain whether they can observe individual genes or, at best, clusters of genes. Nevertheless, all the evidence goes to prove that these minutest genes are the controllers of inheritance. And they have turned out to be giant molecules, each with some specific rôle to play in the development of color of hair, hardness of teeth, or some other of the thousands of characteristics which we inherit.

The science of genetics took its rise as late as the beginning of this century. That is, the first real approach to the understanding of the mechanism of heredity followed the discovery that practically the sole significant material which parents transmit to their offspring is the substance chromatin, the material of which all the wormlike chromosomes are made. It was found that chromatin makes up the chief portion of the sperm cell, the sex cell from the male. And in the case of the egg cell, the sex cell from the female, there appears to be little else but chromatin and reserve food. Hence, was it not logical to assume that chromatin contained the whole machinery for regulation of the offspring's development of its parents' characteristics?

The opening up of an entirely novel field of research placed the basic meaning of chromatin beyond any question. The highest honors for leadership in this field belong to Dr. T. H. Morgan, of the California Institution of Technology, who received the 1933 Nobel award in Medicine for his outstanding labors. The lowly vinegar fly, Drosophila melanogaster ("black-stomached fruit-lover"), has been in a major way the organism experimented with—though biologists have not neglected to check their results by ferreting out the secrets of wasps, barley, corn, wheat, primroses, jimpson weed, and many other living things. In this new branch of science, not only the chromosomes have been exhaustively investigated, but even the ultra-microscopic units out of which these wormlike rods are constructed. Modern scientific probing has penetrated down from the microscopically visible rods of chromatin to their constituent particles, the genes, whose measurements are in terms of a few hundred-thousandths of an inch.

More than 25,000,000 vinegar gnats have been examined. Excellent reasons lie behind this magnitudinous study. A human generation appears about every 25 years; the fruit-loving gnat reproduces in 12 days. Moreover, these gnats are readily raised by the tens of thousands in milk bottles in the laboratory. They have only four pairs of chromosomes, and it is not difficult to distinguish between the individual rods. Best of all, the vinegar fly has many heritable characteristics which are easily recognized: form of body, color, shape of wings; color of eyes; number and types of bristles; susceptibility to disease; and length of life. Finally, Morgan was awarded a Nobel prize in *Medicine*—because the laws of inheritance which apply to the fruit fly apply also to man. Like the fruit fly's body shape, human feeblemindedness, shortfingeredness, and color blindness show up, generation after generation, in response to the manner in which heredity's machinery operates throughout the animal and plant kingdoms.

MORGAN went far beyond merely proving that a given chromosome bears the determinants (genes) for a given characteristic, such as eye-color. By delicate and difficult technique, he demonstrated that a given determinant is located in a given region of a chromosome. Astoundingly, he was ultimately able to construct accurate maps of the chromosomal positions of the various physical bases of definite features of the species; that is, maps of gene locations. Tens of thousands of breedings have attested the accuracy of his chromosome mapping. Genes once had existence in theory alone. Today their existence is an established fact.

Now we are certain that behind susceptibility or resistance to disease in wheat or potato; production of milk with a high content of butter fat; liability to hog cholera; record egg-laying—behind these characteristics and many another valuable financially, lies the gene as the fundamental unit, out of which the machinery of inheritance is constructed.

Once bio-scientists became satisfied that the gene is a real, physical unit, they sought its structure, its properties, and its arrangement in the chromosomes. Their findings have been amazing, not merely to themselves, but to physicists and chemists as well.

Compounded of a million atoms yoked in a bafflingly intricate design, the gene is gigantic among molecules. Though of course as a molecule it is (probably) invisible even beneath the most powerful lenses, its dimensions are for a molecule actually tremendous: somewhere

THE MACHINERY OF INHERITANCE

By BARCLAY MOON NEWMAN

near a ten-thousandth of an inch in length, and some fraction of this measure in diameter.

The chemical classification of this super-molecule seems to be with the proteins, which are exceedingly complex compounds of carbon, hydrogen, oxygen, nitrogen, often sulfur, phosphorus, and other elements, and which are assumed to be the truly essential molecules of life. Certainly, no live material without protein is known—or supposed to exist. Examples of proteins are hemoglobin, the pigment which gives red blood corpuscles their color; albumin, the main constituent of egg-white; and the milk protein, casein. The ultra-microscopic virus of mosaic disease of tobacco is another protein, recently obtained in bulk as glassy, needlelike crystals, each made up of countless molecules. These too are super-molecules—also with many an uncanny property of the gene.

The genes are strung end to end to form wisps, called chromonemas, and these fine threads are bound together to produce a chromosome. The machinery of inheritance therefore is no more and no less than a vast and stupendously intricate system of chemical systems—the basis of whose chemistry is the particle, the gene, a super-compound.

IN cell division, chromosomes are seen to reproduce themselves. The gene, the foundation of the chromosome's architecture, must do likewise. Or, rather, genes, by their individual multiplication, construct new chromosomes. Here is an almost unbelievable, a wholly novel, ability of a molecule: to create its like out of the lesser molecules of a suitable surrounding medium. Only in the gigantic virus protein have we discovered such a remarkable property—almost incredible to the physical scientist, who is used to far simpler aggregations of atoms.

For an approach to this problem of self-creation, or autosynthesis, we must consider the enzyme, also believed to be a formidable protein, though not so accomplished a one as the gene. Digestive ferments, such as trypsin of pancreatic juice, stimulate and regulate the breaking up of complex compounds into simpler molecules, known as amino acids, which the body can then assimilate. This disintegration can be reversed, however: an enzyme under appropriate conditions works backward—builds up amino acids into proteins (or unites them into protein-like compounds). If a super-enzyme had the power to fashion not simply great molecules out of small ones, but moreover great molecules precisely like itself, would we not have autosynthesis, as in the gene? And so it is thought that a clearer idea of the workings of enzymes may give us a better grasp of the self-production of giant molecules, like the genes, the cogs in heredity's mechanism.

In the first 25,000,000 fruit gnats studied, about 500 heritable changes in eye-color, length of life, susceptibility to

Dr. T. H. Morgan, economically the nation's most significant Morgan

germs, showed up. Such heritable modifications of the ancestral characteristics are mutations. For example, every so often a young gnat, offspring of red-eyed ancestors, is born with the mutation, white eyes. Man has made valuable use of natural mutants like the seedless orange and rust-resistant wheat.

How do the genes, linked by the thousands to make chromonemas, cooperate to change a microscopic, one-celled embryo into a billion-celled man—and even a man very closely resembling his parents? We must assume that the genes have the ability not only to reproduce themselves, but, still more like super-enzymes, to start, regulate, modify, and terminate the biochemical reactions which, all together, mean life—and growth of many diverse tissues and organs and organ systems into a body astonishingly similar to that of the preceding generation. Incomparable abilities!

We have to speculate that the gene, as a super-enzyme, causes a bafflingly complex chain of chemical processes in the protoplasm in which the chromosomes swim. And this chain must include the production of innumerable stimulators and regulators; that is, enzymes, every one with its kingdom of biochemistry to supervise and keep harmonious.

Far from halting his labors in despair at the vastness of such chemical systems, the embryologist has persisted in his attack upon these deepest mysteries of vital existence. Thus, recently, he has been able to exhibit the presence, in the developing animal, of substances called organizers, which promise to turn out to be super-enzymes, given substance and activity through the agency of the genes.

IN 1900, Dr. Hans Spemann, now of the University of Freiburg, Germany, began a laborious series of researches upon the embryology of amphibians, including newts and salamanders. He cut newt eggs and young embryos into pieces, and observed the development of these pieces with a view toward finding the stages at which special determiners of particular kinds of tissues appear—or might appear. He transplanted bits from an early embryo to certain definite sections of more fully developed embryos, to watch the effects of possible early-appearing or late-appearing super-enzymes, or organizers. In the course of these experiments, from one embryo he took tissue which would normally produce the spinal cord of the young animal, and transplanted this tissue into another embryo. A spinal cord came into being in the second animal where one would not ordinarily be formed. Hence, the transplanted cells must manufacture organizers which stimulate surrounding cells to change into a particular kind of structure: a spinal cord, in this case.

Spemann's work established the fact that an organizer determines whether a group of cells becomes spinal cord or becomes skin, or some other sort of tissue; and that such activators bring about the growth of organs each in its own proper place and each with its own proper functions. His achievement won him a Nobel award in 1935.

The transformation of the single-celled offspring into smoothly functioning adult, with billions of cells, must involve many a super-molecule, the delight of the biologist and the confusion of the physical scientist.

All illustrations courtesy American Telephone and Telegraph Company

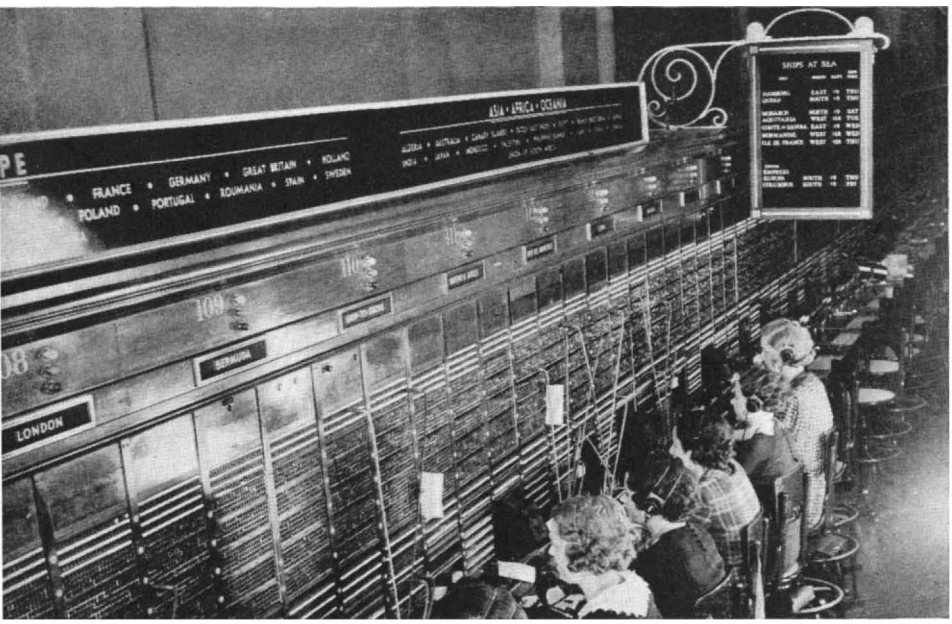
'America Calling'

How A Transatlantic 'Phone Call is Made

By A. P. PECK

1 Within an average of 12 minutes after an American subscriber puts in a call for a party in London, the connection is made and conversation is carried on as clearly and easily as if the called party were only a few blocks away. Behind this commonplace occurrence (an average of 50,000 overseas calls are made yearly, 60 to 65 percent of them being transatlantic), there is a vast array of technical developments and their application, aimed toward maintenance of service and speech quality

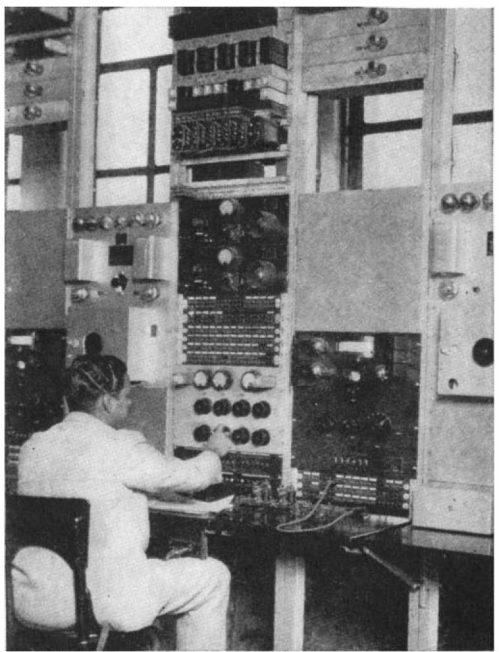
2 The United States subscriber making the call asks his local operator for "Long Distance" (*above*); she in turn connects him with one of the operators at the switchboard through which all overseas calls are handled, shown at 3



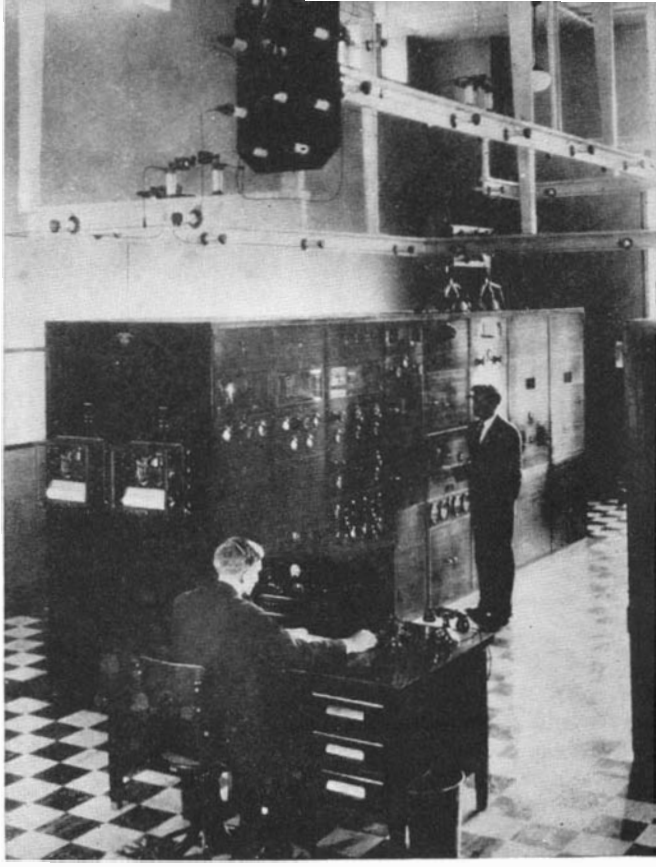
3 *Left:* The "Overseas" board through which passes the call to London. Here are handled most of the 'phone calls set up between the United States and foreign countries by wire and radio telephony. First duty of an operator receiving a call at this board is to write down all details of the destination of that particular call

4 *Left:* After the "Overseas" operator looks up the number of the called party in London, she passes the information to the London operator over the radio circuit. At the desk shown are assembled 'phone books of the principal foreign cities reached by the radio service

5 *Right:* The wire part of the overseas circuit passes through the control room in the same building as the switchboard. Here operators maintain a constant watch on the apparatus; here also outgoing speech is "scrambled"



6 To insure privacy of overseas telephony, speech is "scrambled," or inverted in frequency; anyone listening in with a radio receiver would hear sounds resembling almost anything but coherent speech. The above drawing, fanciful in its execution, shows briefly what happens. The voice frequencies of "America calling" are scrambled to sound something like "on oy ikau ki yung"; they are unscrambled when they reach the receiver



7 From the control room shown at 5, a wire line carries the voice of the speaker to a short-wave transmitting station at Lawrenceville, New Jersey (*above*), whence it is hurled across the Atlantic by a directive radio antenna system, picked up at a receiving station near London, and sent on its way once more by wire

8 *Left:* The radio control room in the London Trunk Exchange, where the voice from the United States is unscrambled. Here also operators keep check on the functioning of all associated apparatus, and control the volume of current passing through the circuit so that transmitted speech will at all times be within the easily audible range—neither too loud nor too low for perfect understanding

9 From the radio control room the incoming voice is passed by wire to the International Exchange in the same building, whence it is routed through the local telephone exchange system and finally reaches the party being called

10 *Right:* The call is completed. Quickly and without hitch, two parties on opposite sides of the Atlantic have been connected by wire and radio, an accomplishment made possible by the findings of intensive scientific research

PERSONALITIES OF

Why the Diamond is so Hard and Copper Soft... Why Silicon Carbide Abrasives are Exceedingly Hard ... Other "Whys" in Terms of Their Fundamentals

METALS, like people, have personalities. Some metals, such as gold, silver and copper, are soft and yielding; they can be stretched into fine wires or flattened into sheets a thousandth of an inch thick; still the parts cling together. They are the best conductors of electricity we know. Other metals, such as tungsten, vanadium, chromium, and bismuth, are hard and unyielding. When struck with a hammer they shatter into splinters or crumble to powders. A fine tungsten filament is just the thing for an electric lamp, for tungsten is a rather poor conductor of electricity. So great is the resistance offered to the passage of the electric current that the filament becomes white-hot. Fortunately for the electric lighting industry, tungsten has the highest melting point of all the metals.

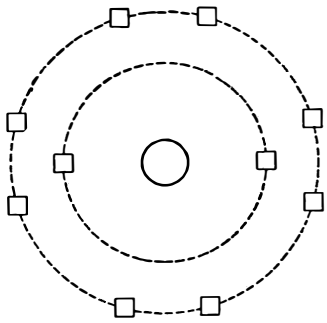


Figure 1: **In the neon atom the nucleus is guarded by eight outpost electrons: a self-contained unit**

Pure metals are chemical elements—as are pure non-metals such as the diamond, sulfur, and the glowing neon gas so widely used in advertising signs.

Has science any way of explaining the personalities of the many elements or shall we merely accept them as God-given attributes? Can science tell us why the diamond, which is nothing but pure carbon, is the hardest substance known and a total non-conductor of electricity; why neon is a gas; why sulfur is brittle and crumbly and an excellent insulator; why copper is soft and yielding and the best cheap conductor of electricity, while titanium is hard, brittle, and a poor conductor of electricity?

As human behavior seems to be controlled largely by the genes, those tiny biological regulators of heredity, so too the behaviors of the elements seem to be controlled by the electrons, genes of the atom. Science has long realized that elements are made up of atoms and that the atoms of any given element are alike—far more alike than peas in a pod. When we look at a piece of gold, we are looking at untold billions of gold atoms lined up in some kind of orderly array, each atom held in some mysterious manner to its neighbor atoms. In the diamond, too, is orderliness, even more regularity than in gold, with each of the myriad carbon atoms joined to its fellows in a definite pattern. What determines this orderliness? It is the number and arrangement of the electrons.

In the past decade or two, science has probed deeply into the atom with its delicate electrical probes to discover that the atom, itself, is not the tiny, hard ball we once imagined but a complex affair indeed. Each atom might well be likened to a company of soldiers in war maneuvers. There are large and small companies comparable with light and heavy

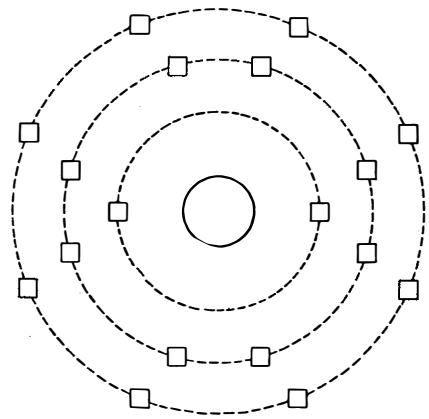


Figure 2: **The argon atom, though larger and heavier than the neon atom, also has eight outpost electrons and is a self-contained unit**

atoms. In the center, compactly massed, is the main body of troops representing the nucleus of the atom—and its mass. Far out on the flanks, guarding the main body and acting as contact patrols, are the flanking electrons, small in mass but highly important. Small companies will have out but few of these flanking patrols, while larger forces will be surrounded and guarded by many flanking units. Thus we may picture the atom as a central mass, the nucleus, small in size but heavy in weight, surrounded at some distance by flanking electrons, the number of such electrons depending on the massiveness of the nucleus.

IT is to these flanking electrons that we turn in order to understand the behavior of the atom and the element. As in any well organized fighting force, the electrons are assigned positions in flanking zones. If a zone is full—and a complete outer flanking zone never contains more than eight electrons—additional electrons must take up positions beyond the completed zone. The atoms of some elements have their outpost zone complete with eight electrons. This magic number constitutes a perfect defense. The atom is guarded on all sides and the eight flanking electrons form, as it were, a magic and impenetrable ring. Such atoms are self-contained units. They need not—in fact never do—herd together in flocks or fleets for mutual defense. Each atom travels its solitary path independent of its fellows. If there is no herding together there can be no solid, and elements whose atoms have such perfect symmetry will be gases. Such elements are the so-called noble gases: helium, neon, and argon (Figures 1, 2). The flanking electrons hold tight to the atom and, while they can be loosened and temporarily removed, they flip back into place again in a hurry. The scientist explains the colorful glow of neon gas as due to this flipping back of electrons when they are temporarily displaced by a high-voltage discharge.

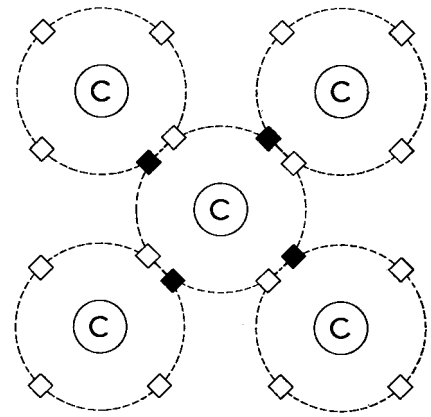


Figure 3: **By co-operative sharing, the central carbon atom obtains an outpost zone of eight electrons**

THE ELEMENTS

By SIDNEY J. FRENCH, Ph.D.
Assistant Professor of Chemistry at Colgate University

In the noble gases there is a complete isolation of atoms and a complete lack of co-operation between atoms; but next, in contrast, let us turn to the diamond as an example of the most complete and perfect co-operation between atoms. The diamond is composed entirely of carbon atoms and carbon atoms are highly gregarious. We return once more to our war-like analogy. Each carbon

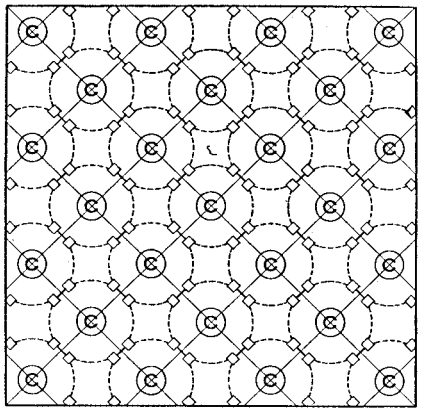


Figure 4: **Arrangement of carbon atoms in the diamond, showing why the diamond is so hard: its atoms are compact and tightly locked**

atom has four flanking outpost electrons—just half of the magic number of eight. Imagine, if you will, five carbon companies in war maneuvers, a central company surrounded by four others. Each company must maintain contact with the others through its four flanking contact patrols. Patrols from adjacent companies pair off, giving the central company eight patrols around it—again the magic number (Figure 3). But this is a process of sharing patrols; there is no self-contained unit. These co-operating patrols serve to hold the companies in a fixed and rigid relationship to one another. There can be no skewing of the battle front or lagging behind of one flank. This, then, constitutes the acme of perfect co-operation, perfect sharing of responsibilities. In the diamond each carbon atom is attached to its four surrounding neighbors by pairs of flanking electrons, one member of the pair coming from each atom. Only on the outside of the diamond is the symmetry of eight electrons incomplete. Since this co-operative sharing process can be continued indefinitely there is no theoretical limit to the size of a diamond crystal. It is no wonder that the diamond is the hardest substance known to man, for the atoms are small and the co-operating electrons hold the many atoms in a tight and rigid embrace (Figure 4).

But, there is still one puzzling fact to be explained. Everyone knows that electrons are negatively charged and everyone likewise knows that negative charges repel one another. How, then, is it possible for two electrons to co-operate as a pair in holding atoms together? Science believes that these electrons spin like tiny tops. Each is a little dynamo setting up a magnetic field around it. If two electrons are spinning in the same direction, these fields will repel one another. If, however, the electrons spin in opposite directions, the fields may interlock, drawing the electrons together as a co-operating pair. Like two gear wheels in mesh, they work together while spinning in opposite directions.

Though silicon atoms are somewhat

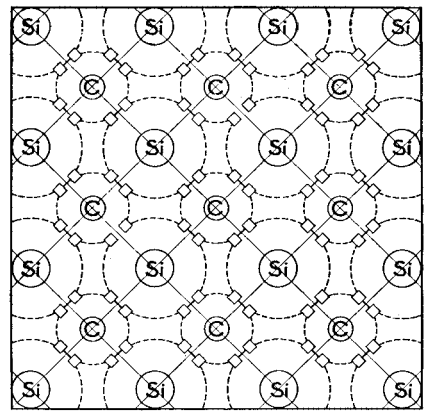


Figure 5: **Arrangement of carbon and silicon atoms in Carborundum. Each silicon atom is surrounded by four carbon atoms and each atom of carbon by four silicons; yet by the sharing method each interior atom has eight electrons**

heavier and larger than carbon atoms and possess eight more flanking electrons, the arrangement of the electrons is such that there are again four outpost electrons. So silicon, like carbon, forms hard, rigid crystals; but, more than that, silicon and carbon atoms can be alternated in a common crystal just as companies of French and Moroccan troops might co-operate through their contact patrols. This compound, silicon carbide, known commercially as Carborundum, is almost as hard as the diamond and is commonly used as an abrasive.

