Telepathy and Clairvoyance

By WALTER FRANKLIN PRINCE, Ph.D.

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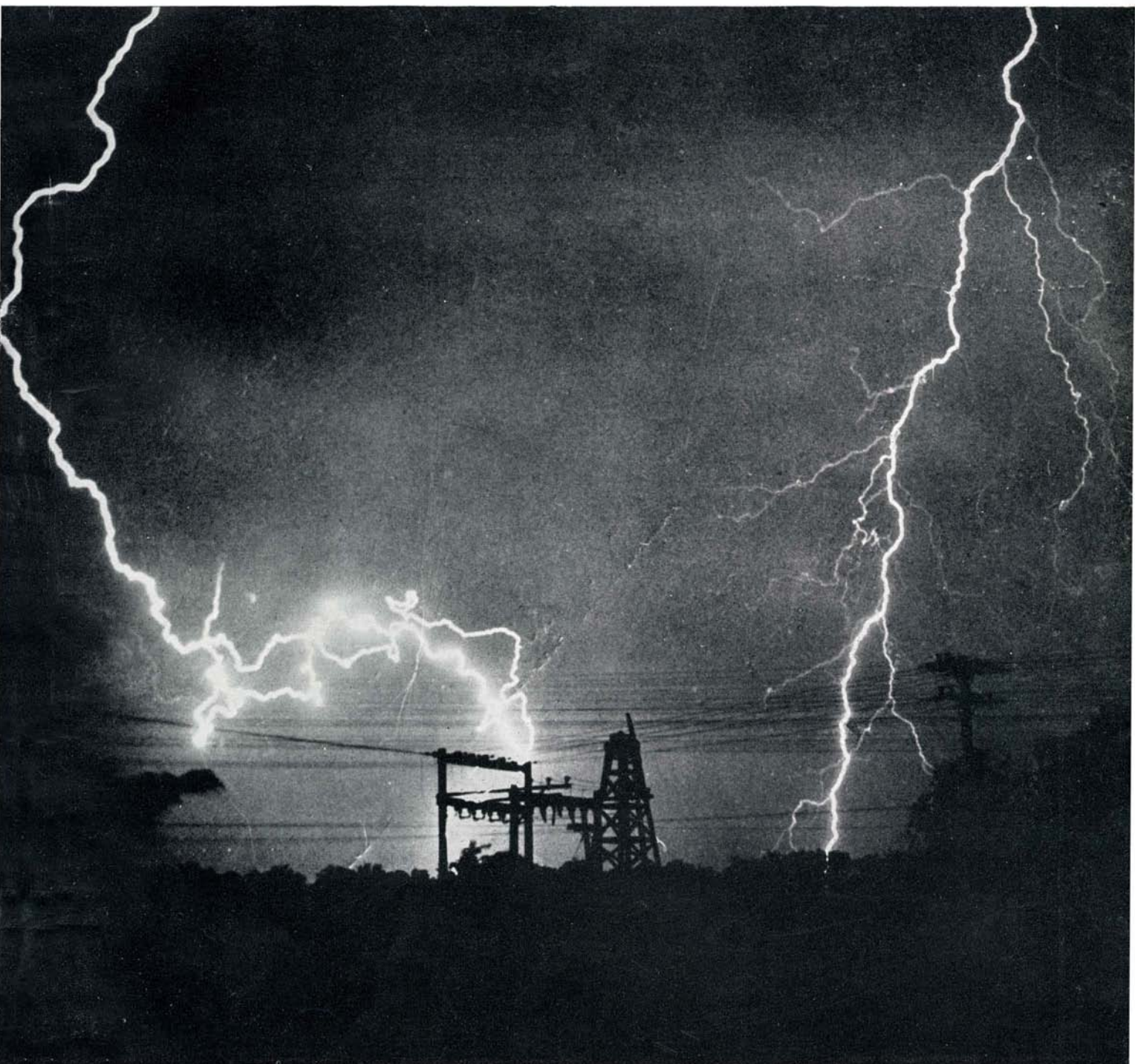

Nature Dwarfs Man's Handiwork (See page 1)

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NRA CODE

CONTENTS · JULY · 1934

Cover

THE unusually fine example of lightning photography reproduced on the front cover of this issue is published through the courtesy of the General Electric Company. The photograph, symbolical of the forces of nature which man must constantly combat, was taken at Drumright, Oklahoma. The switching station at the left, which the lightning appears to be striking, is in the line of the Oklahoma Gas & Electric Company, and an oil derrick shows in the background.

SCIENTIFIC AMERICAN DIGEST

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ACROSS THE EDITOR'S DESK

CONSIDERABLE interest in the subject of dew ponds has been aroused by the publication of an article in our May 1934 number. Among the correspondence prompted by this article are letters from Professor H. O. Croft, Head of the Department of Mechanical Engineering of the State University of Iowa, and from Dr. F. A. Brooks, Division of Agricultural Engineering, University of California. We hope to be able to publish these and other letters in a future issue but can take space here for only short quotations. Professor Croft writes: "E. A. Martin in the *Geographical Journal* . . . points out that, for the vicinity of the Croydon dew ponds, the natural rain-fall is about 35 inches; the natural evaporation is 18 inches annually; the natural condensation is 0.36 inches annually. This gives a net amount of about 17 inches annually which collects in the pond. This, then, would lead one to suppose that dew ponds may be constructed wherever the rain-fall exceeds evaporation. But should they not be called storage reservoirs?" Dr. Brooks writes: "Although dew ponds are a physical possibility in California, whether they would be practical depends upon the relative expense of obtaining water in other ways. Certainly no experiment should be made without a thorough analytical study and the determination of radiation, nocturnal air-flow, and atmospheric conditions at the location chosen." More of this subject later.

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AS has been the case with every newly developed industry, that of air conditioning has been surrounded by a mushroom-like growth of semi-truths which tend to mislead the unwary and at the same time to depreciate the value of true air-conditioning in its application to industry and the home. "Air conditioners" for about 25 dollars have appeared on the market, which, upon investigation, are usually revealed as nothing more than a humidifier, a fan, a heating unit, or a cooling cabinet. Even devices which diffuse perfume through the air of the room are advertised as "air conditioners." So much of this thing has been going on that it is little wonder that public ideas about air conditioning are, to say the least, somewhat muddled. We have in hand an article on the subject of popular fallacies regarding air conditioning which will set many of these matters straight. This article will be published in the very near future.