We may safely conclude that this perfect co-operation between atoms possessing four outpost electrons to provide eight electrons around each interior atom results in extremely hard, brittle substances.

WHEN we turn to the metals we find a quite different situation (Figure 6). The copper atom has but one outpost electron. Obviously, copper atoms cannot be self-contained units like neon atoms, nor yet units capable of perfect co-operation like carbon atoms. The lone electron has an immense space to guard. It must be an electron with a good mount capable of great mobility if it is to maintain contact between numerous neighboring atoms. It must be first on one side of the atom, then on the other, pulsating, as it were, between atoms. With such conditions existing there can be no great rigidity of formation. There can be skewing and lagging; atoms can slide past one another to take up new positions but still the lone contact electrons keep the atoms from falling apart. The copper atom army is one of great flexibility. No wonder copper can be pounded into thin sheets; these atoms slide easily into their new positions (Figure 7). Then too they may be strung out one after the other in fine wires.

Now copper is an excellent conductor of both heat and electricity, while the diamond conducts neither. Heat causes atoms to vibrate more rapidly; mobile atoms can transmit such vibrations from one to the other easily while atoms held rigidly in place cannot. Thus is explained in simplest terms the ability of

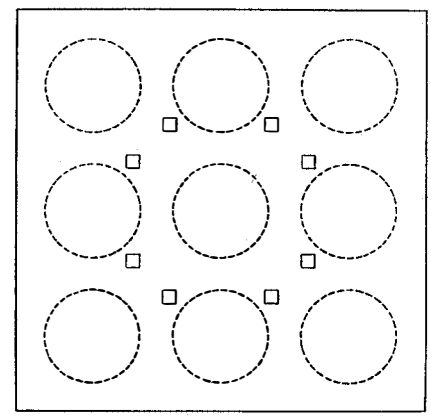


Figure 6: **In metal atomic structures there are too few electrons to be shared in fixed positions between atoms, consequently the electrons are mobile, free to move**

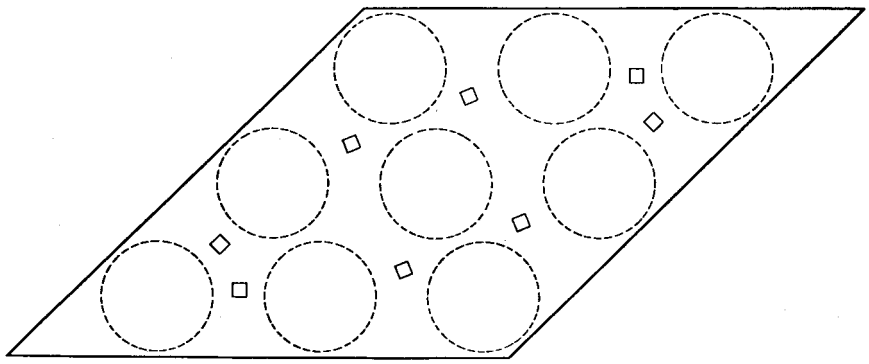


Figure 7: **Metals can be flattened out and worked because the lone outpost electrons are not capable of holding the component atoms in rigid positions**

copper and the inability of a diamond to conduct heat.

Modern science regards an electric current as a flow of electrons. As the jerk of a locomotive transmits the jerky impulse successively to car after car of the following train, so electrons are thought to transmit the electrical impulse to successive electrons. When electrons from a battery are shoved in at one end of a wire, there is a continuous displacement along the line to the other end where the electrons may be removed (Figure 8). We have, in effect, a line of dominoes standing on end. As the first is knocked over, it transmits the impulse to the next and successively to each in turn.

Without mobile electrons there can be no transmission of the electrical impulse. The greater the mobility, the greater the ease of passage of the electrical current. Hence, copper, silver, and gold, with but one outpost electron per atom, are our best electrical conductors. In the diamond electrons are in fixed and rigid positions and in symmetrical groupings. There is no mobility; hence the diamond is a non-conductor of electricity.

WE have described in some detail three fundamental types of atoms, those which possess eight flanking electrons and are self-contained, those which possess four flanking electrons and represent the acme of co-operation, and those which possess but one flanking electron to form the mobile metals. We have passed from the most perfect gases through the most perfect and most rigid of substances to the very soft and yielding metals. We have pointed out three extremes of personality: the self-contained, the co-operative, and the mobile. Intermediately we should find intermediate personalities and so we do.

Metals whose atoms possess two flanking electrons are as a rule somewhat harder than copper and are fairly good conductors of heat and electricity, while metals with three flanking electrons are still harder and are poor conductors of electricity. Some elements possessing five, six, or seven flanking electrons are gases because of the ability of two atoms to co-operate in sharing electrons and thus build up symmetrical flanking units of eight. Here, however, each independent unit is not an atom but a pair of atoms co-operating as a stable combination. Others of these elements, like sulfur, are solids, somewhat brittle and crumbly and non-conductors of electricity. In them the sharing of co-operating electrons is, at best, an imperfect one and none of these solid elements approaches the diamond in hardness and few have the luster so characteristic of metals.

However, the entire story has not yet been told. The element titanium, though hard and brittle, is a fair conductor of electricity and is definitely a metal. But, like carbon, its atom has four flanking electrons. This should make it, like carbon, a non-metal. Evidently the mere number of flanking electrons does not tell the entire story. Let us return once more to our analogy. Titanium is a much larger and heavier atom than carbon and possesses four zones of flanking electrons where carbon has but two. Obviously, the outpost electrons will be far from the nucleus and the titanium companies far apart. The contact patrols have a large area to cover and protect; hence, they must be considerably more mobile than those of the carbon atoms. We find that this greater mobility has a considerable effect on the behavior of the element. It is more metal-like in its personality. Thus, as an increase in the number of electrons tends to make the element less metallic, so an increase in the weight and size of the atom may in part offset this tendency.

There is still another factor which tends to make these heavy atoms more metallic in nature. In atoms having three or more outpost electrons one pair of electrons often tends to drop back into a zone nearer the nucleus. For example, aluminum atoms possess three outpost electrons, yet aluminum is a rather soft and yielding metal and conducts electricity well. As a metal it might well be classed with copper, silver, and gold as having but one outpost electron. Bismuth, in spite of its five outpost electrons, is definitely metallic, though it is hard and brittle. Its metallic nature can be attributed both to the massiveness of its atoms and the tendency of one pair of electrons to drop back from the outpost zone.

THE personalities of the elements are not reflected in their electrons but determined by their electrons—"genes" of the atom. At all times their behaviors are predictable and consistent, for genes are constant. Standing at one end of the line of elements are the noble gases, exemplified by neon, with their symmetrical structures of eight electrons and their self contained, rugged atoms. In the center of the line is carbon, greatest exponent of communistic sharing; each atom is joined to four fellows through the medium of its four electrons with rigid and unyielding bonds. At the other end of the line stand copper, silver, and gold, soft and yielding, adaptable and flexible, poor in electron genes but rich in mobility.

Dominating the entire line is the "rule of eight." It was by arranging the elements in order of the increasing weights of their atoms that Dmitri Mendeléeff, back in 1868—long before electrons were known—discovered this famous "law of octaves," the periodic law of the elements. With the discovery of the electron came a striking verification of this great law—and its explanation: when a quota of *eight* electrons is complete a new zone begins. In rows of eight, then, each row a graded period, one row beneath another; and in seried columns, each column a chemical family, shrewd Dmitri Ivanovitch Mendeléeff characterized the elements each in its own personality frame, yet each related to all others in his remarkable periodic table.

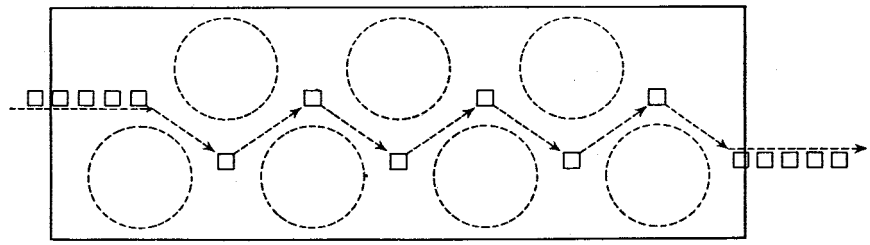
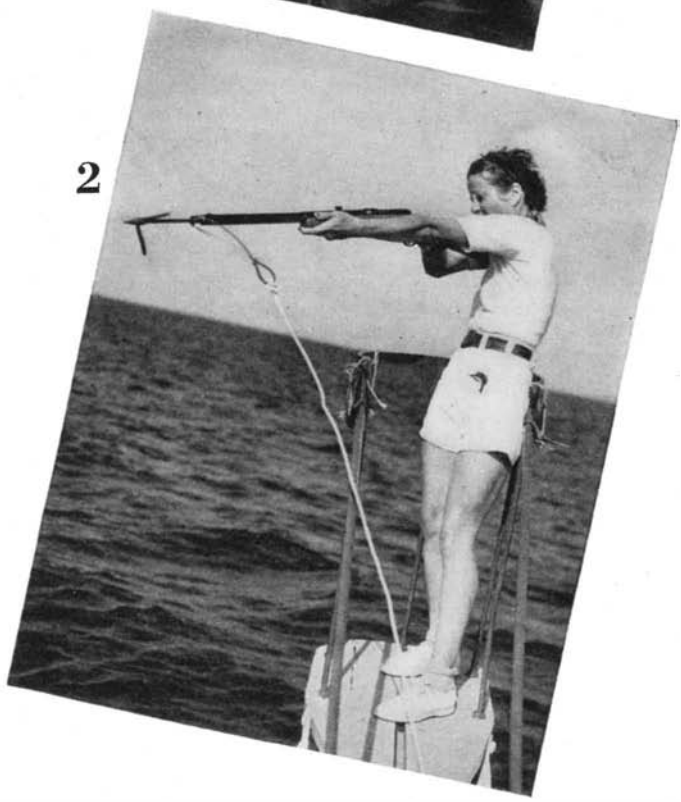


Figure 8: **Diagrammatic representation of the conduction of electricity by a metal. (All the figures in this article are diagrammatic.) Electrons enter the wire at the left, are displaced from atom to atom, and leave at the right. In an actual cross-section of wire there would, of course, be billions of atoms**

Shark Shooting for Sport

UNTIL recently used solely by commercial fishermen for harpooning swordfish, a Swedish harpoon gun has now become a part of the equipment of sport fishermen. A 10-gage shotgun shell gives it an accurate range of 75 feet, after which the attached harpoon line offers sufficient drag to pull the iron down.

1



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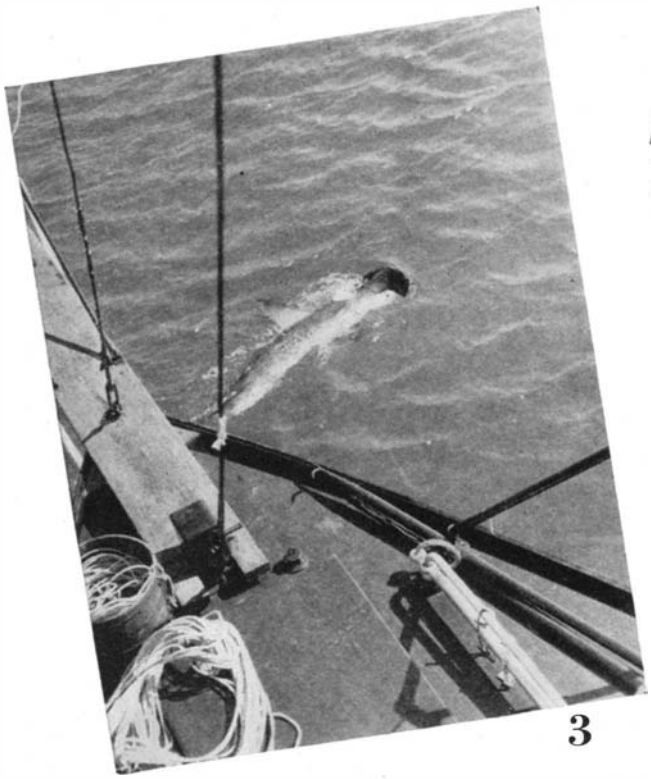

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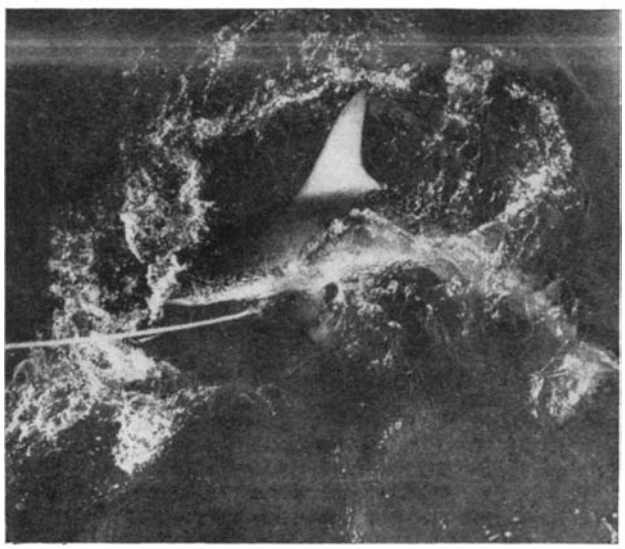


Thrills of deep-sea fishing are combined with those of big-game hunting when the quarry is a huge shark and the weapon is a harpoon gun. The photographs show the use of the gun and include an unusual picture of a shark that has been successfully harpooned. At 1, Jean Smythe, wearing her catalin sailfish emblem awarded for entering the first sailfish in a recent West Palm Beach Fishing Derby, is loading the steel dart, with line attached, into the gun barrel. A shark sighted and the boat maneuvered to position, she takes aim, 2, at the huge hammer-head swimming under the pulpit, 3. A squeeze of the trigger and the steel dart sinks home. Thrashing in the water, twisting and turning in its endeavors to shake off the dart or slash the line, the shark is shown in the water at 4. After harpooning, the 12-foot fish is played to the boat and dispatched

STERILIZING WITH 'LIGHT'

Microbe "Death Ray" . . . Invisible Ultra-Violet Rays Kill Bacteria . . . Harmless to Humans . . . Inexpensive . . . Lamp for Hospitals, Food Handlers

By F. D. McHUGH

NEW patrons of a bank at Suffern, New York, are puzzled these days by a curtain of pale bluish light that falls between them and the tellers, along the grilled windows. For some reason, bank patrons try to get as close to tellers as possible, and bank employees suffer more than an average number of colds. Invisible radiation emitted by slender 30-inch tubes at the tops of the grilles protect tellers in this bank from infection.

Casual buyers of meats in the Economy Stores, of Boston, have recently become acquainted with the same "lights," and with a new word, "rentschlerization." In a cafeteria at Bloomfield, New Jersey, drinking glasses as well as meats and other perishable foods are "rentschlerized." In the operating rooms of Duke Hospital, Perth Amboy Hospital, and others, the faint bluish light streams down on operating areas, with the result that operating-room infections, ordinarily met with in several out of each hundred major operations, now are almost unknown in these hospitals.

ALL these are indications that effective, economical sterilization with ultra-violet radiation is here. Bacteriologists have known, almost since the days of Pasteur, that ultra-violet radiations would kill microbes. But attempts to put this knowledge to practical use on a wide scale have failed, because ultra-violet lamps used in the efforts have produced, along with the germ-killing radiation, unpleasant quantities of ozone and heat; have been expensive to make and operate; and have required high intensities of output to produce the necessary degree of sterilization.

The ultra-violet spectrum, though invisible to the eye, contains many more "colors" or different wavelengths than even the visible spectrum. Ordinary ultra-violet lamps emit most of these "colors," though it is well known that some have little or no effect on bacteria, while others produce such special effects as tanning the skin, forming ozone in the air, and the like. Appreciable power is necessary to produce this enormous long spectrum of invisible light; ordinary ultra-violet lamps operate hot, are expensive to make, may be dangerous, and the bactericidal effect is low in efficiency.

The heat emitted by such lamps makes their use uneconomical, for example, in refrigerators. When used to aid in the sterilization of meats and other foods, it was found that the ozone produced by some of the wavelengths hastened rancidity in fats. The lamps required the use of quartz envelopes to transmit the ultra-violet radiation, and thus were so expensive that they were not commercially practical for sterilization. Furthermore, they required too much electric power to operate.

A solution to this problem of making light-sterilization practical cost Dr. Harvey C. Rentschler, Director of Research of the Westinghouse Lamp Division, and his associate, Dr. Robert F. James, staff bacteriologist, more than five years of research. Because what they developed is both a radiation source and a method of using the radiations, it has been formally and formidably named "the Rentschler-James Process of sterilization with ultra-violet radiation." In meat and food shops, at soda fountains and taverns where the process is used, it has already been shortened to "rentschlerization."

The process is both simple and inexpensive.

It was known that some portions of the ultra-violet spectrum killed bacteria more effectively than others, but these regions were not exactly defined. Dr. Rentschler's first task was to invent a meter that would measure accurately the amount of invisible radiation of any selected wavelength (or "color") being emitted by his experimental lamps. His ultra-violet meter, the outcome of this preliminary research, is now used throughout industry wherever ultra-violet is used in any process.

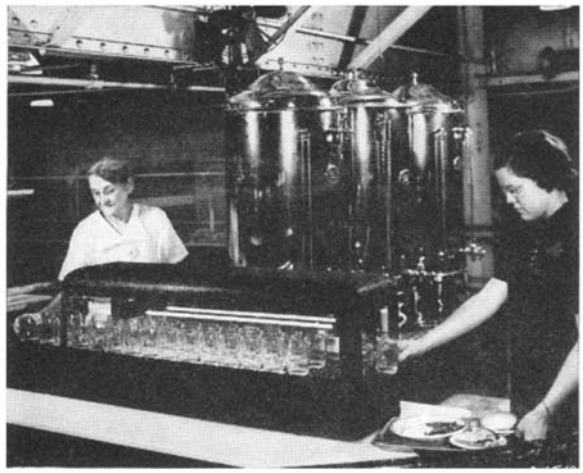
The next step was to test, tediously and painstakingly, the effect of various ultra-violet wave-bands upon bacteria and other micro-organisms. This task, alone, could have consumed a lifetime of effort, had not Dr. Rentschler and Dr. James devised a rapid method of making bacteriological tests. They confirmed the belief of other physicists and bacteriologists that some portions of the ultra-violet were more deadly to microbes than others. Moreover, they found the wave-band which appeared to be the most effective. This microbe death-ray—harmless to humans—has no name, but is designated as in the neighborhood of the 2537 Angstrom unit band.

With this knowledge, they undertook to devise a lamp that would be sturdy, inexpensive to make and operate, and of such shape as to provide the greatest germ-killing power over the area to be sterilized. When they had decided upon some sort of gas-discharge lamp containing a bit of mercury vapor and several other light-emitting gases, there still remained a special problem: Ordinary glass is opaque to a wavelength of 2537 Angstroms. Drs. Rentschler and James found their answer to this problem in a special glass that is particularly free of iron, a metal that strongly absorbs the bacteria-killing wavelengths. The first "Sterilamps" were thus created in the Westinghouse laboratory at Bloomfield, New Jersey.

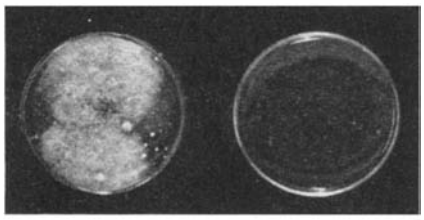
A large refrigerator equipped with the new "lights" to protect and preserve meats

When news of the Sterilamp reached the medical profession, Dr. Deryl Hart,

Surgeon-in-Chief of Duke Hospital, Durham, North Carolina, immediately asked for a chance to experiment with it. Preliminary tests were so satisfactory that operations were then performed on patients, beneath the Sterilamp, and from the first the results were striking. While the bactericidal radiation did not eliminate more than 80 to 90 percent of the bacteria in the extreme corners of the room, it did kill virtually all the bacteria in the air about the operative wound and the supply and instrument tables.



In a cafeteria, a customer takes a water glass from a rack over which two Sterilamp tubes are mounted to sterilize the glasses and prevent growth of bacterial colonies by air-borne germs



Two laboratory petri plates exposed to air in a cow stable. Bacterial growth on one at left is from contaminated air, while one at right is kept free of air bacteria by rays from the new lights

Those major operations performed with the radiation showed no infection and the post-operative temperature curves of the patients were much lower than previously. As a result of Dr. Hart's successful experiments, Sterilamps have since been installed at the Mayo Clinic, Rochester, Minnesota; the New York Medical Center; the Perth Amboy, New Jersey, Hospital; and elsewhere.

Another problem to which the Sterilamps are readily applied is that of cheaply and effectively sterilizing drinking glasses and other utensils in restaurants, bars, and soda fountains.

In a recent survey published in *Survey Graphic*, Roger William Riis disclosed results of a test conducted on glasses in several New York City soda fountains picked at random. Water-glass rims produced 37, 112, 225, and 330 bacterial colonies; milk glasses produced 114 colonies; fruit juice glasses 115 and 444. In another test, 12 office workers were asked to kiss sterile plates. Each kiss produced from 10 to 560 bacterial colonies.

Two professors of Michigan State College, investigating public drinking places in Lansing, found as many as 100,000 bacteria on a single glass. Bacteriologists at Massachusetts State College beat them by 250,000 germs per glass. An examination of glasses at soda fountains in Montgomery, Alabama, revealed that 40 percent of those found were pathogenic—disease-producing.

So well known has this condition been that years ago the majority of states and hundreds of communities passed what were meant to be stringent ordinances requiring the sterilization of eating and drinking utensils. Forty-six states today have such laws on the books, but in general they are not enforced, because it is recognized that none of the sterilizing methods—chemical, hot-water, or steam—is practical. To meet this problem, Sterilamps are installed in series along the inside baffles of bars and soda fountains, in wire glass-holders, or any other convenient form. They operate at temperatures only four or five degrees above room temperature. They give 99.99 percent sterilization in a few seconds' time and maintain constant sterility up to the time of using.

LAST year an epidemic of septic sore throat was traced to its source in a railroad terminal in the New York area. Within two days it had reached several commuters' towns along the railroad line. Meanwhile, what had been one case of septic sore throat in a commuting New York business man was transmitted to his wife, thence to the maid, the children, and finally throughout the community. Moving picture theaters and lunchrooms were examined. In one of the latter, traces of septic sore throat organisms were found in the water used to wash glasses and eating utensils. The proprietor was co-operative. Sterilamps were then installed, and septic sore throat was stamped out at that focal point and kept from re-appearing.

Since bacteria and mold usually found on meats in storage are killed by the Sterilamp, low-temperature storage in meat shops becomes unnecessary. The refrigerator needs only to chill the meat enough to prevent flabbiness and render it firm enough to be cut readily and neatly. Use of Sterilamps does not, therefore, make refrigeration unnecessary, but it appreciably reduces the cost of refrigeration. Results from experimental installations indicate other advantages, too, including reduction of dehydration loss from 6 percent down to 1 percent of total meat purchases; reduction of trimming loss from 10 percent to less than 5 percent; and so on.

An installation of Sterilamps in a refrigerator of Scherer & Company, Mahwah, New Jersey, has resulted in an increase in meat sales of more than 50 percent in eight months, without any advertising or publicity. The store owners report that many of the regular customers are now requesting outside cuts. They also estimate an annual saving of 830 dollars due to reduction in mold, slime, and dehydration losses. The operating cost of the installation, including Sterilamp renewals at six-month intervals, is 130 dollars a year.

IN the baking industry, the Sterilamp has been put to practical use by several companies. Two large firms have been using the lamp to retard mold growth on fruit cakes. Before the lamps were installed, spoilage on the cakes amounted to about 15 percent. After exposure to the radiation and after certain changes had been made in the baking set-up, spoilage fell to a trifling 1 or 2 percent. Most of this improvement has been credited to the lamps.

Drs. Rentschler and James still consider the Sterilamp so new, and its possibilities so enormous, that they are unwilling to make predictions beyond those for which actual installations have provided data. They have learned, however, that microbes are only a tenth as hard to kill in the air as on the surfaces of food or dishes, and this suggests that many air-borne diseases can be controlled by ultra-violet sterilization.

Since the existence of the process has become known, bacteriologists have been clamoring for installations in their laboratories, to control air-borne contamination of samples and utensils. Poultry raisers have been experimenting in the control of chicken diseases by installing the lamps in hen houses. A large drug and cosmetic manufacturer has Sterilamps in his toothpaste mixer and over his unwrapped cold-cream jars. Theater owners have been writing to inquire whether the lamps could be installed to give patrons a free bath of germ-killing radiations as they enjoy the show. Sterilamps will probably soon be installed in household refrigerators, in the kitchen, and in the dish cabinet, to prevent the spread of colds and other maladies through the family. This slender tube, with its faint bluish glow and its unseen ultra-violet radiation may soon, indeed, be a familiar and healthful landmark on the domestic scene.

Some Astronomical Finds

The Best Fish are Not Always Caught by the Best Equipped Fishermen . . . The Little Fellow With a Small Telescope Makes Finds of Unusual Interest

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

THE old proverb that there are as good fish in the sea as ever were caught still holds true for the astronomical observer. He does not have to look back regretfully to some golden age in the past, when noteworthy discoveries were made, and lament that only routine work and drudgery remain for his portion. The industrious observer is still rewarded, now and then, by coming upon something unusual and remarkable. Several good finds of this sort, which have recently been announced, are worth recording here.

First we may pick a report by an Austrian observer—Lause, of Innsbruck. His equipment, as he describes it in a sentence, is not calculated to arouse the envy of others—a small telescope, set up in the open air with no fixed mounting, no driving-clock, no photometer, and an unfavorable climate. But this modest equipment is sufficient for the study of variable stars, by the familiar method of eye estimates, and Herr Lause has devoted his time to the useful, but not always easy, task of determining the periods of eclipsing variables.

Since the eclipses follow one another at intervals equal to the orbital period, it would be very easy to find this if one could observe under ideal conditions. But, if one eclipse is observable, the next is only too likely to come in the daytime, or when the star has set, or in bad weather, and many revolutions may elapse before another eclipse is actually seen. If the two eclipses have been well observed, so that the time of the middle of each is known within a few minutes, the true period should be some exact sub-multiple of this interval. What fraction it is can be found out only by following the star till more eclipses are observed. Then, when we have three or four separate time-intervals, each of which should be an exact multiple of the period, an answer can ordinarily be obtained. Simple arithmetical methods of the trial-and-error type are usually quicker than elaborate algebra.

ONCE in a while, however, there is trouble. For the star now in question, DI Herculis, Lause had a dozen observations of eclipse, but could not find a period to fit them. Finally when seven more eclipses had been observed (by patient watching, never knowing when to expect them) the puzzle was solved. There were two sets of eclipses. Those of each set came at regular intervals of 10.5502 days, but the eclipse of the second set came more than eight days after the preceding eclipse of the first set, and not quite 2½ days before the succeeding one. Until the two sets of eclipses were disentangled, it is no wonder there was confusion. The two sets of eclipses were independently discovered, and announced first, by Kordylewski.

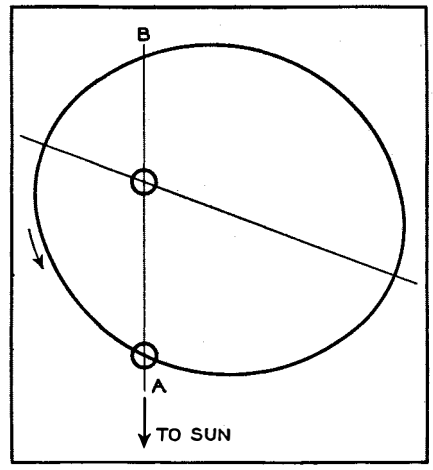


Figure 1: Eclipsing binaries

Readers familiar with eclipsing pairs will see at once what the two sets of eclipses mean. The pair consists of two stars of nearly equal brightness, revolving in a highly eccentric orbit, as shown in Figure 1. At position *A* on the orbit one star comes in front of the other and produces an eclipse of series I; at position *B* it goes behind and there is an eclipse of series II. The time taken from the first eclipse to the second is (by Kepler's Law) proportional to the area of the part of the ellipse on the right of the line *AB*, the interval until the following eclipse, to the part of the ellipse on the left of *AB*.

Lause finds that the principal eclipses (series I) are deeper than those of series II and last longer. The difference in duration is explained by assuming that the distance between the stars is greater at *A* than at *B*, and the orbital revolution consequently slower. The actual lengths of the eclipses are small, 0.36 and 0.26 days, and the losses of light 52 and 40 percent of the whole. It follows from this that the brighter star must give out at least 52 percent of the total light (since its eclipse, which may be partial, cuts off so much), and cannot possess more than 60 percent, even if the secondary minimum is a total eclipse; and it is not hard to show that the two stars must also be of roughly the same size. For a rough calculation we may assume them equal. We then find that the diameter of each is 11 percent of their average distance, and secure the scale-diagram of the system shown in Figure 1. The average density of the two stars can be calculated and comes out one-third of the sun's—a quite ordinary value.

TO put a scale of miles on the diagram, spectroscopic observations are necessary. As the star is of the eighth magnitude, these should be easy to obtain—and also precise photometric measures. The observers with big telescopes will presumably obtain these data within a few years; but the discovery of the remarkable nature and interest of the system will remain to the credit of the man with the small instrument.

Another eclipsing pair, of equal interest, has been studied by two Russian observers, Zverev and Kukarkin. This star, UX Ursae Majoris, was discovered —also in Russia—by Beljawsky in 1933. The present observers, in their first few nights' work, found strange behavior: "Sometimes the star would be almost invisible while the next observation, made after 20 or 30 minutes, would show the star in its normal brightness." It was soon found that there were regular eclipses occurring at intervals of $4^h\ 43^m\ 12^s.39$ but lasting only 40 minutes. Midway between the deep eclipses, in which 62 percent of the light is lost, occur shallow ones, with a loss of only 7 percent.

Apart from the short period, the light-curve of this system is quite of a stand-

ard type. There are two stars, revolving about their common center of gravity in circular orbits. One is ten times as bright as the other and about 10 percent larger in diameter, their radii being 21 and 23 percent of their distance apart. These elements represent the observations admirably and the conclusions appear to be well established. The remarkable one appears when the density is computed, for the results come out 20 times the sun's density for the bright star, and 11 times for the fainter one. These are much greater values than have ever before been found from a study of stellar eclipses. They show that here, for the first time, we have conclusive evidence of the existence of a star intermediate between ordinary stars and the vastly denser white dwarfs. The existence of such stars has long been suspected, for several white stars of spectral Class A are known, which, though probably nearly as hot as Sirius, are of only about the sun's brightness. Their spectra are somewhat peculiar, and it has been supposed that they were dense bodies. Now, in this case, the thing can be proved. The new variable is unfortunately very faint, of magnitude 12.7 at maximum. Photographs show that it is a white, and not a red star, but only the 100-inch telescope can photograph its spectrum. We may hope to hear from this ere long; meanwhile the "little man" may again be encouraged to hear that the observations on which the present important conclusions are based were made with a 7½-inch telescope, by the usual method of estimating the brightness of the variable with respect to a series of comparison stars. The magnitudes of these stars were carefully measured with a photometer by the same observers.

ONE more circumstance—perhaps the most curious of all—should be related. When the observers realized the remarkable character of the star, they wrote to the great Russian observatory at Simeis to ask whether it was shown upon their photographs. It was looked up, found on 71 exposures—and reported to show no variation! This must have been disconcerting to the visual observers. But when they had worked out an accurate period they found, that, as luck would have it, every one of the 71 photographs had been taken when the star was not undergoing eclipse. A diagram showing the phase of the variation for each exposure shows that they are scattered thickly over the whole period, with but a single gap—and in that gap, covering one eighth of the period, the eclipse happened. The chance that any observation made at random should miss the eclipse is 7/8. On ordinary principles of probability the chance that every one of 71 observations should miss it is $(7/8)^{71}$ or 1 in 13,000. The photographs were not actually taken at random, but as series of exposures on a few plates, at regular intervals. Whether this should modify the calculations of probability is a question for specialists, but it is evident that here we have a well-attested case where a very improbable event has actually happened. It may be recalled, however, that hundreds—probably thousands—of other variable stars have been similarly looked up on photographs, and no such case of missing every time has been recorded before.

Members of the Louisville Astronomical Society edging a 20-inch disk of Pyrex on their machine in quarters lent by the University of Louisville, Louisville, Kentucky. In the group are a gas chemist, a garage owner, a manual training instructor, a paint maker, a mathematics professor, a type-caster, a bridge engineer, and the treasurer of a glass company—typical combination of amateurs. The society meets weekly, discusses astronomy and telescopes, and will ultimately complete this telescope of 100-inch focal length which will then be used jointly by the University, the public, and the makers

Another interesting discovery, of a different sort, is reported from Stockholm. It came in the course of routine observations for stellar parallax. Among the stars on the working list was one of magnitude 11.6, with the considerable proper motion of 0″.95 per year. Measures of a series of photographs led to a parallax of 0″.089—putting the star at a distance of 36 light-years, and making its real brightness 1/400 of the sun's. All this is quite in the ordinary run; but an objective-prism photograph showed that the star had a spectrum of Class A—in other words, that it was a white dwarf. In luminosity and spectrum, this star resembles the companion of Sirius, and it is altogether probable that it, too, is of very small size and enormous density.

From the same observatory comes another discovery of the same sort, made by the same observer, Dr. Ramberg.

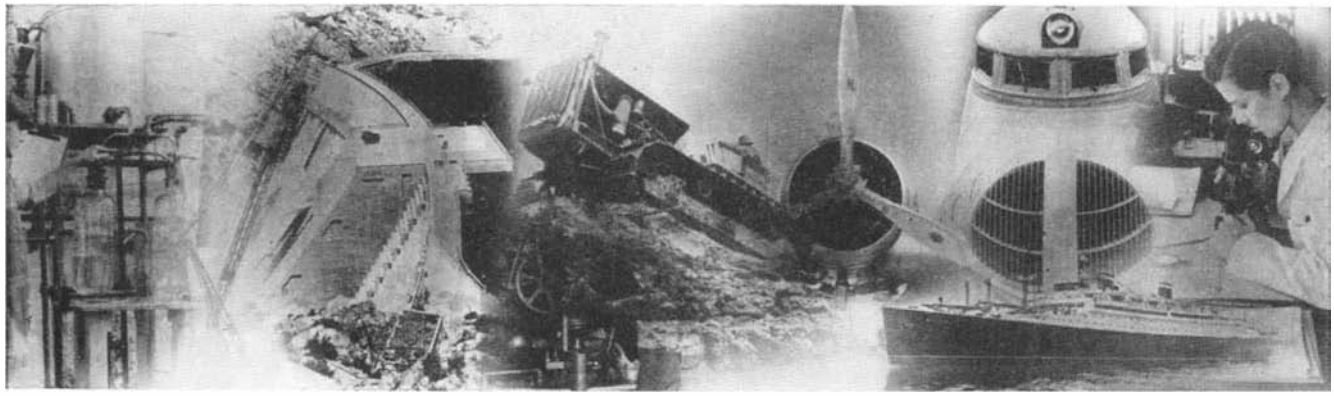
Ever since Lewis Boss discovered the great moving cluster of the Hyades, in Taurus, and determined its distance, a search has been made for fainter members of the cluster. This is a straightforward piece of work, for the cluster stars move fully a second of arc in ten years and a displacement of this amount cannot possibly be missed when photographs taken at an interval of a decade or more are compared. A considerable number of faint cluster stars, discovered in this way by van Rhijn and Raimond, have been observed spectroscopically at Stockholm. Among these, Dr. Ramberg has found two, which though very faint, show spectra of Class A. What is more, they have the peculiar and very characteristic features distinctive of white dwarfs. The hydrogen lines are extremely wide and diffuse, and the spectrum is unusually strong in the ultra-violet.

This excellent work adds three more to the short list of white dwarfs previously known. The last two, like the first, are faint, giving out 1/250 and 1/350 of the sun's light. Visually, they are hardly brighter than the fourteenth magnitude.

The last two stars raise very interesting and puzzling problems. Their motion indicates clearly that they are members of the great Hyades cluster.

NOW all the stars of this cluster are moving together through space and it is reasonable to believe that they have had a common origin, and hence to guess, at least, that they may be of about the same age. But there are stars of almost all kinds in this cluster—red giants, of great diameter, ordinary white stars, of moderate size, like Sirius, stars like Procyon or the sun, and fainter red dwarfs down to the limit of observation. We have good reason to believe that these ordinary stars derive their energy from the gradual transformation of hydrogen into other elements (See, Scientific American, July, 1937, pages 12-13), and have still a long life of luminosity before them. But the white dwarfs, with their enormous density, undoubtedly are throughout most of their substance very nearly in the degenerate state which marks the final stage of a star's history (so far as we can now understand it at all). They should not be in this state unless they had exhausted almost all their internal energy and lived through all but the final stages of their lives.

How they come to be members of the same cluster as ordinary stars, and presumably of the same age, is at present an unsolved problem. It is not quite new—Sirius and its companion present a similar case—but this additional discovery adds emphasis to a question which as yet no one can answer.—*Princeton University Observatory, March 25, 1938.*



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

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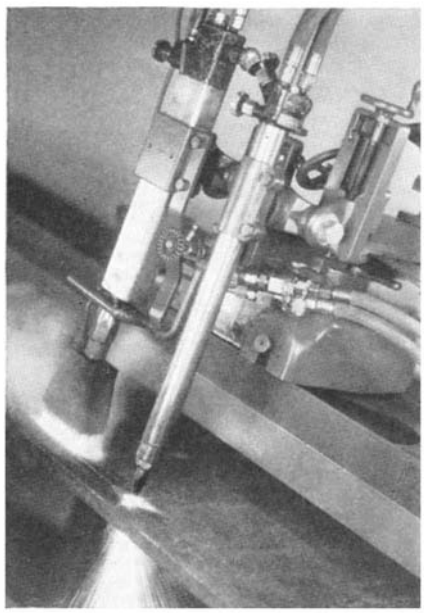
Chemical Engineer

Flame Softening of Flame-Cut Steel

ALTHOUGH the vast majority of steels may be flame-cut without any detrimental effect, there are a number of the hard grades of steel, particularly the low-alloy, high-strength steels, which tend to harden along the cut edge following the cutting operation.



Flame following flame

A new process, known as flame softening, provides a simple and economical means for removing this undesirable hardness. Multi-flame heating heads, which usually operate simultaneously with cutting, furnish additional heat to the body of the metal so that the cut edge is either annealed or tempered, depending on the type of steel. In the accompanying illustration, one-inch thick, low-alloy, structural steel plate is being softened following cutting by means of a 30-flame heating head.

Vitamins in Fish

VITAMINS A and D are supplied by the oil of fish livers. However, recent investigations in Norway have shown that the oil in the bodies of the fish also contains desirable amounts of these valuable materials. Brisling have been found—even after smoking, canning, and storing—to contain 90 to 960 international units of vitamin A and 1000 to 3000 international units of vitamin D per 100 grams. Herring similarly contain both vitamin A and vitamin D even after kippering and canning. The proportion of vitamin in the fish body oils is only about 1/10 of that in the liver oils, but nevertheless has a considerable value.—*D. H. K.*

LAMPS

THE United States uses 50,000,000 60-watt lamps a year. Five years ago they cost 20 cents each; now they cost 15 cents. Because they give 15 percent more light, they give us, free, over 16½ million dollars' worth of electricity.

As Others See Us

UNDER the caption, "Just Foolishness," the London, England, *Sphere* recently made this comment: "The United States contains 6 percent of the world's area and 7 percent of its population. It normally consumes 48 percent of the world's coffee, 53 percent of its tin, 56 percent of its rubber, 21 percent of its sugar, 72 percent of its silk, 36 percent of its coal, 42 percent of its pig iron, 47 percent of its copper, and 60 percent of its crude petroleum.

"The United States operates 60 percent of the world's telephone and telegraph facilities, owns 80 percent of the motor cars in use, operates 33 percent of the railroads. It produces 70 percent of the oil, 60 percent of the wheat and cotton, 50 percent of the copper and pig iron, and 40 percent of the lead and coal output of the globe.

"The United States possesses almost $11,000,000,000 in gold, or nearly half of the world's monetary metal. It has two thirds of civilization's banking resources. The purchasing power of the population is greater than that of the 500,000,000 people in Europe, and much larger than that of the more than a billion Asiatics.

"Responsible leadership which cannot translate such a bulging economy into assured prosperity is destitute of capacity. But pompous statesmen, looking over the estate, solemnly declare that the methods by which it was created are all wrong, ought to be abandoned, must be discarded; that the time has come to substitute political management for individual initiative and supervision.

"There is only one way to characterize that proposal, . . . it is just damn foolishness."

"Bliffy Sniffer"

PERHAPS you have wondered how telephone men are able to find the right wire among the hundreds which fan out like straws in a broom from the end of a telephone cable. For years it was a tedious task. But Bell System engineers have recently brought forth the "bliffy sniffer," shown in use, in the accompanying illustration, by a cable splicer.

You can see that this "bliffy" is not a hound dog with supersensitive nose; it can't bark, bite, see, or smell. But it can hear

How "bliffy" does its "sniffing"

and, in a jiffy, sniff out the proper wire in a cable. Thus when cable is being installed, or when repairs are made, the voice service can be extended or restored much more easily and quickly.

The "bliffy" is really an "exploring amplifier," consisting of a box containing an amplifying set, a head-phone, which is worn by the splicer, and an instrument shaped like a pencil, which he holds in his hand, and which does the sniffing.

When repairs are to be made, a tone is sent out from the distant central office along the wire in question. The repairman clamps the "bliffy" telephone on his head and passes this pencil-shaped detector over the bundle of wires. Without any metallic contact, it picks up the tone, identifying at once the wire he wishes to reach.

Radio Warning at Railroad Crossing

A NEW device invented jointly by J. Edwin Smith, formerly railway claims attorney, and Leroy M. E. Clausing, radio consultant, to prevent accidents at railway grade crossings, has just passed a successful test with a perfect score.

The device consists of an automobile radio receiver which performs the dual service of warning the automobile driver of an approaching train and furnishing the usual broadcast programs.

The warning signal is emitted by a small compact transmitter, located at the grade crossing and actuated by approaching trains, as are the warning bells and gates. The transmitter is designed to minimize the radiation field, so that the range is limited to a short distance of about 100 feet from the antenna. The latter is strung along the road for about one quarter mile on each side of the crossing, so that the driver has ample time to stop the car, regardless of speed.

The portion of the receiver used for amplifying the warning signal is automatically turned on when the car is started. Reception of broadcast signals is optional at all times but they are automatically shut off or blocked out by the warning signal from an approaching train, so that the unmistakable warning tone commands instant attention. A distinct and different tone is emitted for trains moving in opposite directions on double tracks to prevent drivers from crossing the tracks just after one train has passed and another is approaching from the opposite direction.

The price of the improved auto radio will be practically the same as that of an ordinary auto radio and the cost of the small low power transmitters at the crossings is also very low, so that the item of cost can not stop the immediate installation of positive protection, by the railroad companies, bus companies, trucking companies, and privately owned automobiles.

It is estimated that at least 95 percent of the 4484 grade crossing accidents, with a toll of 1875 deaths and 5136 injuries in 1937, could have been prevented, had such an invention been in operation during that period.

An experimental set-up of the radio railroad crossing warning

When baby cries, a sensitive microphone (right) transmits the sound to the distant reproducer shown above

Radio Nurse

NO, it won't change the baby! That fact was made clear at a recent demonstration of the much-talked-of "Radio Nurse," a development of Zenith Radio Corporation.

It is in reality an extremely sensitive sound-transmitting device consisting of two small units—one a "guardian ear" which picks up even the slightest sound in the room in which it is placed and transmits it, highly amplified, to the other unit which may be placed in any other room in the house. Both units are put into operation by simply plugging them into an ordinary light socket, no special wired connection between the two being necessary, thus allowing the units to be moved from room to room as needed.

The principal uses for the new device are expected to be in the care of children and invalids, although it also has possibilities as a burglar alarm, not to mention scientific eavesdropping.

During the demonstration, the demonstrator put his pocket watch near the "ear." Over the "Nurse" it sounded like the clank of a railroad spike. The fizz of a lithia tablet in a glass of water sounded like a cataract.

STEEL

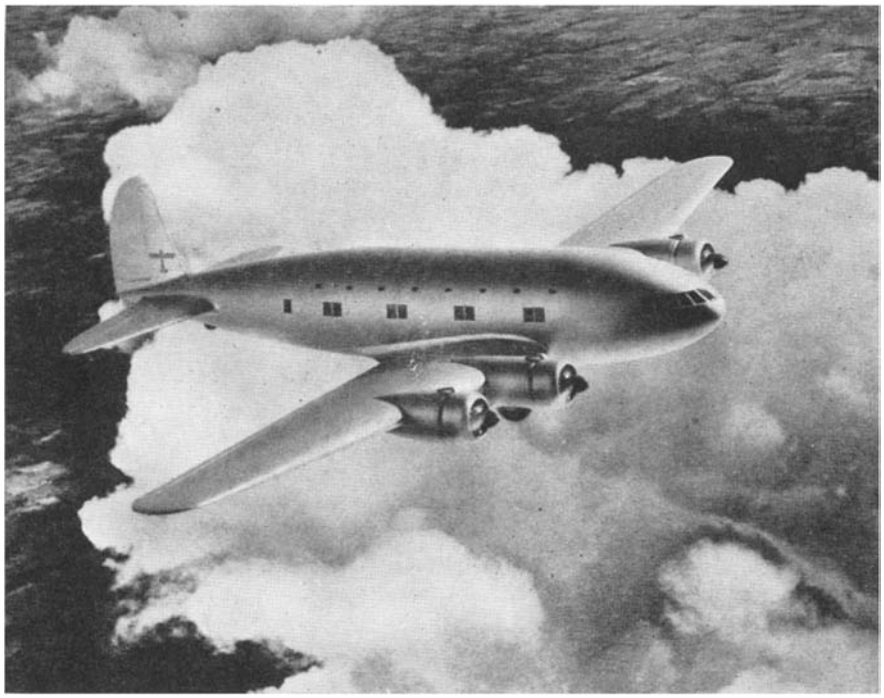
IN the typical small house, an average of four tons of steel and iron are used. This is in the form of nails, bath tubs, sinks, radiators, steam piping, furnaces, flashing, leaders and gutters, conduit, and the like.

Fireproof Fabrics By Simple Home Process

FABRICS can be fireproofed and made safer for clothing and house furnishings by a simple and inexpensive home process of dipping them in a colorless liquid, a solution of seven ounces of borax and three ounces of boric acid in two quarts of hot water. This treatment, says Dr. Martin Leatherman, of the Bureau of Chemistry and Soils, United States Department of Agriculture, will not protect fabrics from injury by flame or intense heat, but it will prevent the fabric from bursting into flame, and spreading fires that endanger life or cause the destruction of homes.

The borax-boric acid solution may be applied by dipping fabrics until they are thoroughly moistened, then wringing out the excess and allowing them to dry. Treated cloth may be ironed just before it is dry. Or the solution may be applied by sprinkling or spraying the fabric enough to moisten it. This method is likely to be more convenient for rugs, draperies, and upholstered articles. Addition of a little soap will make the treatment more effective for canvas and other textiles that do not wet easily.

Fireproofed fabrics are particularly de-



How the Boeing Stratoliner will appear in flight

sirable for curtains and hangings in the home which are likely to be blown against lamps or candles, for the coverings of ironing boards, for rugs near fireplaces, and even for children's playsuits. The solution is not weatherproof, and articles that are washed, such as curtains and playsuits, will have to be fireproofed after each washing. The treatment does not affect the textile colors and does not injure the fabric. It does have a slight protective effect in counteracting the destructive effect of acid and sulfur fumes from stoves and furnaces. Its most desirable feature is its ease of application.

The Boeing Stratoliner

THE problems of the supercharged passenger cabin for sub-stratosphere use have quite frequently been referred to in these columns. The first ship actually flown with a supercharged cabin is the twin-engined Lockheed, delivered for experimental purposes to the Army Air Corps. In a few months the Boeing Company will have completed a supercharged cabin ship for scheduled transport of passengers. Very appropriately this new plane will be called the Boeing Stratoliner.