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"CORN, our major industrial crop, moves steadily toward industrialization. Ever since chemists found the way to break down the kernel into its components, the golden grain has been playing an increasingly important rôle away from the farm. Today, about two million tons undergo factory treatment. The products derived from it are used in more than thirty industries and further penetration is by no means remote." Thus is introduced an article entitled "Industrial Corn" by Phillip H. Smith, scheduled for publication in an early issue. Mr. Smith has prepared an article which tells the whole story of corn and its industrial applications.

NEXT MONTH

¶ Professor Alexander Klemin on research and your motor car.

¶ "Is the Battleship an Obsolete Unit?" by a prominent naval authority.

¶ Rattlesnakes and their bites; how to combat the effects of snake poison.

COMING

¶ S. F. Aaron, well-known naturalist, on the fallacy of the protective coloration theory in nature.

¶ "The Ether: Riddle of the Ages": The present status of this convenient physical concept.

●

ONE of the moot questions of international armaments concerns the battleship and its status in the line of defense. There can be no argument about the fact that since the World War there have developed outstanding advances in war matériel; undoubtedly the most spectacular of these is the airplane and airship. Have aircraft and other defensive and offensive mechanisms rendered the present-day battleship obsolete? The majority of American authorities answer this question with an emphatic "No"; in some other countries the leaning appears to be in the opposite direction. A careful analysis of the battleship as it stands today, showing how it has kept pace with development in other lines, has been prepared for us by a naval authority and has been scheduled for publication next month.

●

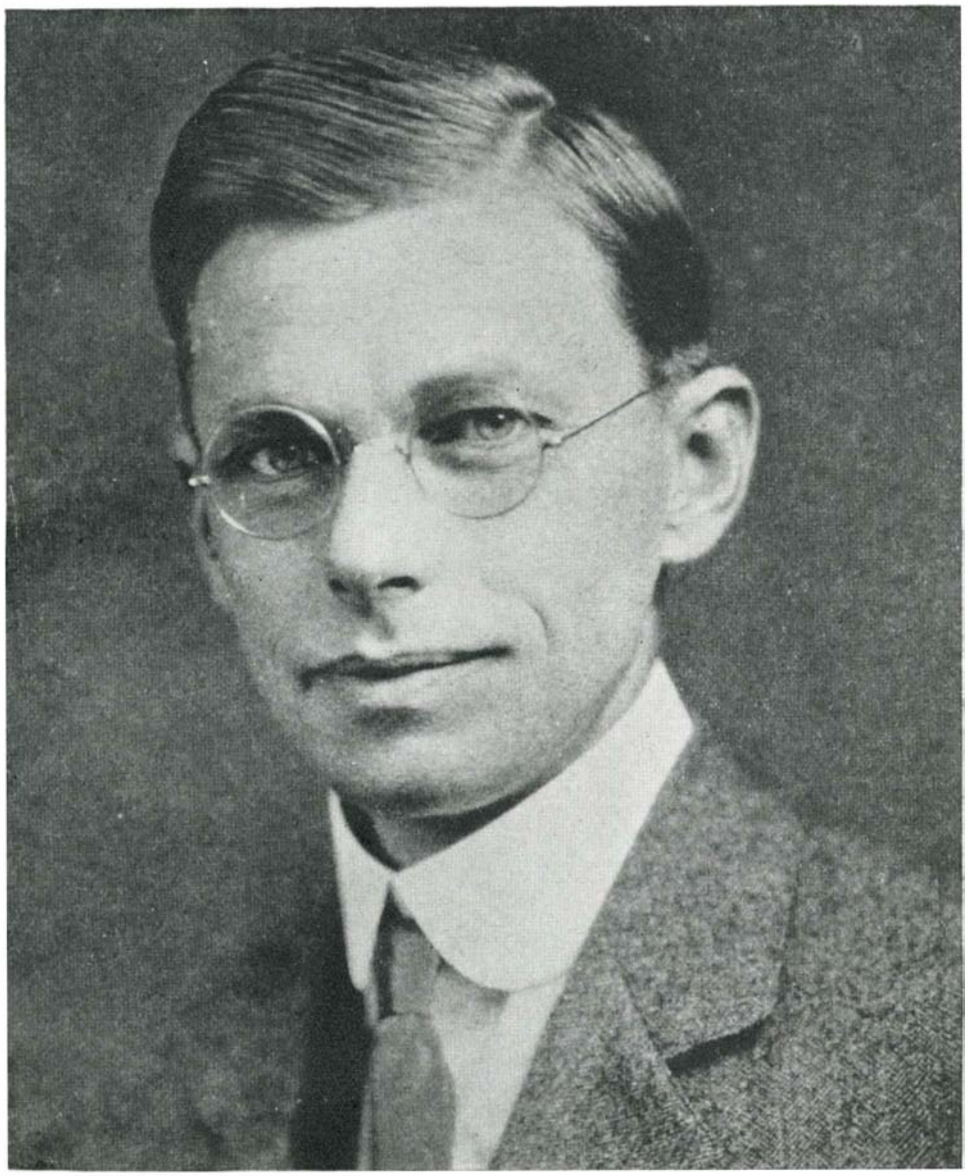
AT this season of the year when hundreds of thousands of people turn to the out-of-doors for recreation, snakes become a popular subject of discussion and fear. Because of this fact it is comforting to note the following quotation from an article entitled "Rattlers and Their Bites" by Will C. Barnes, to be published next month: "Forest officers, cowboys, and others constantly out in the open become accustomed to the thought that reptiles are part and parcel of their daily life and accept the hazard without much concern. With the exception of two or three varieties, common snakes are harmless. . . ." Mr. Barnes goes on to tell of those snakes which really constitute a menace to humanity because of the poison which they inject when striking, and tells of common-sense methods of preventing disaster when bitten by a poisonous snake. One important part of his article is the emphasis of the following statement: "Don't use whiskey."

●

ONE of the treasure troves of the archeologist is located at Ur in Chaldea. So much valuable material is located here that for the past 11 years the Joint Expedition of the British Museum and the Museum of the University of Pennsylvania has been busy locating, preserving, sorting, and cataloging the finds, and the end has by no means been reached. This work is of vast importance to the study of mankind and his progress through the ages. A record of the progress to date and a general résumé of the work accomplished during the 11 years is told in a two-part article by C. Leonard Wooley, Director of the Joint Expedition, the first of which will appear next month.

Hugo Gernsback

Editor and Publisher



JAMES BRYANT CONANT

IN recognition of his many contributions to chemical science, Dr. James B. Conant of Harvard University has been awarded the medal of The American Institute of Chemists, presented annually for outstanding service to chemistry in America.

Dr. Conant has done notable work in establishing the chemical structure of many complicated organic compounds, including the hemoglobin of the blood and the green coloring matter of plants, called chlorophyll. He has devised new methods of laboratory technique for better understanding of the mechanism of organic chemical reactions, as well as new modes of attack upon molecules for a deeper insight into the impelling forces which cause reactions to occur. He has established a quantitative measure of the effect of the arrangement of atoms in molecules upon the tendency of those molecules to enter into direct chemical combination.

Dr. Conant has written three textbooks and many papers on fundamental subjects in organic chemistry. In 1932 he was awarded the Charles F. Chandler Medal by Columbia University for his researches in oxidation and hemoglobin, and in the same year the William H. Nichols Medal of the American Chemical Society. He is a member of the National Academy of Sciences, rigorously selected body of ablest American men of science.

Subsequent to the award of these honors and when he was just 40 years of age, he was selected as president of Harvard University—a fact which speaks emphatically of his abilities as a man of science and as a man.

Courtesy *The Du Pont Magazine*

THE DEBRIS ROSE 600 FEET INTO THE AIR

WHERE Ol' Man River swept around Giles Bend, above Natchez, Mississippi, the United States Government Engineers decided to eliminate the 23½ mile kink by constructing a new channel 1½ miles long. Most of the work was done with drag lines and dredges, but at one place it became necessary to use explosives to remove a "high spot" in the channel where cypress stumps were imbedded in tough blue clay. Here a detour channel had to be blasted. This striking illustration shows what happened to the stubborn stumps and the clay when 1500 pounds of ditching dynamite went to work.

Hubert E. Pearce (left) and Dr. J. B. Rhine experimenting for clairvoyant perception. In this case, Mr. Pearce calls off the designs on the Zener Cards, which are left piled up until the end of the experiment

EXTRA-SENSORY PERCEPTION

Results of a Remarkable Series of Controlled Experiments for Telepathy and Clairvoyance

By WALTER FRANKLIN PRINCE, Ph.D.
Research Officer, Boston Society For Psychic Research

DUKE UNIVERSITY, Durham, North Carolina, has within a few years grown from a college to an institution with about 50 buildings and hundreds of instructors. It is perhaps the first university in the world to offer to its students a course of lectures in psychic research. The head of its department of psychology is Dr. William McDougall, formerly of Harvard and earlier of Oxford University.

Dr. J. B. Rhine is associate professor in the same department. I became acquainted with him in 1926. Beginning about three years ago, he occasionally wrote me, in laconic terms, that he was getting extraordinary results from experiments for telepathy and clairvoyance. Not until he had continued this work for three years and until nearly 100,000 experiments had been made, would he write the report which the Boston Society for Psychic Research has issued in a book of about 180 pages.

Telepathy (perception of thoughts by non-sensory means) and clairvoyance (direct perception of objects by non-sensory means) are included under the term "Extra-Sensory Perception." Both are abhorrent to the large majority of scientific men, in spite of the formidable evidence furnished by many published series of experiments for the former, which no one attempted specifically to impugn, and the hitherto less though still imposing evidence for the latter. Yet many men of high scientific standing have conducted experiments and have become convinced of one or both. Such names as these come to mind: Sir W. F. Barrett, F. R. S. (professor of physics, Royal College of Science, Dublin), Balfour Stewart, F. R. S. (professor of physics, Owen's College, Manchester), Sir Oliver Lodge, F. R. S. (principal of and professor of physics in the University of Birmingham), Henry Sidgwick (professor in Cambridge University), Mrs. Sidgwick (principal of Newham College, Cambridge, and one of the most intellectual women in England), Charles Richet (professor of physiology, University of Paris), Brugmanns (professor at Groningen University), Tischner (professor, University of Munich). Myers, Gurney, Podmore, Bruck, Warcollier, and many other persons of university connection or education with degrees of distinction could be named were there space.

HOWEVER, I do not know that anyone before Dr. Rhine has experimented for telepathy by methods which would not, theoretically, allow the seeping in of clairvoyance. He has conducted a vast number of experiments in such a way as to isolate each from the other. If the agent simply mentally visualizes objects, with no corresponding material objects present, and the percipient gets results beyond chance, telepathy is indicated. If objects (such as diagrams on cards), unseen by any one, are "guessed" rightly in a ratio safely beyond chance, this would indicate clairvoyance.

Prof. William McDougall, head of the department of psychology, Duke University, and chief sponsor of the work reported herewith

Dr. Rhine's experiments in both have yielded results so high above chance as to give convincing evidence of both

Table XXXVI

**Distance between Agent and Percipient, in P. T.
With Four Subjects
(P. T.=Pure Telepathy)**

Item No.	Percipient	Agent	Same Room		8-12 feet Wall Between		28-30 ft. Two Walls Between		250 miles	
			Trials	Avge. per 25	Trials	Avge. per 25	Trials	Avge. per 25	Trials	Avge. per 25
1.	Cooper	Miss Ownbey	1800	9.2	300	5.8	.....	.....	.....	.....
2.	Miss Bailey	Miss Ownbey	275	11.4	450	9.7	150	12.0	.....	.....
3.	Zirkle	Miss Ownbey	950	14.0	750	14.6	250	16.0	.....	.....
4.	Miss Turner	Miss Ownbey	275	7.7	.....	.....	.....	.....	200	10.1
			3300	10.6	1500	11.4	400	14.5	200	10.1

processes. Indeed one of the curious and perhaps most unexpected facts which the work seems to indicate is that there must be a close relationship between telepathy and clairvoyance, the major subjects possessing both capacities to a similar degree.

Throughout most of the experiments there were used what came to be called Zener Cards, because they were devised by Dr. K. E. Zener. They were in sets of five, bearing diagrams respectively representing a circle, a rectangle, a plus sign, a star, and two wavy lines. In most of the experiments five of these sets, shuffled, were used together. Let it be remembered throughout this article that when scores of successes are given, the mean expectation of chance was 1 in 5 or 5 in 25.