The synthetic photograph of the Stratoliner is a true and accurate portrayal of the plane as it will appear in flight. Our readers have become accustomed to the extremely "clean" aerodynamic appearance of modern transports. Here the process of streamlining is carried a step further and the nose itself is perfectly streamlined, with the cockpit windows embedded in the bow of the fuselage. The elongated "tear drop" shape is entirely desirable from an aerodynamic point of view, and will not interfere with the pilot's vision in the slightest degree. Without definite information, we will hazard the guess that the windows will be of plastic, transparent material. It is difficult if not impossible to give glass the compound curvatures required.

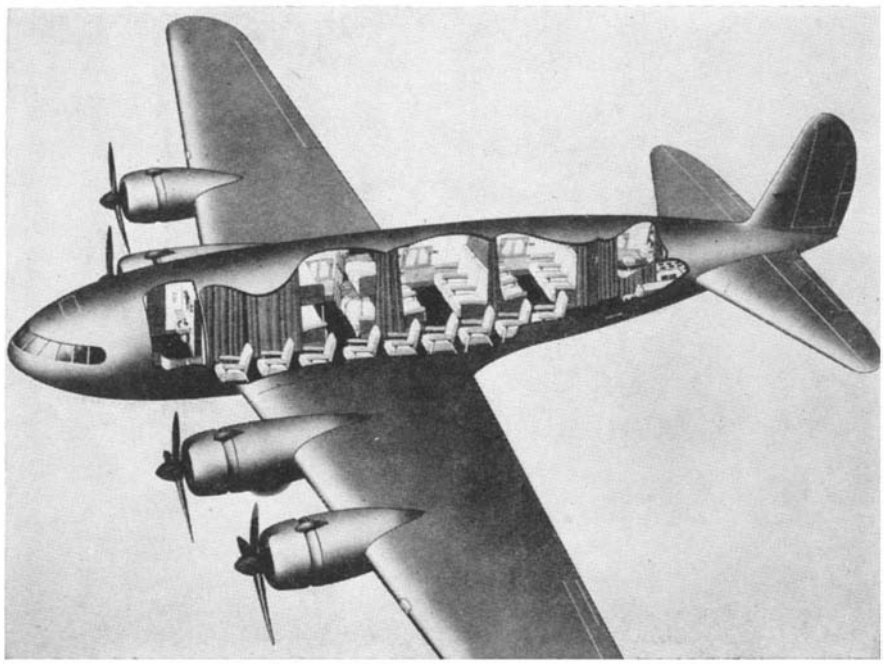
The main items of the specifications of the Stratoliner are: Wing area, 1486 square feet; wing span, 107 feet 3 inches; length, 74 feet 4 inches; over-all height, 17 feet 3 inches; day passengers, 33; night passengers (16 berths, 9 reclining chairs), 25; cargo, 4000 pounds; fuel capacity, 1275 gallons; power plant, four Wright Cyclones of 1100 horsepower each; top speed, 241 miles an hour at 6000 feet; maximum range with 7000 pounds pay load, at optimum cruising speed of 150 miles per hour, 1950 miles.

But the fine design is not the most interesting feature of the new ship. Maximum interest attaches to the interior arrangements and the maintenance of reasonable pressures within the cabin. These interior arrangements are shown in the cut-away sketch. Just aft of the control room, in the nose of the fuselage, is the men's dressing room; then there are four spacious compartments, the first two shown made up for night travel. On the near side of the cabin are nine reclining chairs made up for night travel. At the rear are the women's dressing room and the galley.

The cylindrical walls of the cabin, including windows, doors, and fittings through which pass the controls, are absolutely airtight and constructed to withstand an interior pressure six pounds per square inch higher than the outer air. When the plane is flying at 20,000 feet, the cabin atmosphere will be equivalent to normal atmosphere at 12,200 feet altitude, which is sufficiently comfortable. When the plane is at 14,700 feet the interior "altitude" will be 8000 feet. Thus the cabin is not actually supercharged to sea-level pressure.

Fresh air, drawn through the leading edge of each wing, is compressed by two engine-driven superchargers and circulated throughout the cabin after being heated by condenser type steam radiators. Either of the two fully independent sets of supercharging and heating units will be able to handle the entire job alone, so that there is little risk of failure. The entire system operates automatically with the same ease as the thermostatic control of an air-conditioned home. The blowers furnish sufficient air for 40 passengers. There are individually controlled ventilators. Spent air is discharged through the baggage compartment housed below the passenger compartment.

Of course this marvel of the engineering art will be taken completely for granted by the public when put into operation!—*A. K.*



Cut-away drawing showing the interior arrangement of the Stratoliner cabin

Revival of the Airship?

THE Navy is to have an experimental fund of 15,000,000 dollars for the development of aircraft and of novel surface vessels. In spite of the somewhat lukewarm attitude of the Bureau of Aeronautics, the House Naval Affairs Committee has decided to allot 3,000,000 dollars of this fund to the construction of a rigid airship of about half the size of the *Akron* or the *Macon*. The new airship will be used merely for training or experimental work. Certainly this is a wiser policy than again building the very largest

of craft before further practical information is available for the avoidance of future tragic accidents.

Another sign of the revival of rigid airship activity is the forthcoming completion of the *LZ-130*, sister ship of the ill-fated *Hindenburg*. With indomitable courage the Germans are pushing their plans for the re-establishment this summer of their lighter-than-air service across the Atlantic. Trial flights will come in May. As soon as the tests are completed, a schedule of 15 to 18 round trips will be started at the average rate of three a month until fall. The *LZ-130* is almost identical in dimensions and general appearance with the *Hindenburg*, with the same cubic capacity of 7,000,000 cubic feet. Because it is planned to use helium instead of the inflammable hydrogen, the *LZ-130* will carry only 40 passengers against the 70 of the previous craft.—*A. K.* [At press time, above arrangements are in abeyance awaiting decision on the sale of helium to Germany.—*Editor.*]

A Navy Torpedo Boat

THE Navy Bureau of Aeronautics quite rightly releases only the most meager information regarding its plane developments. So we are lucky to have even a short story to present on the XPTBH-2 torpedo plane built for the Navy by the Hall-Aluminum Aircraft Corporation. These mystic letters probably mean that this is an experimental ship, and a torpedo boat, with designation H-2, but the reader's guess is as good as ours.

Even without detailed specifications, it is quite clear that the Navy has gained a formidable naval weapon. With completely clear space between the two pontoons or floats, there is every facility for launching bombs or a torpedo. Each float is mounted on a single streamlined strut, and not only is clear space thus provided, but aerodynamic efficiency is also gained. A single "monospar" is provided in the cantilever wings, a type of construction which is novel in American practice, although frequently used in British construction. The streamlined supporting struts of the floats have a logical point of attachment to the single spar of the wings. Floats are divided into several water-tight compartments, adding to safety in the case of accidental damage.

The fuselage has been carefully designed from a fighting point of view, and is divided into six compartments housing the various service requirements such as nose gun turret, mid-ship and after gun compartments, and, in addition, pilot, mechanic, and radio cockpits. The wing span is 79 feet 4 inches; the over-all length is 55 feet 4⅜ inches. —*A. K.*

XPTBH-2, carefully designed from a fighting point of view

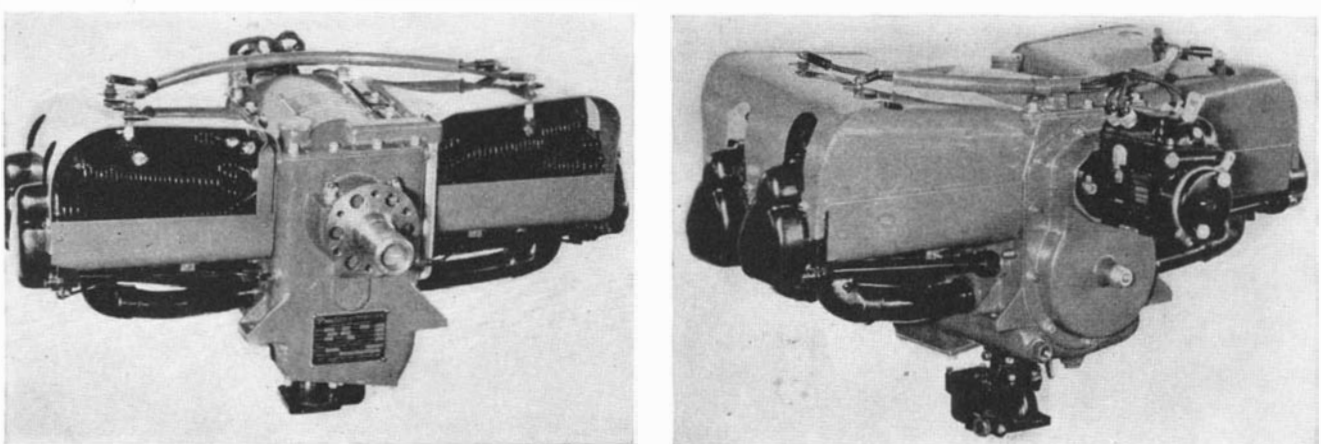
Engines for Light Planes

AMONG the excellent papers presented at the National Aeronautic Meeting of the Society of Automotive Engineers, a particularly timely one is that by N. N. Tilley, of Continental Motors, on engines for light airplanes. The light airplane has had a phenomenal growth in the last two years; further progress of the civil airplane type is bound to come with the development of better motors.

Mr. Tilley gave a fine definition of the light airplane: "It is characterized first of all by its light weight—about 600 pounds empty and 1000 pounds gross, which includes two occupants and ten or fifteen pounds of baggage. The type is simple and reliable. Landing speeds are below 40 miles per hour; cruising speeds are 70 to 90 miles per hour, and top speeds are from 85 to over 100 miles. Twenty-five or more miles are obtained per gallon of gasoline." Certainly this is a very attractive type, but one whose reliability and future are tied up with the provision of really suitable engines.

When light airplanes were first built, the power plant was unsatisfactory. Many of the original designs were based on standard automobile or motorcycle parts to obtain low prices. But it was soon found that continuous operation in the air presented far more difficulties than intermittent operation in earth-bound vehicles. Exhaust valve material had to be changed to the non-burning type used in larger aircraft engines. Crankcases had to be built of heat-treated alloys. Better spark plugs, better materials all around had to be substituted, and greater strength provided in various parts of the design. It is only today, after disappointment and evolution, that satisfactory light-plane engines have appeared on the market. We know of at least five engines in this category—Continental, Lycoming, Aeronca, Menasco, and Franklin.

From 35 to 45 horsepower, the recent light-plane engines have gone to more than 50 horsepower. In spite of higher revolutions per minute, these engines weigh from 155 to 165 pounds. The weight per horsepower is still high, three to four pounds per horsepower, which looks surprisingly heavy when compared with the one pound per horsepower of the large Wrights or Pratt & Whitneys. The extra weight is due in part to the fact that minimum casting thicknesses must be adhered to, and in part because the requirements of low cost minimize the amount



Front and rear views of the Franklin light-plane engine. Note the tunnel cowling in the front view

of machine finish and lead to the use of plain cast-iron cylinders, tappets, and camshafts.

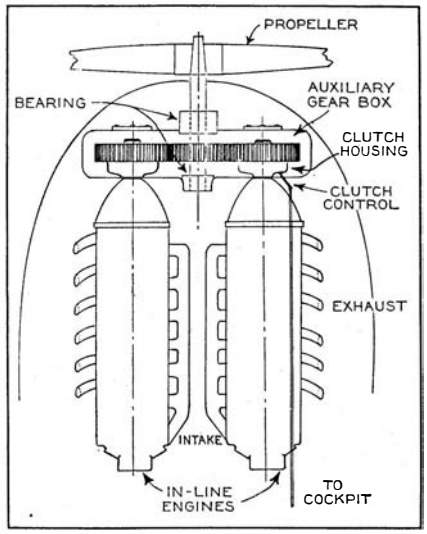
Cooling difficulties have been overcome by increasing the cooling fin area, and the use of tunnel cowlings. Balance difficulties have been eliminated by using four cylinders instead of two, and by arranging these cylinders in horizontally opposed fashion, which eliminates all the most important causes of unbalance. Higher revolutions per minute have made the weight per horsepower at least reasonable. Equipment has remained very simple, but is quite reliable.

Mr. Tilley is satisfied with the achievements, and it is not out of place to describe one of the several types mentioned above. This is the Franklin 50 horsepower four cylinder opposed engine, a derivative of the once well-known Franklin air-cooled automobile engine. As much as 53 horsepower is obtained at 2400 revolutions per minute. The cowling or tunnel was introduced to improve the cooling of the two rear cylinders. This cowling, and guidance of the air flow, now permit the rear cylinders to be kept at approximately the same temperature as the front cylinders. Fuel economy is excellent and lean mixtures can be employed. —*A. K.*

Unitwin Power

THE idea of a multiple-engine power plant driving a single large propeller is by no means new. The Germans tried such combinations, during the war, on some bombers (considered giants at that time) of long range. In fact, we recall that a German bomber actually had four engines mounted together in the nose of the fuselage and driving a single propeller. Gearing and clutches allowed all or any of the motors to be connected to the airscrew. Now the Lockheed Aircraft Corporation and the Menasco Manufacturing Company are co-operating in a power plant to which has been given the picturesque title of "Unitwin." Two Menasco models, each of 250 horsepower, are employed and these are connected to the propeller after the fashion shown in our sketch, although we have no information that this is indeed the method employed, and are merely offering a possibility.

The purpose of such a combination is obvious. The safety of twin engine operation is obtained without the disadvantages. When one motor fails in a normal twin-engine design, there is always an offset torque, which,



Two engines—one propeller

introduced suddenly, may give control difficulties. Also, the offset torque and the idle propeller increase drag and militate against continued flight on one engine.

Of course Unitwin introduces its own difficulties such as gearing weight and losses, use of clutches with accompanying complications, and placing of the engines in the nose where their noise and exhaust are more of a problem than when the engines are disposed on the wings.—*A. K.*

A Mechanical "Alligator"

THE mechanical "Alligator" recently invented and developed by Mr. Donald Roebling, of Clearwater, Florida, is a unique amphibion vehicle that propels itself as readily on water, through swamps, and up hill and down dale, as on firm flat land. Donald's father, Mr. John A. Roebling, having helped the Florida Red Cross relief work in the Okeechobee Lake region, asked Donald, in 1933, to build for him an amphibion rescue machine to assist in this work when needed. Thus it was that the machine came to be developed.

The structure is built of duralumin, a metal that is three times as resilient as steel, and yet has only a third of its weight. The machine has a total net weight of 8700 pounds, and has capacity to accommodate 40 people in its passenger section, which might add as much as three tons to the load. When on rescue work, the "Alligator" would carry a crew of from two to five men, and be equipped with a portable radio set.

One of the interesting features of this amphibion is the fact that the same method is used for propelling it on land and on water; in other words, there is no special propeller for operating the machine in the water. The two continuous treads at the sides of the machine are made up with specially-constructed Link-Belt double-width finished steel roller chain to which curved blades or cleats are attached.

The engine—an 85 horsepower Ford V-8 engine, with Federal-Mogul copper heads to give it a 120 horsepower rating—is located in the rear of the machine. The operator sits at the controls in the cab at the front of the machine. There are two hand levers and a Bendix electric vacuum control system, popularly known as an "electric hand." All clutches and brakes are operated hydraulically.

The speed of this machine, which measures 20 feet long by 8 feet wide over-all, is about 18 miles an hour on land, and 8.6 miles an hour in water.

Mr. Roebling points out that this amphibion could be used for other purposes as well, such as exploring swampy or thickly-wooded sections in the oil fields.

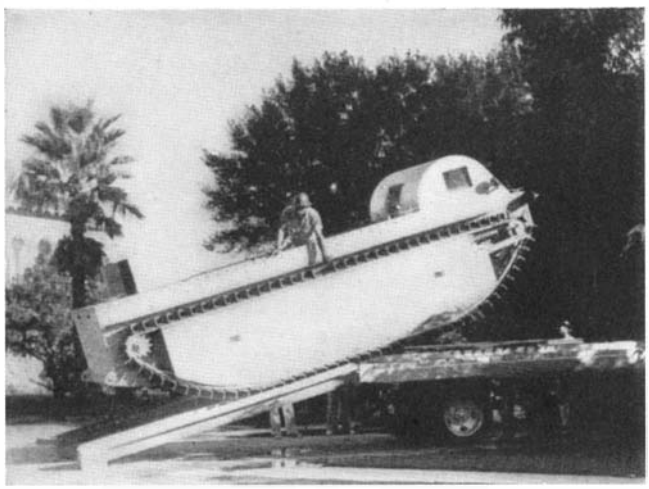
It could travel on ice and snow if proper precautions are taken to prevent formation of ice on the chain.—*Link-Belt News.*

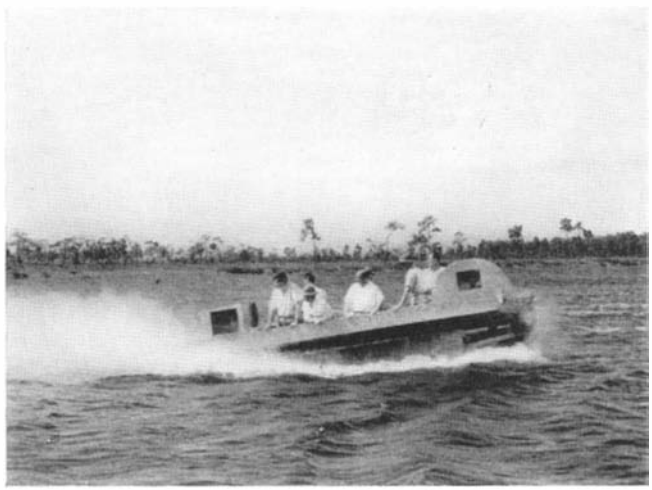
BRIGHT

THE flare-up of the 16th supernova of all history, which was discovered last year by astronomers of Palomar Mountain observatory, was of the order of 500,000,000 suns in brilliance. So distant is the star that its light took 3,000,000 years to reach the earth.

A New Zeolite

IN treating hard water the usual methods of softening leave sodium instead of calcium and magnesium in solution. Water softened in the usual manner is often not suitable for use in making ice. A new material having an action similar to the zeolites, but introducing hydrogen into the water instead of sodium, has recently proved





The mechanical "Alligator" is as much at home on land as in the water. It was designed for rescue work

efficacious. In principle the new material, Zeo-Karb H, has the property of taking sodium ions out of the solution and replacing them by hydrogen. Thus a water containing sodium carbonate, after usual softening treatment, will lose its sodium content when passed over a bed of the new material. The water after this treatment is practically free from dissolved metals of any kind.—*D. H. K.*

America Led

FROM time to time during the past year or two reports have been published concerning work in Russia in the use of preserved blood from suicides as a source for transfusion. So often has this been commented on in various publications that many have been led to believe this technique is uniquely Russian. However, it is considerably older than many may believe. For example, the *British Medical Journal* for June 22, 1918, the final year of the World War, contains a paper describing the same technique, written by Capt. Oswald Robertson, an American Army surgeon serving at that time with the British Expeditionary Forces in France. He discussed the use of blood in this manner, and states that 22 transfusions of bottled blood obtained from the dead were made on 20 individuals, 11 of whom survived.

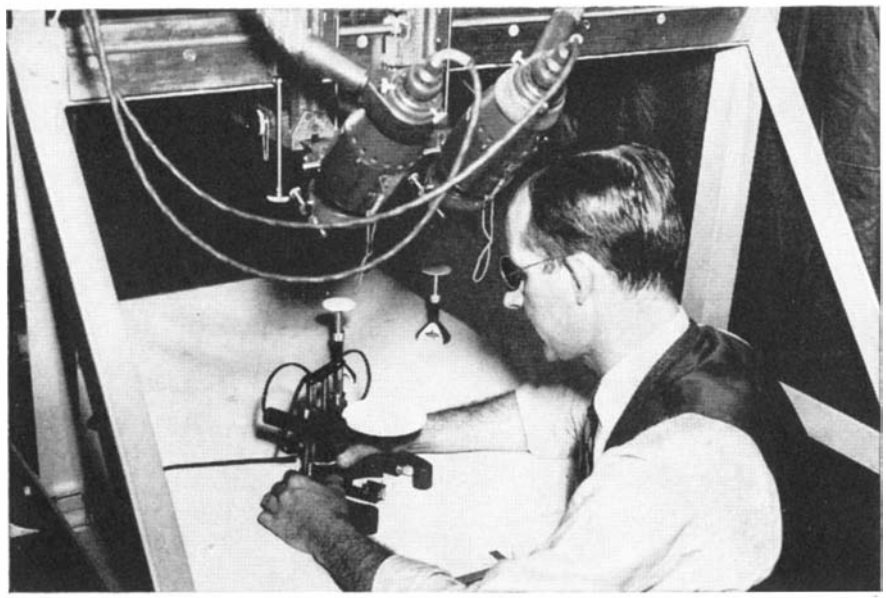
Even then, the technique was not new. Dr. Robertson, in his 1918 article, gives credit to Drs. Payton Rous and J. R. Turner of the Rockefeller Medical Institute for still earlier experiments on this technique.

Do Your Own Sound Recording

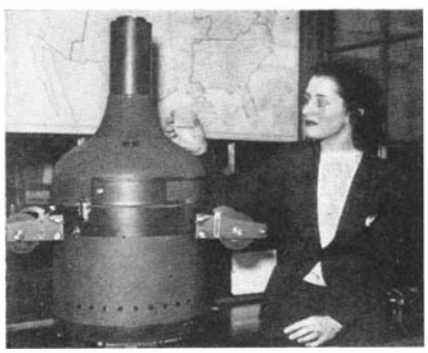
BUSINESSES, schools, sales executives, music teachers, and many others have long desired some method of recording the vocal or instrumental efforts of their members, their sales forces, or students. Such a method is now available in the Presto Junior Sound Recorder, a new and highly perfected home recording instrument. It makes phonograph records of the speaking voice, of singing, orchestra music, of sales solicitations, or of conversations which must be preserved.

This recorder consists of a 12-inch recording turntable, a recording mechanism that cuts the groove in the record as it records the sound, a play-back pickup, a five-tube amplifier having ample power for home use, a loudspeaker, and a microphone with desk stand. The entire instrument is mounted in a carrying case of moderate size and weighs

Sound recorder—compact



***Above:* Tracing contour lines by the new stereoscopic method, using colored glasses. *Below:* Printer and one of the small glass plates**



35 pounds. Operation is simple; it is necessary only to plug it into a 110-volt alternating circuit. A converter may be obtained for using it on 110-volt direct current or on storage batteries.

The records used are mirror smooth, cellulose coated disks, the same as are used by leading broadcasting stations for making electrical transcriptions. Once made the record is permanent and may be played as often as desired, using ordinary steel needles.

RAINBOW IN METALS

ELECTROPLATING has progressed to the point where it can duplicate the rainbow or the color in a soap bubble. By super-imposing a film of copper oxide on bright nickel plate as a base, any color in the rainbow can be reproduced in metal, the color being determined by the refraction of light which varies with the thickness of the film.

Stereoscopic Map and Contour Plotter

THE United States Army Air Corps is reducing 13-square-mile chunks of countryside to little glass plates the size of two and a half special delivery stamps.

Bausch and Lomb Optical Company is now completing for the army fliers a chain of instruments that appear to make the high-booted surveyor with transit and theodolite as extinct as the dodo. Where earthbound surveyors, like George Washington, took days and weeks for field work, the new technique uses an airplane and does the work in a few minutes.

It is not so easy as it sounds, according to the engineers who designed the instruments. A map traced from a simple aerial photograph is not very useful in placing artillery, planning dams, or putting through power lines. For such purposes knowledge of the vertical lay of the land is as necessary as north-south and east-west data.

To measure heights and depths of all the little hills and valleys 20,000 feet beneath a plane cruising at 150 miles an hour, the new Stereo-Mapping Projector equipment uses the same principle as three-dimensional movies viewed through spectacles with one red and one blue lens.

An automatic camera in the plane, shooting at regular intervals, makes pictures a mile apart. Terrain features are thus seen from different positions in succeeding photos just as the two eyes see things from slightly different positions to get depth perception. If the two eyes respectively see the views taken a mile apart, the effect is as if the map-maker had eyes a mile apart.

To achieve this, the seven by nine inch film negatives, each covering, from the usual altitude of 20,000 feet, about 13 square miles, are printed on small glass plates. From them the picture is projected down on a drafting table by two adjacent projectors operating with red and blue light respectively. An observer who looks at the projected overlapping pictures with red and blue spectacles sees with one eye only what the camera saw in the first position and with the other eye only what the camera saw in the other position.

With six separate adjustments on each projector set to bring it into exactly the same angular position that the camera had when it made the corresponding negative, the mapper suddenly sees a single illusory three-dimensional model of the terrain on the table before him. So realistic is it that he may feel an impulse to pat the top of a smooth hill or try to prick his finger on a telephone pole.

To draw his map he moves about on the drawing paper a fixture containing an illu-

minated pinhole mounted directly above a pencil. With the point of light set at a given height, the mapmaker moves the fixture about so as to keep the point in contact with the surface of the illusory ground. The line thus traced passes through all points where the ground is that high. Such a series of lines create a contour map.

With the great reduction in size involved, the highest accuracy must be maintained to make usable maps. A few thousandths of an inch of error may mean many feet in the field.

Synthetic Hard Materials

DESPITE the age-long search for hard materials to make tools and abrasives, nothing has been made or found that compares with the diamond in hardness and efficiency as a cutting tool. Although synthetic silicon carbide is harder than other natural materials, and boron carbide recently developed as a commercial abrasive is harder than silicon carbide, both are easily cut with diamonds. A cheap material that is closer to diamond's hardness is being continually sought.—*D. H. K.*

Stream Sedimentation Studies Provide Valuable Data

A LABORATORY designed to test the sediment-load of streams has been built by the Works Progress Administration of North Carolina across Rocky Creek in Iredell County for the United States Department of Agriculture. Sedimentation studies will be the aim of the Soil Conservation Service work at this station.

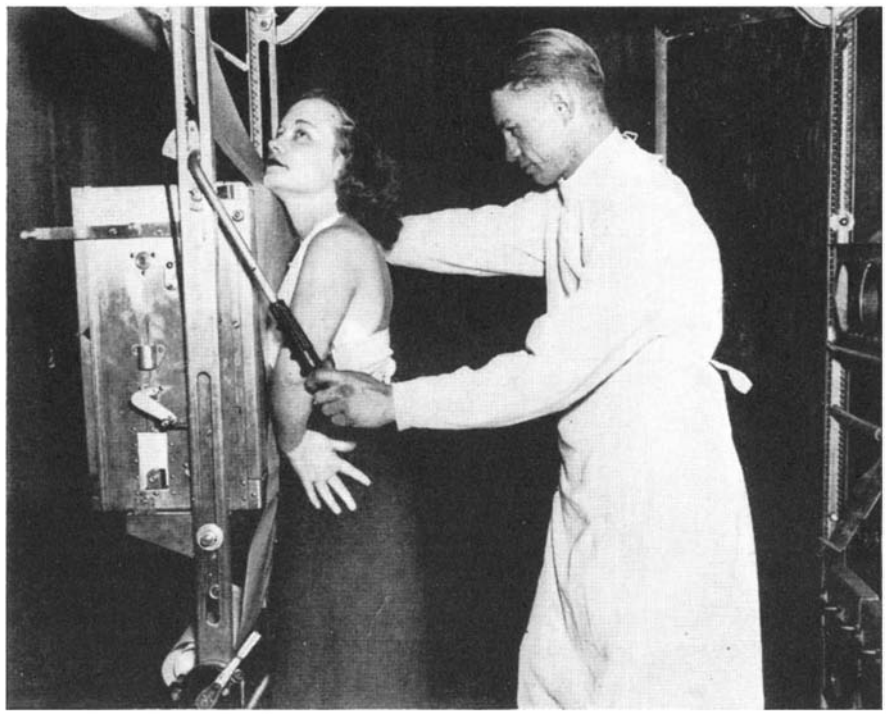
Spanning the stream, 14 concrete veins spaced five feet apart adjoin concrete and stone revetments. Four feet below each section is a 16-inch pipe, leading to a pump house. Hydraulic oil cylinders permit a sample of each or any vein to be pumped into the vats.

Qualitative and quantitative analysis of the samples will be made to determine from the suspended load what bed load of sediment is carried by the stream under all conditions.

North Carolina, immense developer of water power, has a vital interest in the experiments which aim to find out how to prevent depletion of reservoir capacity; to determine the life of a reservoir by finding out exactly what went into it after each rain; the relationship between the sediment load and hydraulic functions of a stream; how much damage is being done to land on a particular watershed and how much would be justifiable to spend in a particular section to control soil erosion and the best method to adopt for that purpose; conservation of navigability of streams; and the prevention of flood damage.

Similar devices are being installed at Greenville, South Carolina, and Dadeville, Alabama.

Full-size set-up for studying stream sedimentation



"Rapid-fire" X-ray equipment for tracking down tuberculosis

The Dragnet for Tuberculosis

THE movement for X-raying youths in school, at the most susceptible age for the development of pulmonary tuberculosis, which was reported in this magazine in November, 1933 (page 215) has subsequently gained strength. While there is nothing especially novel in the use of the X rays themselves, the novelty connected with the routine work described at that time lies in its speed and cheapness. Long rolls of relatively inexpensive sensitized paper, instead of the usual X-ray film, are employed, and hundreds of youths can be X-rayed in the school building in a single day. The method, therefore, is essentially a dragnet to catch cases of tuberculosis while they are in an early stage, and not only makes the disease known to the youths who have it, but forestalls potential reservoirs of germ infection from going about, for several years as often happens, without knowledge.

In many schools this kind of routine search for early cases is now an accepted method and future generations will reap the benefit, not alone in terms of the sufferings saved to the patient but also in terms of economics—dollars and cents saved to the community in various ways.

It seems certain that this kind of approach to the tuberculosis situation will spread, and if it spreads more rapidly than the germs of the disease, it will be all to the good.

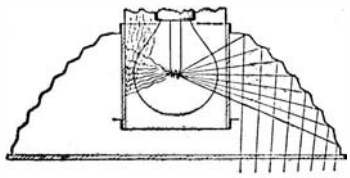
Since the beginning of the present century the death rate from tuberculosis has been reduced in the ratio of 201 to 56, thanks to various measures introduced by science. This remaining figure, 56, can and will be crowded down to 46, then 36 and 26, and so in time will be pretty nearly, if not quite, on its way out.

Dental Light with Less Heat

THOSE who have sat for hours under the heat of ordinary dental lights would find comfort under a new dental light developed by the Wilmot Castle Company. This light throws a spot susceptible of rather exact control, so that there is no need to light all the face. The most important feature is the great reduction of radiated heat.

An ordinary incandescent light bulb con-

Above: **How the new dental light focuses its rays to a concentrated beam.** *Below:* **A heat filter is between the light and the reflector**



verts electrical energy into a very long spectrum of radiant energy. This radiant energy is not heat in the sense of molecular vibration, but is of the same character as visible light and can be reflected in the same manner. Hence if it is not blocked before reaching the reflector it would be reflected and concentrated with the light beam. Blocking it before it reaches the reflector prevents it from being concentrated on the patient or dentist.

The heat-absorbing process employed in this new light is, therefore, a filter glass which will transmit the visible portion of the spectrum but will not transmit the longer wavelengths in the heat portion of the spectrum. This might be compared with the light-filtering action of a piece of colored glass, which simply transmits a certain portion of the visible spectrum and is opaque to the remaining portion.

The optical set-up of the lamp might roughly be defined as a series of narrow, circular reflectors designed at various focal lengths and with each reflector of such diameter that the lower base of one adjoins the upper base of the other. In this way, a non-critical focal point is obtained so that the distance between the lamp and the patient's mouth can be varied without shifting the bulb and reflector.

Upside-Down Dam

TAKING a lesson from Holland's conquest of the Zuyder Zee by pumping its perennial floods over the dykes, the Westinghouse company decided to protect its East Pittsburgh works along the banks of Turtle Creek by damming the valley against the backwater of the Monongahela River and then boosting the Turtle Creek flood over the top of the dam. This work was described during its initial stages in our January issue.

Recently this upside-down dam was completed and tested. One of the accompanying photographs shows its position under the George Westinghouse Bridge, Turtle Creek running into the picture from the left past the Westinghouse company's plant. Over the roadway is one of the gates and over the creek itself is another larger one, both to be lowered and sealed against leakage in the event of a major flood of the Monongahela which often floods the roadway in the foreground. In the structure directly behind the gates are three pumps, each powered by a 5000 horsepower electric motor and each possessing a 10-ton steel propeller to force the water from Turtle Creek over the dam into the Monongahela. The water outlets on the down-stream side of the dam are shown in the right foreground.

Non-Glare Auto Headlights; Patent Tangle Now Unravelled

HIGHLY important news for glare-blinded, night-driving motorists is contained in the recent announcement that the conflict over patent rights on the use of polarizing materials for automobile headlights has at last been cleared.

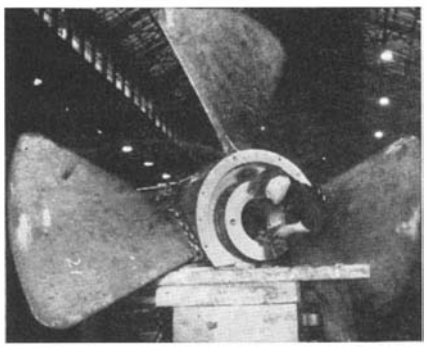
The Polaroid Corporation, manufacturers of sheet polarizing material which is finding wide applications, has acquired the basic patents of Dr. L. W. Chubb for the use of any polarizing material in headlights. Dr. Chubb is director of research of the Westinghouse Electric and Manufacturing Company, but the patents were those of Dr. Chubb personally.

Previously, the application of polarizing material in headlights, to eliminate the hazardous glare at night, has been at an impasse. Dr. Chubb had the patents on the use of materials for this purpose and had demonstrated headlights so equipped. The trouble, in the past, was that the materials which could be used were highly expensive and such headlights would have cost as much as 100 dollars or more.

Edwin H. Land, young Boston scientist who formed the Polaroid Corporation, had invented the cheap, easy-to-make, sheet Polaroid material but was unable—because of the Chubb patents—to apply it to its most valuable use in automobile headlights.

The present pooling of Chubb and Land patents with control vested in the Polaroid Corporation was accomplished by a transference of stock to Dr. Chubb and his associates.

Polaroid was originally invented to solve the headlight problem but while the patent tangle was being unravelled it found wide use in sun glasses and photographic and scientific equipment.—*Science Service.*



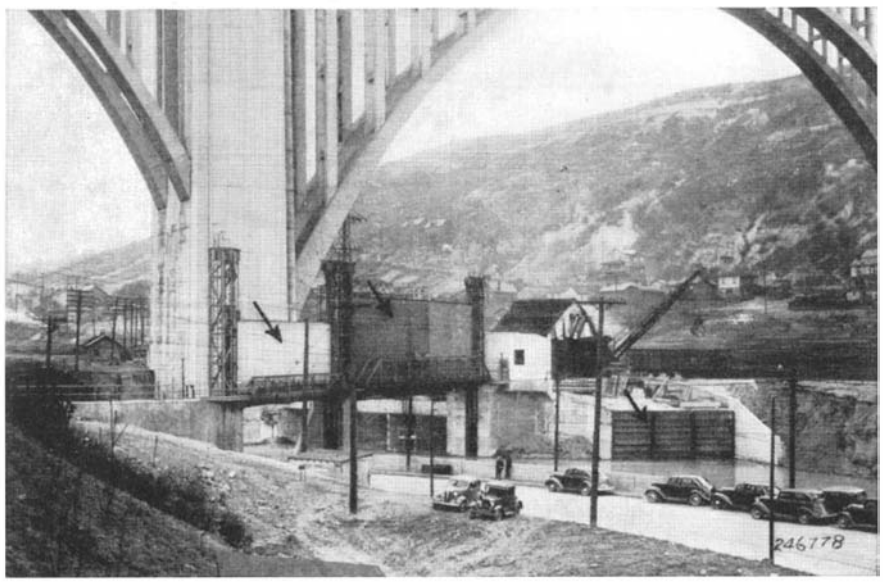
One of the three 10-ton propellers built to detour Turtle Creek around the new upside-down dam described

CHICKENS

THERE has been a steady decline in chicken population on the farms in the United States. In January, the estimated total was 387,251,000, which represented a decline of 7.9 percent compared with last year, a decline of 3.4 percent from 1936, and a decline of 0.7 percent under 1935.

Four-Wheel-Drive V-8

IF you want to drive a Ford V-8 through the sands of the Sahara, on construction jobs where traction is poor, through muddy ground or over soft earth hillocks, the Marmon-Herrington Company will transform a Ford V-8 into a four-wheel drive machine. With such driving, the roughest terrain may be easily negotiated. That company now of-



From left to right, the arrows point to the gate in the roadway, the gate over Turtle Creek, and the outlet on the down-stream side of the dam. See the text

fers a complete line of passenger and commercial cars with power and traction on all wheels.

This company also builds a complete line of heavy all-wheel-drive vehicles of tremendous power and tractive ability but claim that the all-wheel-drive Ford cars out-perform the heavier units in many respects. They are lighter, have greater maneuverability and speed, and easy steering.

PROGRESS

RESEARCH leading to greater progress takes an average of one cent out of each dollar made by industry and agriculture in this country. Industry spends about 1.7 percent of its income, while about 0.37 percent of what agriculture makes is spent for research.

Rest in Bed for Colds

REST in bed is the best treatment for respiratory diseases such as colds, bronchitis, sinus trouble, and "grippe," Dr. Arlie V. Bock of Harvard Medical School recently told the American College of Physicians, basing his opinion on results of this treatment which was given nearly 2000 Harvard students during the past three years, according to a *Science Service* report.

This common-sense treatment, he said, often saves time, trouble, and money in the end. Very few serious complications followed the colds and sore throats and similar ills when treated by simply putting the student to bed in the infirmary.

Dr. Bock advises against the use of sprays, ephedrine nose drops, painting the throat with argyrol or dyes, or packing the nose with adrenalin. He believes such "energetic local treatment" often prolongs the illness by irritating the membranes of nose and throat.

Among the few cases of pneumonia which developed in these students, the cause was found in many cases to be a virus rather than the pneumococcus which generally causes pneumonia.

Living under too great tension, both physically and nervously, is, Dr. Bock believes, an important factor in bringing on colds and similar ills. Since there is no specific remedy for these conditions, he advises that doctors teach themselves and their patients to "live within the resources of their physical and nervous systems."

Improved Transparent Rubber

A NEW form of magnesium carbonate, differing in crystalline structure from the conventional substance, which has the property of producing a greater transparency in rubber than forms previously available, is now being produced in the United States.

Heretofore the magnesium carbonates used in making translucent rubber were imported from abroad, but gross inequalities in the material increased costs, impaired quality, and led to the search for a compound to meet the standards of American manufacture.

Use of the new material, known as "Clearcarb," has resulted in rubber of greater trans-

parency, increased tensile strength and modulus, with a decrease in manufacturing cost. Twenty-five to forty parts per hundred parts of rubber are used in the mix. Its advantages in translucency are obtained through its physical structure. Clearcarb has a constant refractive index of 1.525, intentionally identical with that of pure vulcanized rubber. Under microscopic tests the crystalline structure of Clearcarb appears irregularly globular, whereas the usual magnesium carbonate exhibits crystals.

Rubber products compounded with the new material may be produced in colors at lower cost because their greater transparency permits the use of a smaller proportion of the expensive colors to get the desired shade. The natural color of rubber produced with Clearcarb is a clear, transparent amber.

Transparent rubber is used in, among other things, hot water bottles, gloves, nipples, crêpe soles and heels, and women's overshoes.—*D. H. K.*

Indium Makes Bearings Last Longer

INDIUM, a few years ago a chemical curiosity extracted with great difficulty from rare minerals, is now a full-fledged industrial metal, with an ever-expanding use as an alloying agent for bearing metals.

Motor bearings, resisting millions of revolutions during the life of a car, are now being made even tougher, C. F. Smart, General Motors Company engineer, reported recently, by plating the bearing surface with indium. This surface coating makes the bearing metal resistant to corrosion by the acid oils now in common use in motor cars.

Until recently, babbitt metal, an alloy of tin, antimony, and copper, was used for most high-speed bearings. Today, bearings are lined with silver-copper-cadmium, cadmium-nickel, and cadmium-zinc alloys, which are later electroplated with indium, increasing their resistance to oil corrosion.—*Science Service.*

HOSPITALIZATION

ONE out of every 14 persons in the United States occupied a hospital bed during 1937. He stayed 12.6 days, on an average.

Outlets for Slag

FIFTEEN million tons of blast furnace slag, once a useless by-product for which research has now found a definite commercial value, were produced by the steel industry in 1936, the American Iron and Steel Institute has estimated.

For years the makers of pig iron and steel were faced with the problem of disposing of the slag or cinder formed during the refining of iron and steel, and slag piles grew to such an extent that they covered thousands of acres of valuable land. Applied research, however, has revealed many practical uses for slag, although the tonnage of slag produced still exceeds the demand.

Crushed and screened blast furnace slag has been found useful as railroad ballast, concrete aggregate, road material, covering material for roofs, a filtering medium in sewage-treatment beds, and even as beds for

oyster culture. About 4,250,000 tons of such slag are commercialized annually, at an average value at producing points of approximately 90 cents per ton.

Another class of slag is granulated slag, prepared by forcing a stream of water or steam against the stream of molten slag emerging from the furnace. It is used as a component part of standard cement, as an insulation for concrete highways, in gas and water filtration, in highway and railroad embankments, in cement building blocks and as a soil corrective agent. Over two million tons of granulated slag, with a value of about 25 cents per ton, are marketed annually. Of this amount, an estimated 500,000 tons are used in cement manufacture, displacing limestone valued at approximately $1.50 per ton.

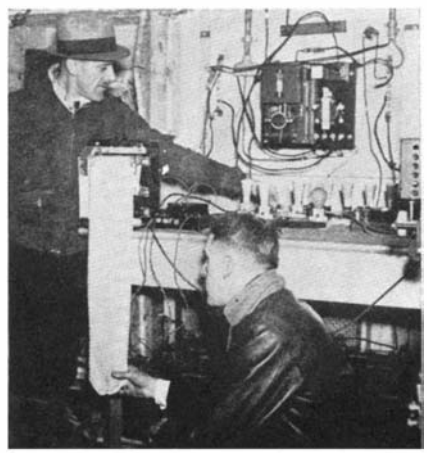
A relatively new use for blast furnace slag is in the form of "mineral wool," fine glass-like threads produced by blowing air into a stream of molten slag. Slag wool is used in industrial and home construction as an insulation against heat and cold. Upwards of 50,000 tons of slag were used for that purpose in 1937.

The slag produced in open hearth furnaces operated in the southern states has a high content of lime and phosphorus oxide, due to the nature of southern iron ores and production processes. Such slag, when finely ground, is a valuable conditioner for soils deficient in lime and phosphorus. It is estimated that 36,000 tons of southern open hearth slag were used for soil conditioning during 1936, and a total sale of 50,000 tons was estimated for 1937.

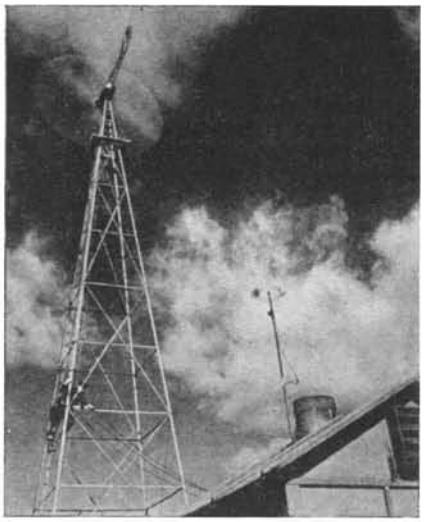
Windmill Power on Phone Line

POWER for transmitting telephone conversations across certain parts of the desert in the Southwest will be supplied by windmills, as a result of tests recently completed by engineers of the Bell Telephone Laboratories at Schooley's Mountain in northern New Jersey. The windmills will be installed on the "Fourth Transcontinental," new trunk route recently put in operation across New Mexico and Arizona. As this important line to the Pacific coast traverses wild country in spots, into which it is impracticable to run power lines, it has been necessary to provide some means of developing power on location.

The windmills drive generators which charge the batteries supplying current to



Experimental apparatus used in testing the wind-driven generators



Windmill on a 'phone line

vacuum tube amplifiers or "repeaters." On this particular route it has been necessary to install repeater stations at frequent intervals because of the new type of telephone channel being used—a "carrier current" system recently developed by the Bell Laboratories. This system, operating on frequencies ranging from 36,000 to 140,000 cycles, will provide 12 voice channels on a single pair of wires. In all, each pair of wires along this route will ultimately carry 16 conversations. [See "The 'Fourth Transcontinental,'" April 1938 Scientific American.—*Editor.*]

This is believed to be the first occasion in which wind-driven generators have been adapted for use on telephone lines. The experiments at Schooley's Mountain resulted in the development of apparatus with a number of automatic features, designed to keep the lines in operation under almost any conditions of operation at the desert stations. Records indicate that there is an almost constant breeze in that region, sufficient to keep the generator charging and yet not too violent. But should there be a prolonged flat calm or should the windmill be damaged, a gasoline-operated generator below the windmill will automatically start when the battery reaches a certain stage of depletion. Should this equipment fail to start, another automatic device will sound an alarm at the nearest "inhabited" repeater station, some 60 or 70 miles away.

Stainless Steel Tiles and Linings

STAINLESS steel will soon find scores of new uses in thousands of homes as a result of a development just announced by the Ludlum Steel Company. Most people know stainless steel and in one way or another enjoy its beauty and lasting permanence. A few years ago it came into common use for paring knives and kitchen cutlery. In recent years, stainless steel has been adopted for all manner of uses where sanitary, lustrous, permanently rust-proof finishes were desirable.

Engineers, aware that public interest and demand for stainless steel in the home were held back only by cost and difficulty of installation, long ago set to work on the problem; after many months of work and testing, they found the answer in Ludlite, an entirely new form of stainless steel.

Ludlite is a composite product. Its outer

surface is Silcrome—strong, thin, stainless steel. Its backing is a tough, flexible, nonmetallic material. By a special manufacturing process, the stainless steel and the flexible backing are permanently bonded through heat and pressure.

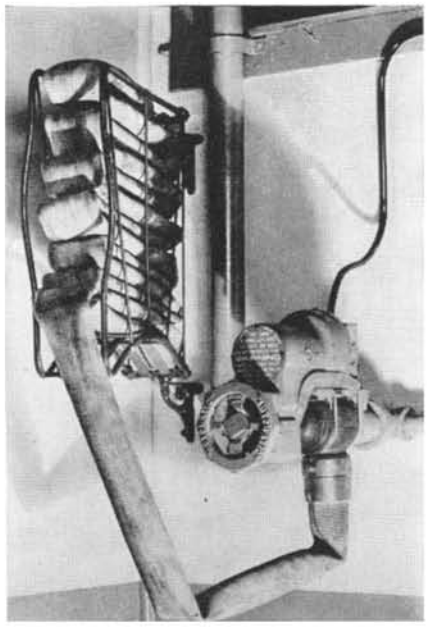
The backing material affords desirable support to the steel and makes it possible to cement the Ludlite to plaster, wood, fiberboard, concrete, and other surfaces. By this means, light gage steel can now be used; extreme flexibility and ease of application result; the flexible backing deadens sound.

The outstanding feature of this new material is the remarkable ease with which it can be installed. It can be cut right on the job with ordinary heavy scissors and can easily be shaped and cemented, nailed, or screwed in place. Attractive molding strip of stainless steel for finishing edges and intersecting surfaces is also available in all needed shapes and styles. Hence, it is a simple matter for the artisan, the home craftsman, or anyone handy with tools to use this material anywhere in the home.

Stainless steel shelves in pantries and kitchens are replacing wood, oil cloth, and linoleum. Sinks and drain boards together with back panels are blossoming out with easily applied Ludlite. Bathrooms are shining in Ludlite tile. Bins and boxes are being lined with stainless steel. Door push plates, fireplace screens, small table tops, trays, and wainscotings are taking on a luster that will last indefinitely.

REMOTE CONTROL HOSE VALVE

HOSE valves can be of tremendous value in fire fighting but to prevent their freezing is frequently a serious problem. The new Rockwood remote control hose valve



Remote control for fire valve

eliminates this problem. There is no water in the exposed section of the piping. The control valve is located in a warm place. The controls are of two types—either a break-glass station is operated or the valve wheel is given a full turn. In either case an impulse is transmitted, and the valve operates and water is at the nozzle without delay.