LET us have an instance of what pure guessing will do. I made 5000 trials with Zener Cards. In the first 1000 I had 209 hits, an excess of 9 above mean expectation. In the second 1000 there were 210 successes; in the third, 199; in the fourth, 193; and in the fifth, 188. None of these, for so many trials, has any significance, and the deviation from mean probability for the 5000 was but 10 (below). Had I guessed on the average 6 cards rightly per 25, I should have had a deviation of 200 above mean chance expectation, or, in other words, it could not have been mere chance, according to the accepted and long established laws of probability.

But turn to Dr. Rhine's subjects and contrast Mr. Zirkle's average of 9.6 successes in 25 in a series of 10,275 witnessed trials for "pure telepathy," or the lumped results of five subjects from 13,750 witnessed trials, part for telepathy, part for clairvoyance, the average score in which was 9. Some series ran below, and even much below, these figures, of course, and some shorter series ran above. But the anti-chance valuation of the three years' work can only be expressed in astronomical figures.

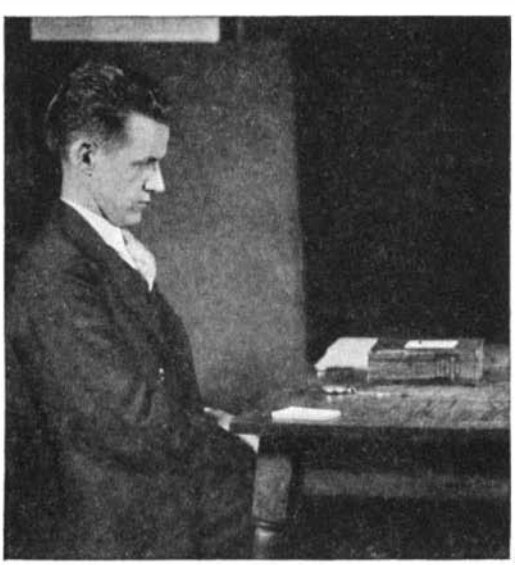
The largest number of experiments were with Mr. H. E. Pearce, jr., a clergyman student. These were all witnessed by Dr. Rhine, his assistant, Mr. Pratt, or both. At first he got only chance average, but rose until he was getting an average of 8.9 correct per 25 "guesses," through 11,250 witnessed trials for "pure clairvoyance."

In one of the photographs he is shown at the left working for clairvoyance with Dr. Rhine. He is attempting to name the cards in the shuffled pack of 25 (5 sets of Zener Cards) "down through;" that is, from the top to the bottom card *as the pack lies untouched*. Usually his eyes are closed, and he has an expression of intense concentration. About a dozen other packs can be seen on the table, and from run to run the pack is changed. Under these conditions, in 1625 calls he got 482 right, or 157 more than mean expectation, and an average per 25 of 7.4. Wallace Lee, a magician, after watching Pearce at this work, was unable to offer any explanatory suggestion, and, trying it himself, did not score above chance.

Other photographs show Mr. Zirkle (percipient) and Miss Ownbey (agent) operating for "pure telepathy" in separate rooms with another room between them. The doors were open but neither had sight of the other. The distance between them was about 30 feet. She signaled with a telegraph key for him to make a trial, and did not set down which diagram she mentally visualized until the time prescribed for the trial had elapsed. Under these conditions, out of 250 trials he was correct an average of 16 times per 25. In 750 trials with but one wall between them, his average was 14.6, and out of 950 trials in the same room his average was 14.0. All these results are astonishing, but perhaps it is still more astonishing that the ratio of success grew with increase of distance. The same thing was observed with other subjects, but not all.

OTHER photographs reproduced herewith show Pearce operating for pure clairvoyance, and Pratt in a building 100 yards distant with a pack of Zener Cards, lying backs up, before him. Any new procedure seems to affect Pearce unfavorably at first. Per 25 through 300 trials his scores were 3, 8, 5, 9, 10, 12, 11, 12, 11, 13, 13, 12—an average of 9.9 including the adjustment period. He did better than when in the same room! Afterward the distance was increased to 250 yards, also with remarkable results. Independent sealed reports were made by each to Dr. Rhine. See also Table XXXVI.

It is especially interesting that the introductions of certain factors into the procedure, such as could not conceiv-



J. G. Pratt (left) and Hubert E. Pearce experimenting for clairvoyance at a distance of 100 yards. Mr. Pratt merely handles the cards, does not look at them, but records the figures after a run of 25. The results are compared later. Mr. Pearce averaged 11 hits in 25 cards, as against an expected average of 5 hits

George Zirkle (left) and Sara Ownbey experimenting for pure telepathy. Miss Ownbey signals with a telegraph instrument when a new card is to be used. The conditions under which the test were conducted, and the results obtained, are described here

ably influence pure guessing, did notably influence the scores obtained. Only the last four to be named were experimental; the first two are as valuable as if they were experimental, but unfortunately the number of experiments so influenced was not as large as desirable.

1. When subjects were ill the ratio of hits fell.

2. Sleepiness from fatigue seemed to bring about the same result.

3. Changes in procedure, such as concealing the cards behind a low screen, then a higher screen, then a screen so high as to conceal the whole body of the agent, tended to lower scores for a time, followed by recovery of ratios, after a period of adjustment.

4. One table of the Boston Society's Report summarizes the effect upon Pearce's clairvoyant perception of the introduction of a visitor while a series was in progress. The visitors, in succession, on various dates, were Professors McDougall, Lundholm, and Zener of the department of psychology, J. F. Thomas, Ph.D., Misses Cousins and Bailey, and Wallace Lee, the magician. In every instance the scores of successes markedly dropped following the visitors' entrance, but after a time rose to nearly as high as or higher than the former level. The summarized figures are these: (1) Before entrance, 925 trials, average per 25 of 9.6 hits; (2) lapse period after entrance, 825 trials, with average score 5.5; (3) recovery period, visitor still present, 975 trials, with average score 10.1. Lee was as baffled as the others.

5. The subject Linzmayer, in the midst of work averaging 6.8 hits per 25, was given a dose of the narcotic sodium amytal. His senses remained clear, though he became a little incoherent in speech. But his clairvoyant capacity was destroyed. In 275 trials he scored only 1 hit above average chance expectation. The results of a similar test on Zirkle will be seen in Table XXXIII. A third test with Pearce was fully as striking as these.