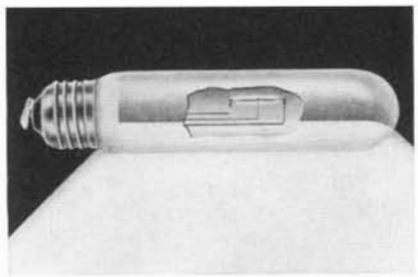
Where there is danger of freezing, the

use of this valve eliminates the necessity of insulating the piping. It has been used successfully with regular wet underground systems which have developed leaks, especially in cases where the cost of replacement was high because of the nature of the pavement. In such cases the piping is normally empty. The loss from leakage during fire service is not serious, whereas if the water is in the piping normally the leakage is tremendous in the course of a year.

The new Rockwood remote control hose valves are used in conjunction with a special main valve which controls the flow of water from the city water mains or other sources of water supply. This main valve is generally located where there is heat throughout the cold weather. The remote control valves themselves are located at various points throughout a property. Thus the piping between the main valve and the remote control hose valve is normally empty.

Tubular Reflection Light Bulb

A TUBULAR lamp, inside silvered, that serves as its own reflector, has just been introduced by the Birdseye Electric Company. The new lamp is side-silvered, and concentrates all the light in a powerful



The reflector is within

beam that makes an angle of 45 degrees with the horizontal, viewed from the side of the lamp, and one of 50 degrees viewed from the end. The reflecting surface, of real silver, is on the inside of the glass. Accurate adjustment of the beam is made possible by a special spring contact base; the lamp may be used in any medium base socket and burned in any position.

The new lamp is made in 25 and 40 watts. Lamps will be available in standard and color correction frostings and in a wide range of colors processed by fusing the color into the glass.

According to Clarence Birdseye, originator of quick-frozen foodstuffs, his new lamp is the first 25-watt tubular lamp in standard voltages to be inside-silvered; the first to be gas filled; and the first to employ a double coil filament.

Among the industrial and commercial applications of the new lamps are: individual machine and inspection-bench lighting; desk lamps; louvres, troughs, and panels; and for show and refrigerator cases.

Parts of Brain Removed Without Loss of Intelligence

LARGE portions of the important frontal lobes of the brain can be removed surgically without damage to the intelligence, it has been reported to the American

Psychological Association by Dr. D. O. Hebb, of the Montreal Neurological Institute and McGill University. Four cases were reported to the scientific meeting by Dr. Hebb, but the identity of the individuals was guarded with medical scrupulousness. All four have been given careful psychological examination after the serious brain operation, and in one case it was possible to compare the scores with results of an examination made before the surgery. In each case, the surgery was necessary because of disease conditions.

One man, after removal of the left frontal lobe of the brain, received a perfect score on a mental test for superior adults. This gave him an IQ of 152, putting him in the "gifted" class. The patient's success in his calling and in life fit in with the results of the mental test, Dr. Hebb reported. This man, as well as the three other cases reported, was right-handed, and therefore the left side of the brain was the dominant side. It has been previously supposed by many physicians that loss of a large part of the dominant side of this thinking area of the brain would mean loss of mental ability.

In another case, removal of between 4.5 and 7 percent of the whole cerebrum left the patient still above average in intelligence.

In a third case it was necessary to remove surgically more than 4 percent of the cerebrum and the disease condition had destroyed an even larger part of the brain. Yet this man's IQ was only one point lower after this serious loss than before the operation.

In the fourth case, after removal of the left frontal lobe, the patient appeared to relatives as of somewhat better intelligence than before. The only ascertainable defect in this man is a possible loss of initiative in business and society.—*Science Service.*

MOTHPROOFING

THE latest siege gun in the war against moths is an old device, the vacuum cleaner. By using it, together with an applicator made by General Electric, mothproofing compounds are forced into the fibers of any textile.

Soil-Less Agriculture At Home

INTEREST in growing plants without soil in chemical solutions has become so widespread that an Evanston, Illinois, company is prepared now to supply kits for chemical gardening at home.—*D. H. K.*

Fungus Lassos and Devours Animal Prey

A FUNGUS—a sort of fifth cousin to the common bread mold—that captures and eats small worms was recently described by Dr. J. N. Couch of the University of North Carolina, reports *Science Service.* While insect-eating plants such as the Venus fly trap and the pitcher plant are quite well known, animal-catching fungi are rare.

This fungus grows in a thread-like form. Loops are spaced at intervals along the thread. These are the traps. When a worm

sticks its head or tail into one of these loops it contracts, tightening up on the worm and holding it fast. At times a worm may be caught by two of the loops.

When the worm is firmly held, small threads grow out from the main thread. They penetrate the body of the worm and digest it. Dr. Couch was able to watch the capture and digestion of the prey.

Lightning Struck Eleven Times

THE Empire State Building, New York City, has been struck often by lightning. In the accompanying photograph, an ordinary camera seems to reveal one brilliant

With a high-speed camera

flash. Actually, when this shot was made, the building was struck 11 times in 0.36 of a second, it was shown by General Electric's special high-speed camera. To the right is a series of blurs, indicating the first of the 11 flashes. The flash second from the left is shown, upon close examination of the photographic negative, as a double stroke, as is the fourth from the right.

Bees Benefit the Other Fellow

THE beekeeper is not able to collect the cash value of the work his bees do—except for the honey they produce—Dr. C. A. Browne, of the United States Department of Agriculture, said recently at a meeting of beekeepers. This by-product labor of the bees, three to ten times the value of the honey and beeswax, is the pollination of growing crops—particularly fruits.

In Germany during the war, said Doctor Browne, bees were much neglected, and a serious drop in fruit crops resulted because of poor pollination. Many other insects are pollen carriers, but early spring when most of the fruit trees are in bloom is too early in the season for most insects other than bees.

Doctor Browne emphasized the need to develop industrial uses for honey to maintain a market so that beekeeping will continue profitable enough to support the by-product work of the bees. Honeys vary considerably in chemical composition and more chemical research is needed to determine the suitability of each type for specific industrial uses.

CAMERA ANGLES

Conducted by JACOB DESCHIN

High Film Speeds and the New Season

WHILE the enthusiastic amateur never permits his camera to gather dust on the shelves during any season and has kept it busy all through the winter months, nevertheless all of us do welcome the advent of spring for the innumerable opportunities for picture-making that these months afford.

"Preparations"

"Up a Tree"

This year we have a rather odd situation in the fact that on the eve of those seasons of the year that are most gloriously suited to general outdoor picture-making because of the longer and brighter days, the chief film manufacturers should be putting out or are on the verge of introducing the fastest speed emulsions ever made available to the general public. And it is particularly significant and thrilling to know that these emulsions, although rated very highly as to speed, have not suffered in the matter of grain and in addition have the advantage of a surprising latitude, permitting over- and under-exposure to an unusual degree.

While fast film and the sunny months may seem a peculiar combination, on second thought it must be seen that although high-speed emulsions are ordinarily associated with outdoor night and indoor shots, at home, in the theater, and so on, there are many situations in the generally sunny outdoors when a fast film is very useful and will do work not easily performed by film of the "regular" speeds. Shadows abound in which detail is wanted; a fast film is needed to "cut" into them and record them properly. The use of fast film also permits employment of the deeper filters without the loss of the advantage of snapshot exposures. Action shots during certain parts of the day or in locations where the sun does not reach directly are facilitated by fast film; even in brightly lighted places, a little closing down of the lens for better insurance of depth is possible without the sacrifice of high shutter speeds. Besides, even during the sunny months, there are times when the sky is clouded over and fast film becomes as welcome as it is during any season of the year under similar circumstances.

"Waiting for the Start"

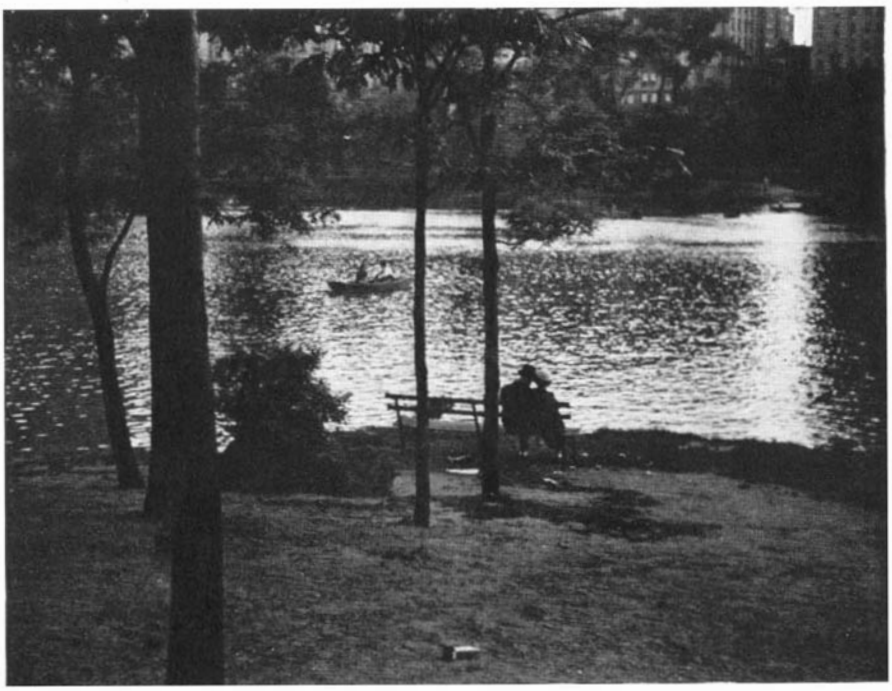
The four pictures accompanying this article illustrate some of the reasons why fast film is helpful any time of the year and not the least in the spring. Not all have been completely successful in the matter of describing the shadow detail and some recorded detail has been lost in the magazine reproduction, but the reader will understand from these the sort of thing we have in mind.

For example, the shadow cast by the squirrel's head must not be so deep as to obliterate the detail on the shadow side of the head and the man's face and hands in "Preparations" should be sufficiently impressed on the film to show up on a print.

Insofar as film speed generally is concerned, if the film is really high speed, as these new films are, and their fine grain characteristics have not been harmed but, in some instances, have even been improved, may we not say that now we have finally achieved the universal film that will do for all occasions, whether shots in the theater at night or snapshots in the park by the light of the open sky?

Developing Filmpacks

NOW and then someone reports the unfortunate experience, when developing filmpack films, that the paper adhering to the ends of the individual films somehow covered a film or two during development, preventing the action of the developer on part or parts of negatives sufficiently long to leave a definite mark. To avoid this in future, we suggest that you try the following precaution. Taking two or three films at a time, snip off the paper edge under the trimming board knife. You must take care, of course, that you cut only the narrow edge where the paper adheres. This operation completed, your films will be clear of all



"A Sure Sign"

paper even before immersion in the developer bath and you will be able to proceed with the developing as secure with regard to the paper hazard as if you were using cut film.

Photography Aids Science

THE popularity of the camera in the purely amateur sense has more or less held the spotlight in this, the Golden Age of Photography. However, the camera has been of such solid and fruitful usefulness in the fields of teaching and research that it recently inspired Dr. Edwin B. Mains, director of the University of Michigan Herbarium, to declare that new cameras and films, together with simplified photographic processes, are facilitating teaching and research methods in the natural sciences.

The new developments of the photographic field, Dr. Mains said in discussing the photographic exhibit of the 1938 Michigan Academy of Science, Arts and Letters in Ann Arbor, are opening up wide fields other than that of recreation for the candid camera fan. They have already provided a means of studying minute botanical detail in accurate color, he said. Another hopeful development seen by Dr. Mains was the fact that the new photographic processes are fast coming within the financial means and abilities of high school teachers and pupils who have not had the facilities that were heretofore necessary for work with the camera and in the darkroom.

Theme Competition

HERE is a third opportunity for the readers of this department to win prizes by competing in a fascinating phase of the art of photography. A definite assignment is given in interpretive photography, to be fulfilled according to each individual photographer's own imagination or artistic ability. Prints submitted in these monthly competitions will be judged on the interpretation of a theme, as well as on pictorial appeal and technical excellence. Each month two cash prizes—$10 for the first prize and $5 for second prize—will be awarded, and there will be two honorable mentions, each to be a year's new or extension subscription to Scientific American.

The simple rules of the contest are as follows: (1) All prints submitted must be mounted, the over-all size *of the mounting* not to exceed 11 by 14 inches. Prints may be any size from 3¼ by 4¼ inches up to the maximum area of the mount. (2) Not more than one print may be submitted by each contestant, it being left up to him to judge his own work, and to select the one which, in his opinion, best portrays the theme of the assignment. (3) Prints may be forwarded by any means desired but each must be accompanied by the required return postage. (4) No names or titles are to be placed on the face of the photograph; on the back of the mounting must be given the contestant's name and address, together with the name of the camera and of the film employed. (5) The competition will be judged by the conductor of this column and the editorial staff of Scientific American. The decision of the judges will be final. In case of a tie for any prize, duplicate prizes will be awarded to the tying contestants. Prize-winning photo-

graphs will become the property of Scientific American to be used in any manner at the discretion of the publisher. (6) No entries will be considered from professional photographers. (7) Prints may be black-and-white or toned; no color prints will be considered. (8) All entries in the third Scientific American Theme Competition (June, 1938) must be in the hands of the judges by July 1, 1938. The results will be announced in our issue dated September 1938. (9) This competition is open to all amateur photographers who are not in the employ of Scientific American.

JUNE COMPETITION THEME: "WORK"

The assignment for the third competition is "Work." In this case, the interpretation of the theme might involve an odd shot of a steam shovel gnawing away at a rocky bank, a laborer taken from some unusual angle, a house-wife in action, and so on to the limit of your resourcefulness. These hints are thrown out at random and are not necessarily to be considered as definite suggestions.

Address all entries: "Work" Competition, Photograph Editor, Scientific American, 24 West 40th Street, New York, N. Y.

Here is something well worth shooting at, both to test your sense of photographic interpretation in competition with others, and because of the prizes involved. Go to it!

Moon Phenomenon

THE "cross" effect sometimes obtained when photographing the sun was recently caught by this department when trying to photograph a moonlight scene. The

"Moon Rays"

lines shooting out from the moon are fairly distinct, although we would have preferred considerably less movement in the clouds. The exposure was about 45 seconds.

Cleaning Trays

AFTER each processing session, it is a good practice to clean the trays thoroughly so that the next time you can get to work without having to clean the trays before starting. Most of us are content merely to run some water into the trays, swish the water around a bit and let it go at that. However, you can purchase at the five-and-ten-cent store a simple household

A platinum print of 1901

device—a stick attached to a miniature mop—that will help you to do the job better. With this you can wash and clean the trays at the same time, work into the corners and along the sides of the trays so that all dirt is mopped away, and generally make the cleaning chore both simple and effective. If you make a regular practice of thus cleaning up every time you use your trays, you will not only be able to begin the next session with clean equipment, but you will also find that the cleaning job is easier to do while the sediment is still moist from the working solutions.

They Were Good Then, Too

NO, we don't know it all. Back in 1901 they were making platinum prints and doing a beautiful job. Witness the example here illustrated, the work of Ernest C. Sherburne, of Boston, now editor of *The Christian Science Monitor's Weekly Magazine Section,* who made the print in 1901 when he was the paper's staff photographer. Today, he is an enthusiastic minicamera fan, having qualified for this title by reason of his devotion to the candid-type of camera, which he employs on every possible occasion.

He thinks the platinum process very simple.

"Print by reflected light," he says in describing the process, "inspect at will for depth, wash in a ferro bath to develop the image, five minutes in hydrochloric, wash five minutes, and that's all, there being no hypo."

Platinum printing is today a lost art and those who would try it will find that they must coat their own paper.

WHAT'S NEW

In Photographic Equipment

If you are interested in any of the items described below, and cannot find them in our advertising columns or at your photographic dealer, we shall be glad to tell you where you can get them. Please accompany your request by a stamped envelope.

Photrix Meter

THE Photrix electric exposure meter, which can be worn fastened to the wrist, like a watch, leaving both hands free to operate the camera, is said to work on the same principle as any other photoelectric exposure meter, with the difference that the Photrix does away with setting levers or dials. Of course, the Photrix ($16.00) may also be held in the hand like any other electric exposure meter. The Photrix has no computer dial, the function of this dial being performed by an arrangement of the scales.

Briefly, the distributors say, the secret is this: For a number of popular film speeds and F: stops—for instance 23 SCH (24W), F:11 or 20 SCH (12W), F:8, and so on—the exposure time can be read directly at a glance. For other F: stops, all one has to do is to go stepwise to the right or to the left on the scales of stops and exposure time. For use with moving picture cameras, a "frames-per-second" scale is inserted in the exposure time scale.

The scale of the Photrix is 1¾ inches long with clear, equally spaced figures over the full extent of the reading range. The face of the Photrix measures 2 by 2½ inches, the thickness of the meter being only 13/16 inches. It is shown in the illustration compared with a folder of matches. The Photrix externally is smooth Bakelite and glass without any protruding parts.

Quinotol Developer

QUINOTOL, a developing agent of great versatility, hitherto obtainable only as a foreign product at relatively high prices,

has now been introduced to the American market as an American product. While Quinotol (Chlor-H-Quinone) has not been generally familiar to amateurs, it is not new to the experienced photographer. The uses of Quinotol (oz. 50¢; ¼ lb. $1.75; 1 lb. $3.00; 5 lbs. $5.50) are multiple and when made up according to the Formula LR23, which is now announced by the distributors, may be employed in developing chloride, chloro-bromide, and bromide papers as well as negatives in both tray and tank.

16-MM ENLARGER

A NEW type of enlarger for making black-and-white negatives from single frames of 16-mm motion pictures is the Kodak 16-mm Enlarger ($15.00). Negatives may be made in a few seconds from either black-and-white film or Kodachrome, and from these enlarged negatives, both contact prints and greater enlargements are possible.

The enlarger is of particular value to the amateur movie enthusiast who possesses no darkroom or other facilities for making enlarged "stills" from his 16-mm reels. It permits making a series of negatives in rapid succession, and eliminates the need of immediate processing.

The enlarger is constructed, for compactness, in the form of a folding Kodak and is loaded and operated in much the same way. A film gate, mounted in front of the enlarger lens, has a mask opening the exact size of the 16-mm frame. The film is positioned over this opening, between guide pins. A locating pin engages one perforation, keeping the film in exact alignment. There is no cutting of the movie film. After positioning, the cover of the gate is closed, and a brief exposure made by incandescent light.

With a film frame of average density, a five-second exposure is correct with "SS" Pan film, when the film gate is held 5 inches from a No. 1 Photoflood lamp. The enlarger loads with 616 film.

MAGNO VIEWER

A NEW type of device for viewing Kodachrome and Dufaycolor slides, as well as 35-mm black and white positives and negatives, pictured here, is completely enclosed in a small metal box, which is set up or closed, as desired, quickly and without bother. The compactness of the unit makes it completely portable. The Magno Viewer ($17.50) is equipped with a condenser lens that provides a two-times linear magnification of the 35-mm positive; that is, a picture about two by three inches. The "observation" window effectively shields the lens and thus assures a comfortable view of the magnified picture, the illumination, by transmitted light, being provided by a specially designed lamp of the Osram type.

In connection with the Magno Viewer, announcement is made of a new type of 35-mm transparency frame ($5.50 for 25)

made of a special composition material. Instead of having to be bound with tape in the usual transparency frame manner, the positive or transparency is simply placed between two thin pieces of glass, inserted in the frame and snapped into position where it remains firmly in place.

Mushroom Flood Bulb

THE Schickerling Mushroom Bulb Photo Flood ($1.00), so named because its main body is shaped like a mushroom, is announced as the first significant improvement in photographic lighting since the introduction of flood lamps. The invention of Conrad Schickerling (known throughout the radio industry for his advancements in radio vacuum tubes), the Mushroom Bulb has an average life of 10 hours of peak performance, plus 10 to 15 hours more of adequate working illumination, giving improved color balance throughout.

The unique construction features of the Mushroom Bulb include the concentrated cool coil filament, large heat dissipation area, much higher actinic value, silver nitrate and argon filler, and an ultra high vacuum. It has an inside reflector and an outside frosted diffuser. Due to the unusual filament design, the Mushroom Bulb is said to project a whiter light with an improved red actinic ratio.

The Schickerling Mushroom Bulb may be used in all phases of photography where artificial light is needed—in the home, for studio work, copy work, commercial photography, in laboratories, and for still and motion pictures. Moreover, it is claimed, it has a longer life than the average Photoflood, thus becoming more economical. This bulb operates on either A.C. or D.C.

V. P. Camera

MADE in England, the V. P. Twin camera (99 cents), taking 16 pictures on any standard vest pocket film, has just been introduced here. Among its features is a ground, polished, and centered meniscus lens which permits sharp portraits and snapshots from a few feet to infinity. The V. P. may easily be loaded in daylight. The shutter is fixed on the front of the camera, giving instantaneous exposures without vibration. The film numbers are seen through a double window in the back of the camera. The view finder is instantly snapped into position for either horizontal or vertical pictures.

Superpan Supreme

AGFA Superpan Supreme, the fast panchromatic film recently introduced to the motion-picture industry, has been made available in cartridges, spools, and darkroom loading packages. Although a new product, exceptional recognition has already been given to this film, for Supreme, together with the Agfa Ultra-Speed Pan, is the first film in seven years to win the motion-picture industry's highest honor, the Class I award for technical achievement of the Academy of Motion Picture Arts and Sciences.

As supplied for 35-mm still cameras, the

new film will replace the Fine Grain Superpan formerly supplied and which it doubles in speed, though it cuts down the grain size of the former film. Greater brilliance, antihalo protection, and a surface coating for minimizing abrasion marks are other features of the new film.

Until new cartons can be provided, Superpan cartons bearing the label "New Type" or "Supreme" are being used and can be identified as containing the new Superpan Supreme.

Arc Lens Shade

SCIENTIFICALLY designed for working with or against the light, the Arc Lens Shade ($1.00 to $2.00, depending on size) has a unique, tapered shape, eliminating cut corners. It is easily and firmly attached to all standard lens mounts. Distributors claim it will help to produce clearer, crisper pictures, entirely free from lens flare.

Electric Agitator

THE Imperial Electric Agitator is designed for the purpose of shortening negative developing time. The agitator ($16.50) makes possible quick, positive, and even agitation, scientifically controlling the grain and resulting in precise, clear negatives. The Imperial Agitator uses a minimum amount of electricity and is made to accommodate all miniature developing tanks.

Bakelite Developing Trays

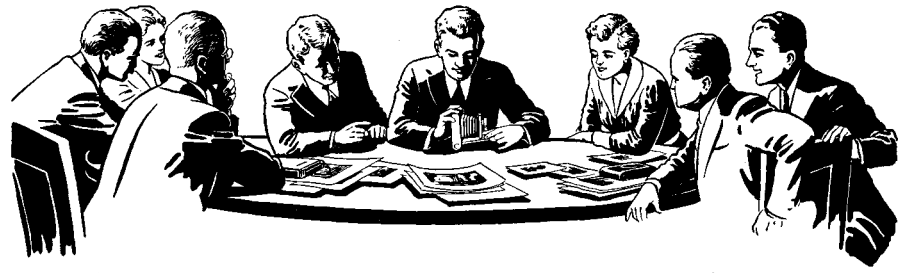
TWO economical developing trays, constructed entirely of Bakelite molded and designed to develop large-sized prints, have recently been introduced. Solid and heavily constructed to withstand considerable abuse, the trays have no reaction on the developer and hypo baths, and, being chemical resistant, they are unaffected by the corrosive action of those chemicals.

Center-Numbering on Roll Film

CERTAIN cameras now on the American market take twelve 2¼ by 2¼ inch exposures on B2 or PB20 roll film; to accommodate cameras of this size where "window-watching" is required, the manufacturers of Superpan, Super Plenachrome, and Finopan have provided these films with center-numbering. This center numbering is printed on the protective paper of the roll-film so that as the film is wound through the camera, the numbering will readily indicate the proper spacing of the 12 exposures.

Imperial Magniviewer

THE Imperial Magniviewer is a flexible optical lens mounted on a universal joint on the enlarger easel or retouching table. The Magniviewer ($5.50) provides better definition and greater accuracy, giving sharp, highly magnified images in true proportion. It may be quickly and easily fitted to the baseboard of any enlarger.



CAMERA ANGLES ROUND TABLE

JACOB DESCHIN, *conductor of our "Camera Angles" department, will answer in these columns questions of general interest to amateur photographers. If an answer is desired by mail, enclose a stamped, addressed envelope. Queries should be specific, but Mr. Deschin cannot undertake to draw comparisons between manufactured products nor to advise on the purchase of equipment or materials.*—The Editor.

Q. I would like a filter but do not know what color to get—red, yellow, or green. I want it to use when taking clouds and snow pictures, chiefly. Which color would be the most satisfactory?—D. S.