6. Giving caffeine seemed to have the effect of improving the score, at least after a period of lowered averages. See Table XXXIII.

The Report is scientifically sponsored, is specific and detailed. Success was not dependent on dictation by the subjects or the deceptive conditions of "physical phenomena." The task of determining the truth with the use of Zener Cards is extraordinarily easy. Miss Turner made up her mind to convince her hitherto skeptical university teacher, Dr. E. She ran 100 trials, with scores per 25 of 8, 11, 7, 7. He simply held the cards behind a notebook. Was that not sufficient? But during the three years many procedures were devised to block every explanation which imagination can suggest.

FOUR members of the psychological faculty witnessed more or less of the work. Several graduate assistants in the psychological department helped in the testing. Some of these got significant results as subjects. Other subjects were graduate students. A number of series are entirely independent in their personnel from any other. It is indeed difficult to suppose that in Duke University there has existed for three years a combination of conspiracy and childish incompetence, involving at its two extremes at least 16 persons, the majority members of the teaching staff of the psychological department, or graduate students of high standing in the same.

Perhaps the unprecedented results are accounted for, in part, by the perfect harmony in the department presided over by Professor McDougall in relation to such experiments, in part by the tactful methods of dealing with subjects by Dr. Rhine and his assistants, and in part by the prodigious patience exercised in trying out and segregating favorable subjects and continuing work with these for long periods of time. We have already seen above that extra-sensory perception appears to be a capacity of utmost delicacy, to be dissipated or lowered by the slightest disturbance.

Dr. Rhine argues with much force against the various "radiation" theories which have been proposed to explain extra-sensory perception. He considers it to be a purely "psychic" faculty, but for all that, "natural," in that it is included in the order of nature.

Table XXXIII

Effect of Caffein and Sodium Amytal on P. T. Scoring
Zirkle, Percipient; Miss Ownbey, Agent
(P. T.=Pure Telepathy. No objects, such as cards, etc.)

Date	*Conditions Drugs, etc.*	*Trials*	*Hits*	*Avge. per 25*	*Remarks*
	Total, with Zirkle well	1,300	767	14.8	This gives Z.'s normal scoring level.
7-23 7-24	Last 2 days before caffeine test	250	128	12.8	Z. was running about 2 below par.
7-24	5 gr. caffeine	300	176	14.7	The drug brought him up to his average.
7-25 7-26	Normal; intervening period	250	136	13.6	Last 2 runs before drug, 7-26 gave av. p. 25 of 13.5; this is a check.
7-26 A.M.	5 gr. sodium amytal	300	94	7.8	Very sleepy; drop from 13.6 of 43%, and 9.7 times the p.e. diff.
7-26 P.M.	3 hours after amytal	300	74	6.2	Extremely sleepy. Drop still greater, 54%.
7-26 P.M.	5 hours after amytal; 5 gr. caffeine	300	114	9.5	Rise of 3.3 above preceding; a 53% rise and clearly a significant change.

OUR POINT OF VIEW

Too Much Illumination?

NO DOUBT while you are reading this editorial a man will be accidentally killed, for someone is accidentally killed in the United States every six minutes of the 24 hours or, say, every five minutes of the normal waking hours. Studies made by the statistically-minded show that one fifth of these accidental deaths are the result of poor vision, both poor eyesight and poor illumination.

Dr. Matthew Luckiesh, a leading authority on lighting, tells us now in a new book that one fourth of the school children of this country and one half of the adults have defective eyes, but still we do not regard this as a crying first-class national problem. In order to show that it is just such a problem he asks us to make an odd mental transformation. We are to suppose that all of these people with defective vision have wooden legs instead. Fifty million pairs of wooden legs instead of fifty million pairs of defective eyes. Now you can *see* wooden legs, while defective eyes seldom show their defects to others. The fifty million wooden legs would at once assume the status of a major national issue. None the less, persons with defective eyes are cripples. According to Dr. Luckiesh, much of this defective vision and the accidents caused by it are avoidable. One large source of these accidents is insufficient illumination where we work and live—not merely where we read.

There are, however, persons who worry about over-illumination. As Dr. Luckiesh points out, our eyes, like those of the other animals, evolved under daylight conditions and are therefore adapted to strong light. Few realize just how strong daylight is, even in the shade. For instance, people sometimes compare strong lamp illumination with sunlight. There is no comparison. It happens that, just as these comments are being written at a desk, there is a 300-watt electric lamp at a distance of just seven feet overhead. It is noontime and for a very few minutes at noon the sun sends a shaft of light down into the deep canyon between two adjacent office buildings and this falls on the same desk. Which is the stronger, the illumination of the 300-watt lamp or the sun? Powerful as the lamp ordinarily seems, when the sun breaks in it is literally put into the shade. The patches lighted by the sun make the lamp-lighted areas look like heavy dark shadows. Yet several persons have shown solicitation concerning possible eyestrain caused by the "too powerful" lamp overhead. Man did not evolve under 300-watt lamps. He and his ape ancestors have lived for millions of years under the sun. Old Sol's wattage is high. Our eyes are normally sun-adapted.

Dr. Luckiesh finds that the vision of persons who lead outdoor lives is generally better than that of indoor workers—several times better. This cannot be assumed to prove merely that most outdoor workers do not read much, or that indoor workers do, since he shows that one class of indoor workers who do not read or pore over papers—machinists, blacksmiths, housewives, miners, and so on—have much more eye defect than policemen, farmers, sailors and so on who work outdoors. More than twice as much defect, in fact. The seat of the discrepancy is poor illumination in working places—illumination which seems good, perhaps, but which is still incomparably weaker even than normal daylight in the shade. Many of the fatal accidents which happen every five minutes are doubtless due to this comparatively low level of indoor illumination.

It seems difficult to dispel the bogey of too strong light. The sale of smoked glasses is increasing rapidly. Many seek to exclude the ultra-violet rays of the sun by wearing special lenses, not realizing that all ordinary glass already excludes most of them. Wearing smoked glasses is essentially babying the eyes. The more the eyes are babied the weaker they become and the more babying they ask for. The situation often involves an element of self-induced neurotic condition and is akin to some other health fads. We wonder how early man survived without smoked glasses or tinted lenses.

A time will come when man will be able to duplicate in his home and indoor working places the full strength of normal outdoor environment.