A. For all-around purposes it is generally agreed that the medium yellow filter is the most useful; if only one filter is wanted, this is the one to get, for it will do practically everything the average photographic work requires—record clouds against a blue sky, control the light in snow photography, cut down the harshness of sunlit water, and so on. One of its chief virtues is that it requires only double the normal exposure when using panchromatic film; even this may be avoided simply by opening the lens wider by one stop. In most cases the narrowing of the depth of field caused by the larger opening will be of no consequence since outdoor work usually calls for relatively small stops.

Q. I would like to obtain a schedule of the U. S. Scheiner ratings for the following films (films are listed in reply).—J. J. M., Jr.

A. As you probably know, films are rated differently in daylight and tungsten light. We shall, therefore, give both ratings as reported in the most recently revised edition of the booklet, "Practical Speeds of Films and Plates."

	Daylight	Tungsten
Eastman Standard (Kodak Regular)	17	13
Kodak Verichrome	20	16
Kodak Supersensitive Panchromatic	23	20
Kodak Panatomic	19	16
Agfa Standard	18	14
Agfa Plenachrome	20	17
Agfa Superpan (roll and pack)	25	24
Agfa Finopan	21	19

Q. I have a camera using 35-mm film. I have had a little difficulty with grain in enlarging, even though I have used ..... developer in a film tank and have followed instructions as to time and temperature. Would there be any advantage in using this same developer for only ¼ or ⅓ the normal development time and then using a one-solution intensifier of the ..... type to bring my films up to the required density? Would this solve the grain problem for me?—E. B.

A. The developer you mention, while generally satisfactory for larger negatives, is today held not to be suited for fine-grain development. Many fine-grain developers are available, in liquid form ready for use, that will do a fine-grain job for you in fine style if you will take just ordinary precautions as to temperature and time of development. Among the favorites may be mentioned M.P.G., G.D.X., Infinol, Champlin 15, and others. While we have not tried the experiment you suggest, we doubt whether underdevelopment to the extent you mention, followed by intensification, would be as effective, or even as easy, as simple, straightforward development in a regular fine-grain developer. Besides, the intensifier you cite has a tendency to introduce grain on its own account if immersion is prolonged beyond a certain minimum.

Q. I would like to take instant postcard size pictures that can be sold to the posers on the street. The picture is to be a direct photo without the use of negative and is to be finished inside the camera in about one minute. I can purchase such a camera from a storekeeper who cannot tell me how to use it. I would appreciate information.—A. B.

A. The camera you have in mind is described and discussed on pp. 23 and 24 of George H. Chappell's little handbook, "The Itinerant Photographer," and full instructions for operating it may be had by writing to The Daydark Specialty Company, Benton and Baldwin Streets, St. Louis, Mo. The apparatus is called the "Black and White Camera."

Q. As a graduation present I asked my parents for a new camera. The choice was left to me. I wrote to the various companies asking for their catalogues but I was thoroughly lost. Will you please explain to me what the names given to the different shutters and lenses mean? What is the significance of the different focal lengths (F:3.5, F:4.5, F:6.3, and so on)? Do you think I would be capable of operating a miniature camera?—D. W.

A. Though lacking the advantage of your personal acquaintance, we presume you

possess the blessings of sight and the use of your hands; for these reasons, nothing stands in the way of your attaining proficiency in the operation of a miniature camera. It is simply a matter of learning what all the gadgets do and what part you play in their doing it. However, from your questions, we gather that the first thing you ought to do is purchase or consult some elementary book on photography. You can learn to operate a miniature camera in an hour or less but that won't do you any good unless you know something about photography. For example, take your question concerning focal lengths, which you follow with a string of lens speeds, the implication being that you have confused the latter with the former. Since it is impossible adequately to treat your questions in the short space allowed to replies in this department, the best we can do is to say that, broadly speaking and leaving aside all technicalities, the focal length of a lens determines the amount of subject-matter appearing on the negative —the longer the focal length of the lens, the smaller the amount of subject-matter appearing on the negative. Thus, a so-called "wide angle" or "short focus" lens might include the whole side of a room, but from the same vantage point, a long or "telephoto" lens might include only the head and shoulders of a lady sitting in a corner of the room, while a "normal" lens, the one ordinarily supplied with a camera, would take in the entire lady, together with the chair she is sitting on, as well as the fireplace. The F: numbers you list refer to the diameter of the lens as it relates to the focal length of the lens; thus F:3.5 means that the lens has a diameter 1/3.5ths of the focal length. Shutters are principally of two types, the focal plane, so called because the shutter operates directly in front of or on a plane with the film, and the Compur type, which operates between or behind the lens.

Q. **Is it absolutely necessary to have the darkroom completely dark when printing or enlarging? I must work in a closet which admits a little light through cracks around the door and I have been wondering if this is really harmful?—J. L.**

A. Of course, the ideal is a light-tight room, but you will find that the small amount of light thus coming into the work room will not reach the paper provided you are careful to shield the paper by working with your back to the door and using your body as a shield.

Q. **I seem to get good results with my visual exposure meter for what is known as "normal subjects" but where the foreground is involved or holds special detail which puts the subject out of the normal class, I find that I cannot use the values which I read.—N. S. D.**

A. By "normal subject" we presume you refer to a subject in which the range of tone is sufficiently long to permit the meter to "average" the tones (reflections) from, say, the position of the camera, and obtain a generally correct exposure for the scene. However, where it is desired to record a "heavy" foreground or small detail, it is important that the meter be brought closer to the object so that, as much as possible, nothing is included within the angle of the meter other than the specific object or small area in question. In this way, the only light read is that coming from the segregated subject. The reading you obtain in this way, provided you do not permit the shadow either of the meter or yourself to fall upon the object, will be the correct one for the particular subject, regardless of the position of the camera.

Q. **My camera uses 35-mm film and has a lens of F:4.5 speed. What would the speed of this lens be, relatively, when using the new film made by Agfa (Ultra Speed Panchromatic)? What are the possibilities of my camera using this film? Are indoor snapshots at night possible without the use of additional light other than ordinary reading light? —T. R. B.**

A. Roughly estimated, the speed of your lens under the circumstances would be increased to somewhere between F:2 and F: 2.5. The great opportunities thus opened up for users of cameras with lenses of F:4.5 are obvious and should go a long way toward encouraging those persons who cannot afford the higher priced lenses. Actually, what it means is that an F:4.5 lens aided by this film is the equivalent of the expensive fast lenses. Of course, there are other factors, such as the general quality and design of the lens, but the reference made here is entirely to the speed at which an impression is made on a film within a given interval. With this film, indoor snapshots at night by ordinary lighting are "pie" and, generally, this film makes possible many pictures that could not previously be made at snapshot speeds. See also the discussion of the ultra-fast films which appears in "Camera Angles" in this issue. Suggestions for use will be found there.

Q. **Can you suggest a method for quickly drying the grooved Bakelite reel in which film strips are inserted for tank processing, when it is desired to develop one film roll after another? —G. B. A.**

A. After the film roll has been washed in the tank and the negative strip hung up to dry, take the reel apart, immerse the two sections in very hot water, wipe the reel as well as you can with a towel and expose to the heat of a radiator or hot breeze fan. The speed of drying will surprise you.

Q. **In washing a strip of negatives, I use ordinary cold water from the tap. Whatever the temperature happens to be, that is the temperature of the wash water at that particular time. I use an acid hypo fixing bath. Do you think this method of washing is harmful?—J. A. D.**

A. By all the gods of fine-grain development, you are beyond redemption. Of course, if your negatives are large enough, say 2¼ x 2¼ inches, so that you do not have to worry too much about fine grain, the fine-grain stricture that developer, fixer, and wash water should all be of approximately the same temperature may leave your results unscathed. However, a very cold washing, the temperature of which is considerably below that of the fixer, will cover your negative with a filmy, splotchy coating which must be removed before the negative strip is hung up to dry. But this is automatically taken care of if you swab both sides of the strip with a viscose sponge.

TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

LAST month's discussions in this department were rather on the light side, hence this month we offer three items, two of which will rate as advanced amateur telescoptics. All three are by Kirkham. In the first, he gives specifications for a Cassegrainian telescope with a spherical secondary instead of the usual hyperboloidal secondary, in the second he gives data for designing special eyepieces for the RFT 'scope, and in the third something easier. Comments from Kirkham's letters suitably introduce the first item: "The formulas for computing how much correction to put on the primary mirror to make it fit a spherical secondary mirror instead of a hyperboloidal secondary are not very terrible. The spherical aberration of the secondary is computed first and then a primary is designed to produce that much. There is amazingly little difference between the mirror which is necessary and a paraboloid; it amounts to from 70 to 90 percent correction, depending on the design of the 'scope. There should not be any observable difference in the performance when the telescope is used visually, and the job of deforming the tiny secondary mirror, which Porter frowns on so much (ATM, p. 63), is entirely done away with. The formulas are not lying around anywhere that I know of, hence I hereby present them, all worked out and ready to apply. They are based on developments in series by the binomial theorem, and the processes of deriving them would not be intelligible to any but a mathematician, and would not be even very interesting to another mathematician. These developments are on hand, and can be supplied to any who care for that kind of thing."

THE CASSEGRAINIAN TELESCOPE WITH SPHERICAL SECONDARY MIRROR: "The customary curves for Cassegrainian telescopes are the paraboloidal primary and hyperboloidal secondary. As far as I know nobody has ever raised the question of why these curves are used instead of others which might be easier to produce, or even better. Probably the first Cassegrainian telescope was a revamped Newtonian, and the secondary was just naturally made to fit.

"Schwartzschild proposed the aplanatic curves in 1905 and these amount to overcorrecting both mirrors. Apart from increasing the difficulties of construction, these curves are a waste of time and effort, as far as visual instruments are concerned. As a matter of fact, there is no very good reason for not going the other way and removing some of the correction from both mirrors. In changing the figure of the secondary to a sphere, only a fraction of the correction must be removed from the primary mirror. In the usual method of testing a Cassegrainian telescope with a flat, when the secondary is yet uncorrected the entire telescope appears overcorrected. Instead of overcorrecting the telescope as a whole by correcting the primary right up to the full parabolic form, and then going backward by changing the secondary to a hyperboloid, why not stop the correction of the primary at just the right point so that no correction at all will be necessary on the secondary? It can be easily finished up spherical by means of the King test, or by polishing the tool enough to show fringes in monochromatic light, and it will generally be impossible to tell any difference in visual observation between a telescope with these curves and any other curves.

"In Figure 1, if we place a light source at F', the focus of a Cassegrainian telescope having a spherical secondary mirror, a marginal ray will diverge and fall upon the rim of the secondary at H', from whence it is reflected to the rim of the primary mirror at H, and making an angle u' with the axis. If the ray is traced backward along the dotted line, it will cut the axis at a distance b from the apex of the secondary mirror. The longitudinal spherical aberration is $b-p$. We shall designate this spherical aberration by a, and it can quite easily be shown that

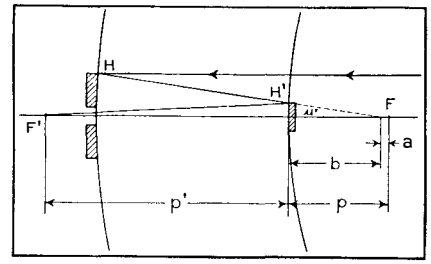


Figure 1: **Sph. Secondary Cass**

$$a=-\left(\frac{R'-p'}{R'-2p'}\right)^2\frac{r'^2}{R'} \qquad (1)$$

where R′ is the radius of curvature of the secondary mirror, r' the radius of its marginal zone, and p' the distance of focus F' from the apex of the secondary mirror.

"Now, obviously, if the primary mirror has this same amount of aberration, then the telescope will be corrected as a whole. If we designate the radius of curvature of the primary mirror by R, the radius of its marginal zone by r, and compute a from the above formula, we may write

$e=-4Ra/r^2=$ *undercorrection* (2)

and the percentage of correction necessary for the primary mirror is

$100\,(1-e)=$ *percentage correction* (3)

The quantities a and e are computed only for the marginal zone, and the percentage found for (3) holds for all zones of the mirror.

"If we designate the radius of any zone of the primary mirror by y, then a parabolic mirror tested at center of curvature has the knife-edge or grating movement (assuming the pinhole remains fixed)

$$A=y^2/R \qquad (4)$$

as every amateur knows. If we want to make a Cassegrainian telescope with a spherical secondary mirror, then the knife-edge or grating motion is simply the percentage of y^2/R given by formula (3), or to state it all together

$$A_0=(1-e)y^2/R \qquad (5)$$

and one has only to apply this correction to the primary mirror, with the assurance that the secondary mirror will fit if left spherical.

"A WORD OF CAUTION TO NON-MATHEMATICAL READERS: These formulas are derived according to the conventions of analytical geometry, which is coming more and more into practice, and it is necessary to bear in mind that, after making a drawing of the telescope such as Figure 1, R and R′ are *positive* if their center of curvature lies to the right of their surface, and negative if to the left. Likewise, p or p' will be positive or negative according as they lie to the right or left, respectively, of the surface. As an example, p' in the figure is negative.

"I have felt for a long time that amateurs have been overlooking a good bet with these 'elliptical Cassegrainians', as the chief difficulty in producing a compound telescope has always been the satisfactory figuring of the secondary mirror. As a matter of fact, this is about the only real difficulty given by Porter on page 62 of ATM as a basis of his 'and why not to'. I might add, however, that the idea was suggested to a Tacoma amateur some time after this theory was worked out by a member of the Lick observatory, and upon investigation, I understand further that Dr. J. A. Anderson suggested it two or three years ago, and expressed the thought that he would like to see it tried.

"There is another interesting possibility. The primary mirror formed by this formula will not be exactly an ellipsoid, but Schwartzschild has shown that mirrors of reasonable sizes conforming to these kinds of formulas differ from ellipsoids only by very small fractions of a wavelength. The direct focal test could therefore be applied, and a complete Cassegrainian telescope produced with no necessity for zonal measurements whatever, making the job on the whole much easier than the ordinary Newtonian job."

THE idea of a Cass of this unusual type turns out, on investigation, to be older than is mentioned above; evidently it is quite aged, in fact. Kirkham, however, hit on it independently. This happens again and again. With thousands of new and enthusiastic recruits to telescoptics, it is not even remarkable that many a man has a bright idea that someone had in his grandfather's day. Your scribe recalled that Dall, of England, proposed a similar idea in the *Journal of the British Astronomical Association* in 1932—a monthly which, by the way, often contains most interesting discussions of telescoptical subjects—and that he had also discussed it in private letters in the same year. But he never published the details. However, as an amenity, since Dall was known to have made three such Cassegrainians of this type, Kirkham's paper was shown to Dall before publication, and Dall at once voluntarily surrendered any special claim to ownership. Kirkham, when then shown Dall's early correspondence, asked that mention be made that the method

suggested in his final paragraph is the same as the one Dall had described in that correspondence with your scribe. This kind of mutual courtesy is a pleasing relief, considering that many a telescoptician, on learning that another had been trespassing on one of his pet preserves without by-your-leave, has growled and given the other fellow the dog-eye. Verily, your telescolumnist knows, because he has so often stood at the focal point of numerous tilts of this kind, this being the exact point at which the brickbats cross.

SECOND item by Kirkham is also introduced by informal comments from his letter of transmittal: "Let me join with others in the opinion that one of the best things that has yet hit amateur telescope making is the RFT and, in connection with this, altogether apart from the spherical Cass problem, equation 2 of the above Cass paper can be used for deriving the proper amount of overcorrection for an RFT mirror to compensate for spherical aberration of the eyepiece, which is very considerable at $f/3$ or $f/4$. A Huygenian ocular has an unpermissible amount of aberration when you get above $f/10$. A Ramsden begins to gum up the image at about $f/5$, and therefore an RFT cannot possibly work its best unless something is done about the spherical aberration of the eyepiece. It amounts in some cases to 50 percent or more overcorrection."

EYEPIECES FOR THE RFT: "In the past, it has seldom been necessary to apply eyepieces to objectives of greater aperture ratio than about $f/8$. A Huygenian eyepiece of 1″ focal length has about .02″ longitudinal spherical aberration at $f/8$—quite enough to interfere with the performance of a first class, fully corrected mirror. Most of us have avoided this difficulty simply by asserting that Huygenian eyepieces are no good with reflecting telescopes, and using Ramsden eyepieces. A characteristic Ramsden eyepiece has been found to have about .006″ aberration at $f/8$, which in practice is altogether negligible.

"The commonly accepted aperture ratio for RFT seems to be $f/4$ (for reflectors), and it now becomes necessary to see what happens to the eyepiece aberrations when called upon to handle such wide cones of rays. While eyepieces can be designed to have no spherical aberration at all, it is never practical to do so. The whole beauty of the RFT plan is in obtaining a wide field as full of stars as possible. Eyepieces have other aberrations much greater than spherical aberration, which have to be kept within limits. An ocular has quite a job to perform if it gives a moderately wide field of view free from excessive astigmatism, distortion, and curvature, and it is generally impossible to make the eyepiece free from spherical aberration and at the same time keep these other errors within workable limits. The things one would have to do to an ocular to free it from spherical aberration and some kinds of color errors are directly opposed to what is needed to keep the astigmatic and other color errors within the desired limits. When the objective is of very short focus, it becomes absolutely necessary for it to be overcorrected an amount corresponding to the eyepiece longitudinal aberration if most satisfactory results are to be obtained.

"It can be shown by a somewhat lengthy

calculation that an ordinary Ramsden eyepiece of 1.14" focus, when used with a fully corrected parabolic mirror of $f/4$ focal ratio, has almost exactly the maximum permissible amount of spherical aberration, so that a star right in the center of the field will not appear to be larger than if the error were absent. We must not jump to the conclusion, however, that the state of affairs is therefore satisfactory. There are six other major errors which, when taken all together, will run the total error of the system way over the limit, especially in the edges of the field. It is easy to see that, if the one error uses up every bit of available 'tolerance' for a star most favorably situated, there is no hope at all for stars to look like more than dirty spots at a distance of 15° to 20° from the center. On the other hand, it is quite simple to overcorrect the primary mirror sufficiently to bring this large central error to zero, so that we have all the tolerances left to take care of the other aberrations about some of which absolutely nothing can be done.

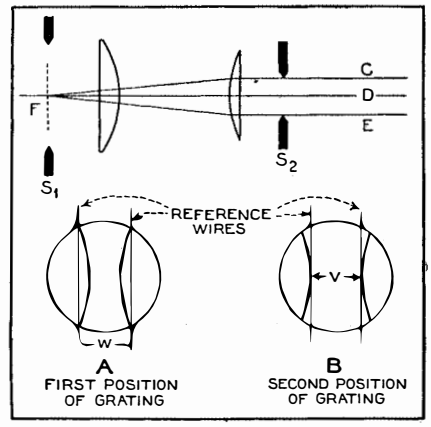


Figure 2: **RFT eyepiece data**

"In most cases, this method gives a rather close approximation to an 'aplanatic telescope'. Since coma is the principal part of the aberrations of a reflector after spherical aberration is eliminated, the plan increases the general usefulness of the system as a whole far beyond what could be hoped for if it were possible or practical to obtain eyepieces free from spherical aberration. The faults of the eyepieces indeed turn out to be a blessing in disguise.

"In order to figure a mirror so that it will have a certain predetermined amount of spherical aberration, it is necessary to know how much the knife-edge must move in measuring the different zones. It is not difficult to show that, calling the radius of curvature of the mirror R, the desired amount of aberration a, and the diameter of the mirror d, the amount of overcorrection necessary is

$$e = Ra/d^2$$

If we denote the radius of the zone we wish to measure by y, then the knife-edge shift for this zone is

$$(1 + e)y^2/R$$

instead of the old formula

$$y^2/R$$

which corresponds to a paraboloid. In these formulas, the aberration a is considered positive when the marginal rays come to a focus *closer to the eye* than the axial rays; that is, when the Ronchi bands behave, in testing the eyepiece by the method about to be given, like those of an oblate spheroid.

"In practice, a is the amount of aberration of the eyepiece to a bundle of rays which pass straight through it. If first class eyepieces are purchased from a reliable dealer (at a fair price!) he may in some cases be able to furnish the telescope maker with exact data as to the amount of aberration of his oculars. In case of oculars of known construction it can be found very exactly by ray tracing, using the formulas given in many optical books. For Ramsden eyepieces of about the usual form, having two lenses separated about three-quarters of the focal length of the entire ocular, neither of which is a compound lens, a sufficiently exact working guess is $a = .018f_e$, where f_e is the focal length of the eyepiece, provided that the objective has a focal ratio of $f/4$. If the particular Ramsden eyepiece differs much from the standard ones described in ATM by Hastings and others, the formula will be quite worthless.

"The aberration can be found quite accurately by experimental methods requiring no special equipment not already possessed by the mirror maker. Figure 2 represents a Ramsden eyepiece being tested for a. A stop S_2 is made exactly the size of the exit pupil of the completed 'scope, and placed exactly in the center of the eye-lens as shown. It is then turned toward a distant streetlight, and a Ronchi grating placed at F, with the eye just behind. A round spot of light will be seen, just as in testing a mirror at center of curvature, and it will be crossed by the Ronchi bands in exactly the usual way. It is more than a safe bet that the eyepiece will have positive aberration, and the appearance will be that of an oblate spheroid. It is necessary only to measure the aberration by King's test, viz., by finding alternately where the grating must be placed to make V in B, Figure 2, equal to W in A, Figure 2. The longitudinal shift necessary is equal to a for that particular eyepiece and exit-pupil. If a couple of thin wires are stretched equidistant from the center, across the stop S_2, they will be plainly visible like ruled lines across the spot of light, and will be very convenient reference marks to go by in judging the position of the Ronchi bands. In the first place, adjust the grating to make the bands coincide with the wires in the center (V), and then move the grating longitudinally until they coincide at the edges (W). The shift will be equal to a. The wires should not be more than one-third the diameter of the stop S_2 apart, preferably somewhat less.

"What kind of eyepiece is recommended for RFT use? Nothing will be found to have much advantage, if any, over the Ramsden ocular of about the usual design, but by all means obtain a first class one. The only really outstanding fault of these oculars is the color error. This can be practically eliminated by several methods without changing the general design of the Ramsden ocular very much, since it is so satisfactory in other respects. The writer has found that the substitution of special glasses instead of the original crown glass can be made to reduce the error almost to the vanishing point. The König ocular is another entirely satisfactory revision of the Ramsden. It is sold under many names by different makers, and is often designated as the 'Achromatic Ramsden'. It has a compound eye-lens made of crown and flint glasses of almost the same refractive index but widely different dispersions. It is not

to be confused with the ordinary Kellner ocular, which is not at all satisfactory. All these eyepieces have about the same central spherical aberrations and longitudinal chromatic aberration, however.

"Most first-rate manufacturers make oculars of truly wonderful character, not all of which are satisfactory for use with very short focus objectives."

LAST October this magazine published an outstanding article in which most human beings were divided into extraverts and introverts, the extravert being a practical-minded, direct-acting, go-getter of a fellow who wants results as quickly as possible and is impatient of theorizing that lacks application, while the introvert finds his fun in thinking. Amateur telescope makers can similarly be divided into extravert and introvert types. The extravert mainly wants a telescope and is impatient of any kind of foolishness like stopping to philosophize about the whichness of the why as he proceeds to make one, while the introvert, who is probably in the majority in this hobby, largely regards the whole job as a good excuse for all sorts of brain racking about such intrinsically interesting things as the following, by Kirkham:

"The amount of glass to be removed in paraboloidizing a mirror varies with the cube of the diameter of the mirror, if the focal ratio is the same in both cases. You have to tear out eight times as much glass in figuring a 12″ mirror as you do in figuring a 6″ mirror, provided that the figuring is done in the center zones of the mirror, and nothing is removed from the edge. Furthermore, the amount of glass removed varies inversely as the cube of the *f* number. For example, you have to remove 2x2x2 = 8 times as much glass in figuring an *f*/4 mirror, as in figuring an *f*/8 mirror. It's quite interesting to note that you have to scrape off 64 times as much glass to figure a *f*/4, 12″ mirror as you do when you figure a 6″, *f*/8 mirror.

"When you figure a 6″ mirror, of 48″ focus, you have to remove .000,108 cubic inch of glass. If all of this was in one chunk, it would make a cube .0477 inch square, or about 1/21″, which looks like a lot more than one would imagine. There is another way to figure a mirror; that is, to leave the middle untouched and remove glass from the outer zones. This method involves removing exactly twice as much glass. The size of the representative cube of glass (1/21″) varies directly as the diameter of the mirror, and inversely as the *f* number. Hence, a 6″, *f*/4 mirror would have a cube of glass 2/21″ thick removed in figuring. A 12″, *f*/4 mirror would have a cube 4/21″ removed."