Synthesizing Economic Recovery

SYNTHETIC "cures" for our economic sickness may help the patient. They may, however, act like speakeasy liquor, which serves the purpose of giving a brain-numbing jag followed by a ghastly, oh-why-did-I-do-it hangover, if it doesn't simply kill at once.

Depression cures, remedies, panaceas have been conceived in countless number by economists both practical and impractical. Most of them bear evidence of birth in great travail, of both pedagogic and demagogic background—of nurse-maidism. With sublime egotism, one medicine man after another has announced that *his* plan will inevitably bring complete recovery and prosperity. The demagogues pander to the public lack of courage; the pedagogues proclaim from their scholastic heights; nurse-maids are appointed by the thousands. All seem to have lost sight of, or at least to have overlooked through ignorance or intent, one of the prime fundamentals—and that is: the basic character of the American people. The problem of economic recovery is no simple one to be solved by three words, but a more careful consideration and a full appreciation of this basic character, plus three words, would work wonders. No "sublime egotism" is ours in making this statement, for it is self-evident, obvious to all who have not been blinded by their own negations.

Scanning the record of the past two or three years, what do we see? Industry taking it on the chin and fighting back? No; the record shows no such stirring sight. Anyone could name, offhand, a large number of industries, basic and vital to the progress of the nation, lying prone in complete surrender, like small children awaiting their nurse-maids. As business decreased, these "great ones," with sighs of resignation to the inevitable, discharged thousands, closed down sections of their plants, locked their research laboratories, and cried out their tales of woe for all to hear and sympathize and become more gloomy as a consequence. The record of industry has not been, as a whole, a very bright chapter, but:

There were some who did hold faith in America's finest traditions, who kept their faith with the people they employed and those who supported them. Faced by the chaos of black years, some did not sit down and sob. Instead, they realized that public demand is an unfathomable sea and that when others declare bottom has been reached it is only that the lead line is fouled. These few, working with this fact in mind, have found new depths in this great sea of demand by dint of increased effort and important new products.

There is the classic example of Cellophane. Research made possible this ubiquitous product and an aggressive searching out of possible uses created a demand for it that is still a seven days' wonder. Another that would not accept defeat is a large business machine cor-

poration. As the fog closed around it, this organization did not whine but, instead, employed more salesmen—*yes, employed more salesmen!* The result has been, according to good authority, a satisfactory increase in business.

Consider the case of the producers of a patented laminated shim which obviates the bending or kinking, the unevenness, and general cussedness of solid shims. This company formerly supplied great quantities of shims to the manufacturers of many automobiles. Several years ago, however, the Marmon company brought out an automobile engine in which the bearings had been finished with greater precision so that shims were done away with altogether. The high pressure oiling system resulted and bearing adjustments were greatly reduced. This success led other manufacturers to adopt the new bearing design, and the demand for engine shims dwindled. The shim company's business had been predicated almost wholly on this type of demand, so here was a problem of first magnitude.

The plant and organization put in a great deal of time and spent much money in the effort to find a new product they could produce. They were unsuccessful. They could then have discharged all employees and locked their doors. But they didn't. They began studying possible industrial adaptations for their laminated shims, and found them by the hundreds—or rather, in effect, invented industrial uses where shims would save time and expense and make for a finer end-product. Air compressors, power and transmission machinery, blowers, rolling mill machinery, and several new places in Diesel motors could use shims. Then a far more valuable use than any other was found.

Today in the assembly of many kinds of machinery, an overall accuracy to a thousandth of an inch is necessary. If four or five pieces are to be bolted together, it is hardly practicable to machine each of these to limits of less than plus or minus one thousandth of an inch. Yet a slight error in each would be cumulative so that the total error might be several thousandths of an inch. A laminated shim, however, permits a wider variation in machining—thus cutting costs—because of the wide adjustments the shim allows. Shims of this type, as a consequence of this firm's unwillingness to accept defeat, not only have become again a successful business but also have contributed to the efficiency—and prosperity—of users.

Our point stands proved. Three words—Vision, Courage, Progressiveness—constitute the sanest, surest, least assailable plan for carrying the country forward. What if it does sound like a Horatio Alger "Do or Die," "Sink or Swim" theme? Let the cynic sneer. The fact is that by use of a little imagination new depths of demand can be reached and new demands created; by use of a little extra energy and courage products can be sold; by employing research as never before, progress can be made. It is up to industry primarily *and* to individuals. Our next and infinitely greatest frontier is, as far-sighted men have remarked, the frontier of science and invention, and this frontier extends to the stars!

It is time to stop waiting for the nursemaids, and be up and doing.

Slot Machines

IT would seem that published facts and figures which expose slot machines for the cheating mechanisms which they are should be sufficient to deter people from playing them and thus automatically force the manufacturers of these insidious devices out of the racket. But human nature being what it is, legal measures become necessary to protect the thoughtless from their own gambling instincts, which so often are exercised in a direction where they have no chance to break even, much less to win.

It is not the man who can financially afford to spend a few dollars to gain the vicarious thrill of gambling who is the victim of the slot machine. It is, rather, the child with a nickel clutched in his grimy fist and the poor, part-time worker who is induced to part with money which should go for the bare necessities of life. The beckoning finger of easy money lures them on, and having lost what little they have, they immediately lay plans for recouping, and the final result all too often is the beginning of a life of crime.

For years legal battles have been waged throughout the country in an endeavor to suppress the slot machine racket. But so strong have the backers of the racket become, due to the huge profits involved, that in many cases they employ squads of gunmen to protect the territory in which their machines are located. Recently, however, New York state has shown that it is possible to give to the proper authorities legal power which will enable them to cope with the racket directly and without hindrance. The recently signed Esquirol-Robinson bill describes slot machines as gambling devices beyond a shadow of doubt, regardless of what subterfuges may be employed to disguise them as venders.

Armed with the newly acquired power which permits them to seize on sight slot machines whether they be in use or not, New York City police picked up nearly 2000 machines in one day. These machines are not to be considered as personal property, but are to be placed in the same category with unlawfully held fire-arms, and are to be summarily dumped into the Atlantic Ocean. Thus is taken the first real step in the suppression of a widespread racket. Second Deputy Police Commissioner Allen of New York City is to be congratulated upon the speed and dispatch with which he has handled the matter; the Esquirol-Robinson bill is to be recommended to other states for study.

"I Won't Fight"

"CALLOW youths without benefit of caps and gowns" is a euphemistic paraphrase of an expression we recently heard describing—with pointed reference to a certain wetness behind the ears—undergraduates who have recently taken up the war against war. Having ourselves passed through the sophomoric stage with egotistical disregard for the experience of our elders in many momentous problems, we would be inclined to smile indulgently were it not for an insidious feature of this battle for a warless world: It is sponsored by subversive elements, by communists, socialists, and other radicals who would weaken the nation so that *they* might gain power. Most of these care naught for American ideals, using foreign racial and religious animosities to dupe and make catspaws of the innocents.

It is of no avail to tell these to read American history to see for themselves that the military forces do not make wars, that preparedness does not start them. (Each of our wars was brought about by the will of the people, the army and navy never even being consulted; and prior to every one we were sadly unprepared.) It would be vain indeed to attempt to show that our present weakness is a menace to world security, that we are tempting aggressive nations by our seeming lack of desire to furnish a stabilizing effect on world diplomacy. It would be foolish to say, to these cunning plotters, that munitions makers do not start wars. In fact, we may just as well be silent; they would not listen for at best they're un-American, know little of our traditions, and hope to force their own unproved theories upon us.

The innocents, however, are another matter. They are simply allowing emotion—adolescent hysteria—to rule. Some years after acquisition of cap and gown, reason will show them that "I won't defend my country" is rather senseless, is quite meaningless. Most of those who waded through blood and muck on the fields of France swore they'd never be fools enough to go to another war. Were they cowards or liars? Just cheerful liars! Most of them would be in the first rush for arms in the event of war, and we miss our guess if the younger generations wouldn't follow closely on their heels. We've been through the whole business and we know the psychology of the youth whose country has been attacked.

WHAT'S IN THE ROCKET?

By G. EDWARD PENDRAY
President of The American Rocket Society

The first successful flight of a liquid fuel rocket in this country, near Staten Island. Mentioned in the text. Because of faulty design this rocket burst at an altitude of about 300 feet, after reaching a velocity of 175 feet per second

A SOCIETY has just been organized in England for the purpose of encouraging experiments with rockets. For some years we have had a national organization of the same kind in this country, which has succeeded in making some important contributions to this much-talked-of but little-experimented-with field. A new local group is beginning an experimental program in Cleveland. In Germany there have been rocket experiments galore for several years. Despite political disturbances and difficulties about money, the national organization of German rocket experimenters is continuing its tests on an important scale. In Soviet Russia several experimenters are at work, with the friendly encouragement of the government, to develop high-altitude and express-carrying rockets. There is a rocket organization in Austria; another in France. The Japanese are also beginning to show interest in this new field of engineering, and have been gathering data lately about the American experiments to transmit to their homeland.

In view of the worldwide attention now centering on the development of rockets, it is time to examine the movement and see what is in it. Are these experimenters hoping to get to the moon? If so, what do they want to go there for? More important still, how will they get back?

Perhaps it is one of the misfortunes of rocket experimental work that imaginative fellows early in the game chose to exploit the possibility that rockets may some day give us command of interplanetary space. The result has been to make every rocket experimenter a little apologetic, and every newspaper man a wit when writing about rocket experiments.

There is plenty of theoretical ground and some evidence for the belief that, given power enough, money enough, and sufficient experimental data, we could shoot a rocket to the moon or Venus or Mars and return. Very likely nothing needs to be discovered that is not already at hand. There are fuels of sufficient power to take us there in properly constructed rockets. The way that such rockets ought to be made (in general) has been worked out theoretically. We have new, light, strong metals and alloys needed for the construction. Patient mathematicians have even gone so far as to solve navigational problems relating to space flight, and to indicate how instruments may be constructed to render such navigation possible.

BUT the moon flight nevertheless is still some time in the future. We must learn to walk before we can run. We must learn how to build a rocket that will travel 25 miles under its own power before we can think seriously of constructing one for a voyage of 250,000 miles. To talk of moon flights now is about as sensible as plans for a nonstop round-the-world airplane flight would have been in 1900.

One of the major reasons why no serious experimenter has yet attempted to build a real moon rocket is the magnitude of the job. The chief hurdle is not to get as far away as the moon, but rather to escape the gravitational attraction of the earth. At ordinary speeds it would require such tremendous quantities of fuel that an interplanetary flight of any kind would be out of the question. But physicists tell us that if we can reach a speed of about 25,000 miles an hour—more exactly, 6.664 miles a second—we can then shut off our power. Provided it is outside the earth's atmosphere, our rocket will thereafter coast to its objective on its momentum, forever outflying the steadily weakening attraction of the earth. Whether it reaches the moon, Mars,

Venus, or some other body in space, or falls into the sun or soars out of our solar system altogether, will depend mainly upon its original aim. If peopled by a crew, a faulty aim may probably be corrected in space—depending on the rocket's fuel reserve and the navigational ability of its helmsman. The amount of such correction however will necessarily be limited because of the extra fuel it would require.