With the above, "Kirk" included a formal proof, but this contains too many integration signs and too many formulas to present here; interested readers may, however, borrow it from ye scribe.

In a private letter Kirkham writes: "The *average* amateur will do well to forget about 'super-colossal-ultra-hyper' oculars and get a real, grade A, plain Ramsden. And then, if someone feels he simply must go high hat, let him go after an achromatized Ramsden and, incidentally, prepare to part with some real kale. It takes a real optical designer just to *pick out* a suitable ocular for special purposes like RFT."

STELLAFANE convention, Sat. Aug. 6.

CURRENT BULLETIN BRIEFS

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

LIGHT FILTERS, by K. Brandt, is a 48-page pocket-size booklet, thoroughly illustrated with photographs and drawings, telling the whole story of the filter problem in amateur photography. It tells what filters do and how they do it; it tells what filters to use under certain conditions and how to use them. *American Photographic Publishing Company, 428 Newbury Street, Boston, Massachusetts.—50 cents.*

YOUR EYES AND HOW THEY FUNCTION is a pocket-size booklet which gives the elementary facts about eyesight. It discusses the eye and how it works; eye defects and how they are corrected; modern lenses and their advantages. It shows the advantages of the better vision which can be obtained through the proper application of optical science. *Write for Bulletin 638A, Scientific American, 24 West 40th Street, New York City.—3 cents.*

PRINCIPLES AND METHODS OF TREE-RING ANALYSIS, by Waldo S. Glock, is a Carnegie Institution of Washington publication, with 100 pages of text and numerous illustrations, containing a detailed exposition of the noted Douglass method of dating prehistoric archeological discoveries by means of tree-ring sleuthing. It also contains much pertinent data on the interpretation of tree-rings in general for those not immediately interested in archeology.—*Carnegie Institution of Washington, Washington, D. C., $2.00 (paper), $2.50 (cloth).*

THIRTY-MILE EYES IN SIXTY-MILE CARS discusses one of the common causes of automobile accidents—defective eyesight. Statistics show the cost of being careless about your eyesight, as applied to the operation of motor vehicles. This cause is comparatively easy to remedy; the booklet tells how. *Write for Bulletin 638B, Scientific American, 24 West 40th Street, New York City.—3 cents.*

BLASTERS' HANDBOOK is the ninth edition of a 281-page pocket-size volume, well illustrated with drawings, discussing practically every conceivable phase of blasting; for engineers, miners, farmers, and so on. Complete index. *E. I. Du Pont De Nemours & Company, Inc., Advertising Department, Wilmington, Delaware.—$1.00.*

WILLSON PRODUCTS FOR INDUSTRIAL SAFETY is something more than an ordinary catalogue. It describes and illustrates industrial safety devices such as goggles, respirators, fume and smoke masks, welding helmets and shields, and so on. Its 34 pages are a veritable guide to personal safety in many industries. *Write for Bulletin 638C, Scientific American, 24 West 40th Street, New York City.—3 cents.*

SERVICES OF THE NATIONAL BUREAU OF STANDARDS TO THE CONSUMER contains numerous illustrations of equipment and devices used at the Bureau to evaluate commodities commonly purchased by the consuming public. The text includes brief items telling what has been done to improve such varied products as automobiles and dental products, electric lamps and shoes, insulation and tableware, and many other things. Information is also given about the establishment of commercial standards and simplified practice recommendations covering many commodities of consumer interest. *National Bureau of Standards, Washington, D. C.—Gratis.*

INDUSTRIAL CAPACITOR MANUAL deals with ratings, required capacities, power factors, and other engineering and servicing aspects of motor-starting capacitors. Simple self-calculating charts are included for solving the necessary mathematical problems. *Write for Bulletin 638D, Scientific American, 24 West 40th Street, New York City.—3 cents.*

THERMAL SPRINGS IN THE UNITED STATES, Geological Water-Supply Paper 679-B, describes the different hot springs and their geology, with maps. *Superintendent of Documents, Washington, D. C.—35 cents (coin or money order).*

DO YOU KNOW? is a collection of short pithy paragraphs regarding railroad statistics, attractively printed and bound in pocket size. For example: ". . . that the first 'Stop! Look! Listen!' sign was drawn in 1884 . . ." ". . . that the employees of the American railroads earn and spend two billion dollars a year for the needs of their families . . ." ". . . that the speed of freight trains has been stepped up 50 percent in recent years . . ." *Write for Bulletin 638E, Scientific American, 24 West 40th Street, New York City.—3 cents.*

THE LARGEST STREAMLINERS IN THE WORLD is a circular giving the technical details of many of the streamlined trains now in operation. *Pullman-Standard Car Manufacturing Company, 79 East Adams Street, Chicago, Illinois.—Gratis as long as limited supply lasts.*

SHOULD HUSBANDS KEEP HOUSE? is a 32-page illustrated booklet that explains how research and the manufacture of steel has helped to make possible a large amount of attractive labor-saving home equipment. It also tells how to take care of this equipment—kitchen ranges, refrigerators, bathroom equipment, cooking utensils, and so on—in order to get the best service from them. *Write for Bulletin 638F, Scientific American, 24 West 40th Street, New York City.—3 cents.*

PICTORIAL CHARTS AND MAPS is a catalogue of available charts which cover such subjects as geography, population, crime, medicine, and so on. It will be of particular interest to instructors and lecturers. *Pictorial Statistics, Inc., 142 Lexington Avenue, New York City.—Gratis.*

LEGAL HIGH-LIGHTS

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

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

Real Teeth

OUT of the mill of the present session of the Seventy-fifth Congress has come a piece of legislation which, because of its importance, warrants much more publicity than it has so far received. The legislation in question is in the form of an amendment to the Federal Trade Commission Act and it represents a radical increase in the power of governmental supervision over business practices.

Heretofore the Federal Trade Commission has had the power to restrain unfair methods of competition in commerce. In construing the power of the Commission the courts have held that the Commission could prohibit only those unfair business practices which were used in competition with other persons engaged in commerce. If no competition existed the Commission could not act even though business practices which were unfair and deceptive to the public were employed.

Under the new Act the Commission is not only empowered to restrain unfair methods of competition but also "unfair or deceptive acts or practices in commerce." Accordingly, it will no longer be necessary for the Commission to prove that the party proceeded against is engaged in competition with other persons.

A significant innovation in the new Act is to be found in the provision that hereafter it shall be an unfair and deceptive act to disseminate any false advertisement by mail or in interstate commerce or under certain other circumstances for the purpose of inducing the purchase of any food, drugs, medical or surgical devices, or cosmetics. The Federal Trade Commission is specifically empowered to restrain the dissemination of such false advertising. Under certain prescribed circumstances the dissemination of such false advertising is a misdemeanor subjecting the violator to a fine of not more than $5000 or to imprisonment for not more than six months, or both.

The Act also makes important changes in the procedure for reviewing and enforcing the orders of the Federal Trade Commission. Heretofore, the orders of the Federal Trade Commission were not self-enforcing but it was necessary for the Commission to apply to one of the United States Circuit Courts of Appeals for an injunction, and when such an application was made the court had full power to review, affirm, modify, or set aside the order which the Commission sought to enforce. Under the new Act the party proceeded against has the right to appeal to one of the Circuit Courts of Appeals. However, if no appeal is taken within the prescribed time, or where the order of the Commission is affirmed by the courts, the order becomes final. Any person violating a final order of the Commission becomes liable to a civil penalty of $5000 for each violation, which may be recovered in a civil suit instituted by the United States. In brief, the new Act provides the Federal Trade Commission with real teeth.

Lyrical Mind

IN a recent suit for copyright infringement based upon the copyright of a popular song, the defendant contended that there should be no award for damages because the lyrics of the song were salacious. In support of its contention the defendant offered to introduce evidence as to the meaning of the words of the lyric, in the mind of the author. The court held that the meaning of the words to the author was immaterial and held that evidence bearing on this point should be excluded from the case.

Disclaimer

UNDER the patent statutes as construed by the courts, a patentee is required either promptly to file and prosecute an appeal or to file a disclaimer in the Patent Office, where one or more of the claims of his patent are declared invalid by a court of competent jurisdiction.

A disclaimer is a formal disavowal of those portions of the patent which really do not form part of the patented invention but were claimed in the patent through inadvertence, accident, or mistake. The failure to comply with the disclaimer statute as construed by the courts results in the patent being void and unenforceable.

In a recent suit for patent infringement the District Court held that one of the claims of the patent was invalid. The plaintiff filed an appeal to the Circuit Court of Appeals within the time prescribed by statute, but the defendant charged that the plaintiff failed diligently to prosecute the appeal, and contended that, accordingly, a disclaimer should have been filed in the Patent Office. The Court found that at about the time of the entry of the decree which adjudged the claim to be invalid the patent had expired. The Court pointed out that one of the purposes of the disclaimer statute was to relieve the public against an asserted monopolistic right which had been patented without justification. Since the patent had expired the public was not being subjected to any unwarranted claim for a monopoly and the Court concluded that the necessity for filing a disclaimer did not exist. In this connection the Court stated:

"A disclaimer filed immediately after entry of the decree could not have preserved to plaintiff anything to which he was justly entitled, nor relieved the public against an asserted monopolistic right which had been obtained without justification of fact. He had nothing to disclaim in which the public had an interest. A disclaimer would have been without effect, and it was not necessary."

RFC

ONE of the consequences flowing from the creation of the various agencies for the relief and aid of business during the depression is that the United States has become involved in a suit for unfair competition.

The Reconstruction Finance Corporation was created by special act of Congress for the purpose of aiding business, and the United States Government is the owner and holder of all of the capital stock of the corporation. In the normal conduct of its affairs the Reconstruction Finance Corporation loaned $250,000 to a shoe manufacturer and took as security liens on all of the real and personal property of the shoe manufacturer, including the right to use the corporate name, the good will of the business and all of its trade marks. Subsequently the shoe manufacturer went into bankruptcy, and to protect its interests the Reconstruction Finance Corporation purchased from the Trustee in Bankruptcy all of the real and personal property of the shoe manufacturer, including the business and good will, the trade marks, and the corporate name. Shortly thereafter two of the defendants in the suit under consideration organized a company for the manufacture and sale of shoes, represented that they were the successors of the original bankrupt shoe manufacturer, and employed the trade name and trade marks which were purchased by the Reconstruction Finance Corporation. The Reconstruction Finance Corporation then brought suit for unfair competition to restrain the use of the trade name and trade marks which it had purchased.

The defendants contended, among other things, that the Reconstruction Finance Corporation was not authorized to engage in business, that it had no business to protect, and that, accordingly, the acts of the defendants did not amount to unfair competition. The court disagreed with this contention, however, and held that the Reconstruction Finance Corporation had the right to make loans and to take security for loans, and that this necessarily gave the Reconstruction Finance Corporation the right to liquidate the security which it had received. The court held, further, that if the acts of the defendants in using the trade name and trade marks prevented the Reconstruction Finance Corporation from properly realizing on the security, the defendants were guilty of unfair competition. In reaching this conclusion the court stated:

"The plaintiff was authorized by law to make the loan and to take security for repayment. The authorization to take security implies the right to liquidate the security * * *. If by defendants' acts it is likely to be unfairly prevented from realizing what it has a right to expect from a sale of the business, the good will, and trade marks, the injury is present and redress may be sought in equity."

Books SELECTED BY THE EDITORS

MILESTONES IN MEDICINE

By Doctors Jeliffe, Stockard, Vogel, Tilney, Sigerist, Wayson, and Timme

THIS volume contains the recent series of laity lectures delivered through the New York Academy of Medicine by noted physicians. These are respectively on the historical background of psychiatry, the mechanisms of heredity, medicine at sea in the days of sail, the evolution of the human brain, the history of medical history, the history of leprosy, and the story of the glands of internal secretion. They vary considerably in interest and significance but all are easily understandable to average laymen. (276 pages, 5 by 8¼ inches, unillustrated.)—$2.15 postpaid.—*A. G. I.*

AN EXPERIMENT WITH TIME

By J. W. Dunne

THE fourth and greatly revised edition of a work that was first published in 1927 and which has since then been the subject of much discussion, pro and contra, among scientific persons. The author, an educated man, no muddled necromancer whether his work is true or false, discovered he frequently dreamed in advance many events that soon transpired with uncanny accuracy, and on prolonged study of these odd agreements he tried to work out a hypothesis of the nature of time. However, any persons who jump to the conclusion that this is any sort of "dream book," or work of occultism or other pseudo-scientific hocus pocus of a too-familiar kind, will err. Whatever it is that Dunne has hit upon, it has been handled by him both scientifically and cautiously. The book is not easy reading except in spots, simply because the matters discussed are not light in kind. The author evidently can cut adrift from the present not only toward the past, as we all can, but sometimes along the future dimension of time, though not at will but only during sleep and not always even then. (297 pages, 5 by 7¾ inches, 21 drawings.)—$2.90 postpaid.—*A. G. I.*

PRINCIPLES OF MATHEMATICS

By Bertrand Russell, F. R. S.

IN 1903 the now famous Bertrand Russell of England published this book and it made his reputation as a great mathematician. This is the second edition of the same work and nothing in it has been changed because, as the author states, the original material is as clear today as it was a generation ago. Russell's fundamental thesis is that logic and mathematics are identical and that what is called mathematics is merely later deductions made from logical premises. This is no A B C book like Russell's "A B C of Atoms" and "A B C of Relativity," but is for the mathematically sophisticated, as some of the subjects dealt with in the respective chapters will show. These are: definition of pure mathematics, symbolic logic, implication and formal implication, denoting, classes, propositional functions, the variable, relations, the contradiction, number and cardinal numbers, addition and multiplication, finite and infinite, theory of finite numbers, addition of terms and addition of classes, whole and part, infinite wholes, ratios and fractions, meaning of magnitude, range of quantity, measurement, zero, infinity, the infinitesimal, continuity, genesis of series, meaning of order, asymmetrical relations. These give an idea of the first third of the book and the remainder deals with various aspects of order, infinity and continuity, space, matter and motion. (534 pages, 6 by 9 inches, unillustrated.)—$5.20 postpaid.—*A. G. I.*

SEASON OF BIRTH

By Ellsworth Huntington, Yale University

THE noted author of "The Pulse of Asia" and "Civilization and Climate" now turns to the question of the relation of season of birth to human abilities and offers to science a profound study of a question which might have made many an eyebrow raise until he has apparently proved that there really is a connection of this kind. However, astrologists and their ilk, in case they now discover in this a confirmation of occult notions, are likely to gain no comfort, for it is in no way tarred with such a stick and has nothing to do with any kind of holdover from mediaeval superstition. The author discusses season of birth, the effect of the birth *season* (not month, day, or hour) on length of life and on sex ratios, on leadership and on genius, also on numerous cognate matters. It is especially flattering if you discover that you were born right in season with the geniuses, especially if you are no genius. (473 pages, 5¼ by 8½ inches, 104 figures mostly graphs, and especially a fine bibliography.)—$3.70 postpaid.—*A. G. I.*

AIRCRAFT PROPELLER HANDBOOK

By Karl Hansson Falk

ENGINEERS, draftsmen, students, pilots, servicemen, and others in the aeronautic industry will find in the pages of this book concise and practical data which does not necessitate a large background of propeller theory. Where it is necessary to give equations they are presented in the most simplified possible form; advanced mathematics are employed only in a few cases where it is unavoidable. (100 pages, 6 by 8½ inches, numerous drawings and charts.)—$4.20 postpaid.—*A. P. P.*

THE LAW OF CHEMICAL PATENTS (Second Edition)

By Edward Thomas

THIS book, as the name indicates, deals with the law of patents as applied to chemicals and to chemical and industrial processes. The author approaches his problem in a rather unusual fashion. The book is not a textbook within the usual meaning of the word, setting forth a treatise on the development and present status of the law of chemical patents. It is rather a compilation of innumerable quotations from court decisions bearing on this subject. Thus each chapter is introduced by a paragraph or two of text written by the author, briefly outlining the subject matter to be covered in the chapter. The remainder of the chapter consists of a series of separate quotations from pertinent decisions. The book is exceedingly well indexed and can be used as a handy reference volume to locate decisions bearing upon the various questions in this field. (675 pages.)—$9.25 postpaid.—*D. H. Kane.*

PROCEDURE HANDBOOK OF ARC WELDING DESIGN AND PRACTICE

Fifth Edition

EVERY year we can count on a great expansion of this book, which was originally published five years ago as a rather thin volume. Last year we said that the Fourth Edition would give to the operating welder, to manufacturers, and to engineers practically everything they desired to know regarding design, procedure, and most effective utilization of this modern means of joining metals. We can only repeat that in this Fifth Edition the same holds true—with many additions. It is well illustrated with hundreds of pictures, drawings, and designs, and is bound in limp leatherette. (1012 pages, 6 by 9 inches.)—$1.50 postpaid.—*F. D. M.*

METEOROLOGY AS RELATED TO THE OPERATION OF AIRCRAFT

By Lieut. Harold Louis Kirby

A PRACTICAL flier and teacher of this subject of many years' standing, Lieut. Kirby has produced a concise, workmanlike text, splendidly illustrated. Kirby's meteorology should be an invaluable book for anyone concerned with weather forecasting, interpretation of maps, and practical meteorological work at an airport. No advanced theoretical treatment is presented but basic principles of meteorology—winds, clouds, weather maps, sudden storms, and meteorological instruments—are frequently and adequately discussed. (120 pages, 50 illustrations.)—$4.20 postpaid.—*A. K.*

A HISTORY OF LAND MAMMALS IN THE WESTERN HEMISPHERE

By William Berryman Scott, Prof. Emer. of Geology, Princeton University

THE second edition, revised and rewritten throughout, of a work which has been a landmark among students of the evolution of the mammals of our western world. The author is a noted paleontologist. For final and authentic scientific book data on the extinct mammals, gigantic and small—on the great elephants, primitive horses, the odd meropus, the uintathere, the toxodon, saber-tooth tiger, and the whole immense host of bizarre new-world warm-blooded

beasts—this textbook is the last word. Not written to entertain, it is strictly a scientific book requiring study and collateral reading. The many illustrations of the great extinct mammals, made by artists who also understand paleontology, are remarkably fine. (786 pages, 5½ by 8¼ inches, 420 illustrations.)—$7.75 postpaid.—*A. G. I.*

MOONS, MYTHS AND MAN

By H. S. Bellamy

THE author is a Viennese collector of myths, many of which concern supposed early race-memories of vast catastrophic cosmic events—deluges and awful destructions such as that of the "lost continent" of Atlantis—and the greater part of this book is a collection of such myths. When the author, after years of such collecting and saturation in mythology, heard of a hypothesis proposed by an Austrian machine builder named Hoerbiger, who believes, among other things, that the moon is a metallo-mineral sphere enclosed in a 135-mile deep jacket of ice and was captured by our planet some 14,000 years ago, he linked up this man's hypothesis to his own collection of myths. The hypothetical events of that period were what started the myths, he thinks—and thus we have this bizarre book. At that, it makes fascinating reading, and it is decidedly well written—not a narrative, not scientific fiction, but straight exposition. However, the reader is warned that the hypotheses presented in it are without standing in the world of science. (351 pages, 5 by 8 inches, 9 illustrations.)—$2.65 postpaid.—*A. G. I.*

LOST ATLANTIS

By James Bramwell

THIS book represents an effort to examine the evidence for Atlantis and, while the author is clearly a pro-Atlantean, he exhibits at least to some extent the scientist's critical faculty. "It may well be admitted," he states, "that the balance of responsible scientific opinion is against Atlantis ever having existed at all." "Balance" here seems to be a charitable word. Similarly, he makes common cause with the scientist against various kinds of occultists who accept Atlantis as a matter of course or of emotion. Elsewhere, however, the book shows heavy leanings toward the romantic. Yet, to the scientific reader who is interested in seeing what there is to "all this recently revived Atlantis business," this would seem to be a much more sensible—or at least less nonsensical—book than the one in the previous review. (288 pages, 5¼ by 8 inches, one map.) $2.90 postpaid.—*A. G. I.*

EARTH-LORE

By Professor S. J. Shand

"GEOLOGY Without Jargon" is the subtitle of this brief but compact book which is the first American edition of a work that received flattering notice from scientists when it was published not long since in England. Jargon—special geological terminology which only the specialist really needs to remember—has previously stood as a high prison wall to keep the science within the narrow confines of the geologist's own group, a fact most regretted by the geologists themselves. Professor Shand goes as far as it is possible to go toward explaining about geology without asking his reader first to master an immense glossary of the specialist's terms. A newly added chapter on Atlantis, Mu, and other "lost continents" sets the reader straight about these myths so beloved by the incurably romantic who would identify human legends a mere few thousands of years of age with geologic events that took place many millions of years ago or else not at all. "There is no valid reason to believe that any 'lost continent' has existed either in the Atlantic or in the Pacific since man appeared on the earth," he says, and the other geologists agree with him. (144 pages, 5 by 8 inches, 49 illustrations.)—$1.90 postpaid.—*A. G. I.*

FLAME

By Oliver C. de C. Ellis and William A. Kirkby

A MONOGRAPH which starts with the study of a candle flame and proceeds to give the complete physics of flame. Some of the section headings are: Rise of Pressure, Convection and Gravitation, the Registration of Motion, the Fundamental Speed of Flame, Reaction Velocity, Thermal Conductivity, Detonation, Mechanism of Ignition, Phosphorescent Flames, and Spectrography of Flame. These are only a few of the subheads, to indicate the highly technical nature of this volume which is of convenient pocket size. (136 pages, 4½ by 7 inches.)—$1.35 postpaid.—*F. D. M.*

ASCARIS

By Dr. Richard Goldschmidt, University of California

THE story of life, as told by a noted biologist. It gives the gist of biology in readable form and one which presupposes no previous scientific knowledge. This book has been well-spoken of among men of science. (390 pages, 5½ by 8 inches, 160 illustrations.)—$3.40 postpaid.—*A. G. I.*

FAMOUS MEN OF SCIENCE

By Sarah K. Bolton

THE 16th printing of a book which was first published in 1889, hence the book has been through the purifying fires. Today it appears in modern typography and binding, with added chapters on Edison, the Curies, and Marconi. The chapters give narratives or portraits of the lives of Copernicus, Galilei, Newton, Linnaeus, W. Herschel, Cuvier, von Humboldt, Davy, Audubon, Faraday, Lyell, Agassiz, Darwin, Pasteur, Fabre, Kelvin, Huxley, and those previously named. While not juvenile, it is perhaps best suited to reading by youths in their teens, because the lives are described in such a way that the young reader is likely to wish to emulate and choose science as a vocation. (376 pages, 5¼ by 7¾ inches, with illustrations of the subjects of the silhouettes.)—$2.15 postpaid.—*A. G. I.*

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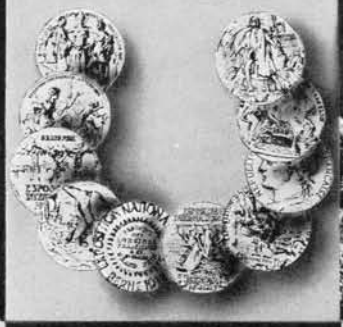

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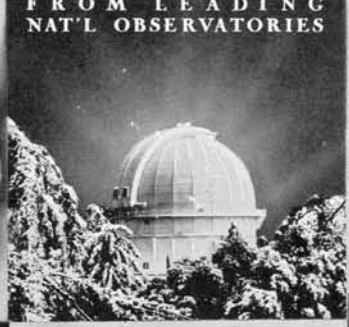

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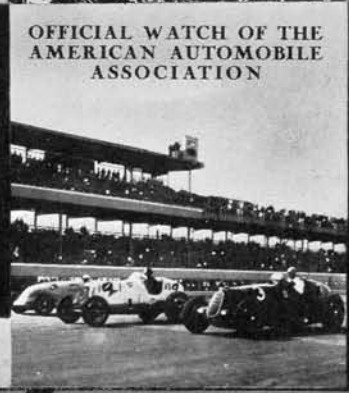

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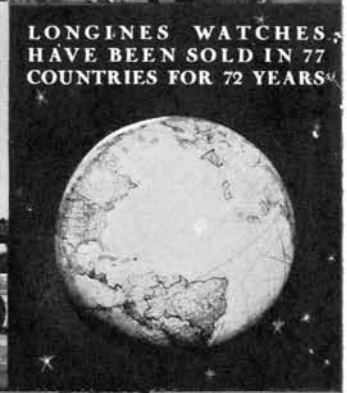

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