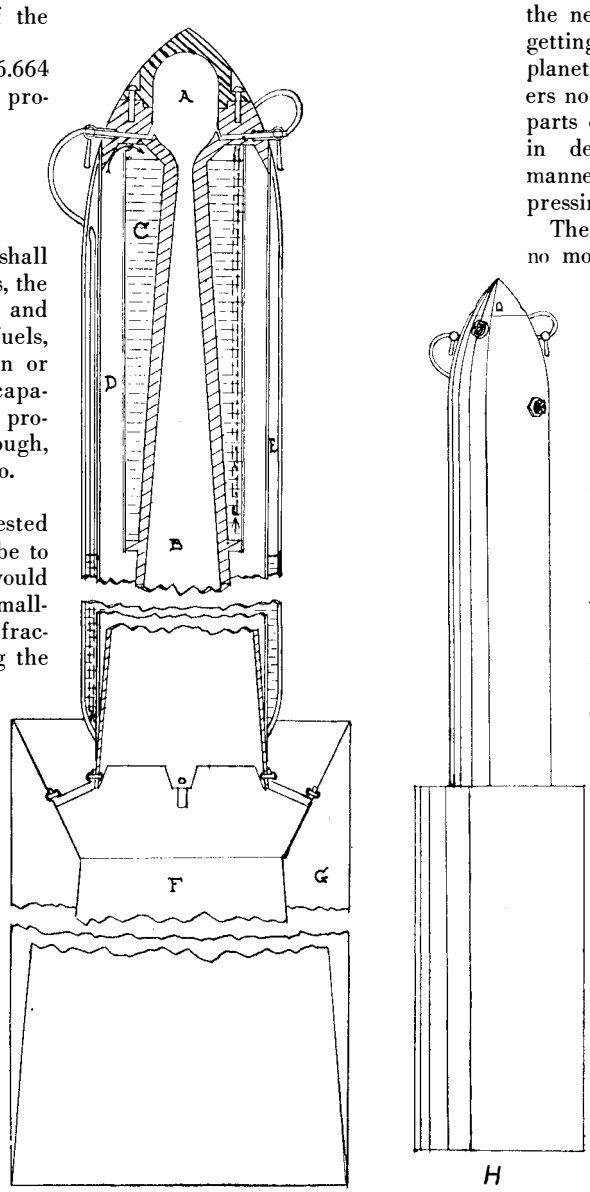
Now, building up a velocity of 6.664 miles a second, especially in a projectile large enough to carry a crew, will require enormous quantities of energy. If the physicists produce their much-discussed atomic energy, it will help us a great deal. If, as is more likely, we shall have to depend on present materials, the likely fuels will be liquid oxygen and liquid hydrogen or acetylene. These fuels, mingled and fired in an explosion or "blast" chamber, are theoretically capable of giving us the speed we need, provided we can devise a rocket large enough, yet light enough, to carry the cargo.

EXPERIMENTERS have suggested that one way to do it would be to construct a "step rocket." This would consist of a series of rockets, the smallest carrying the passengers and a fraction of the fuel, the next carrying the first and a larger quantity of fuel, and the third and largest carrying a great deal of fuel and the other two rockets as excess or "pay load." The largest step would be shot first. When burned out the hulk would be detached from the other two rockets and the second rocket ignited. It, too, would be dropped off when empty, and the fuel remaining in the smallest step would be used to build up the final speed, and to supply energy for maneuvering in space.

Three such steps, it has been calculated, should be enough to get us forever away from the earth. If we are going to the moon, a single additional step—four in all—would bring us back, because the moon's gravitational attraction is much less than that of the earth. If we are going to Mars, we would probably need two additional steps; to Venus three, to provide energy for the return.

Now, if we assume a pay load of ten tons, consisting of a crew of four men and necessary equipment, and a 3 to 1 ratio of fuel to non-fuel load, the total weight of a three-step rocket, ready to start on an interplanetary journey, would be about 5120 tons. This is certainly not an impossible size for such a craft. But when it comes to adding a fourth and fifth step, the total starting weight mounts with great rapidity. The first steps would work out about as follows[1]:

Fuel	*Pay Load*	*Construction*	*Total*
	First Step		
60 tons	10 tons	10 tons	80 tons
	Second Step		
480 tons	80 tons	80 tons	640 tons
	Third Step		
3840 tons	640 tons	640 tons	5120 tons



A rocket designed by Bernard Smith and the author. Height, 66 inches, weight, 20 pounds, thrust, 60 pounds. *A*, combustion chamber; *B*, exhaust nozzle; *C*, gasoline tank; *D*, nitrogen pressure tank; *E*, oxygen tank; *F*, thrust augmentor; *G*, parachute; *H*, exterior view

A fourth step added to this rocket would have to be large enough, obviously, to carry all the others as pay load. Assuming the same ratio of pay load, fuel, and construction, it would bring the total weight up to about 40,960 tons—an interplanetary vessel about as large, though probably not as costly, as a first-class battleship.

These figures give a pretty graphic idea why we haven't gone to the moon long ago, and why it will probably be some time yet before a successful interplanetary attempt is made.

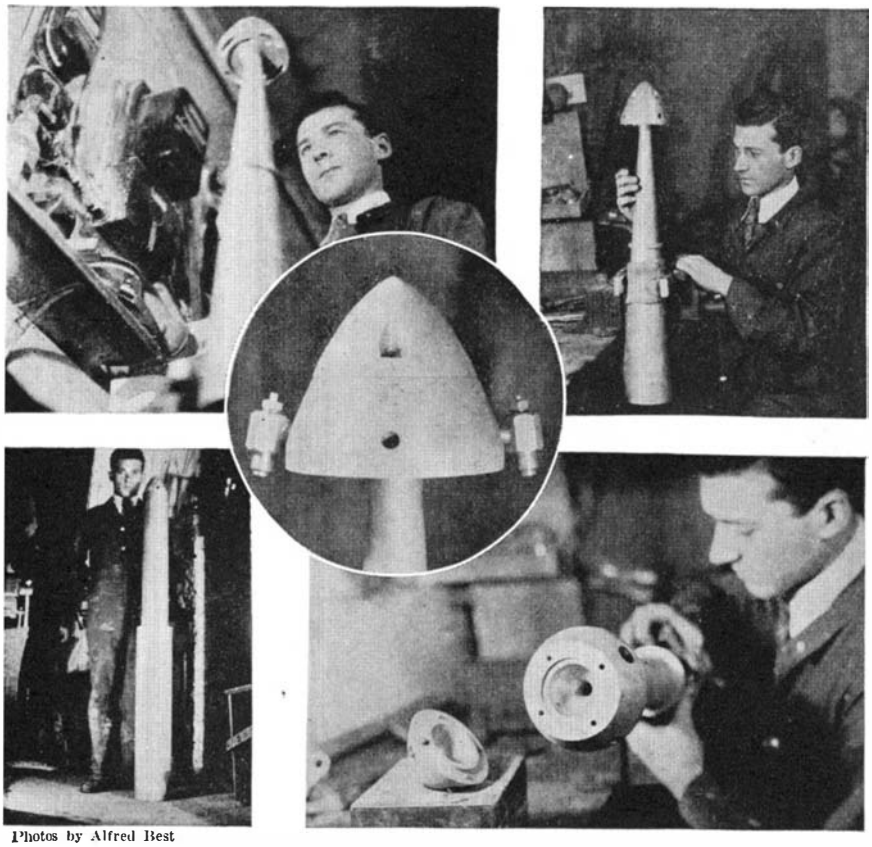
Fortunately there are other uses for rockets, much closer to home; uses which, like the automobile and airplane, may work a new and greater mechanical revolution in our civilization in the next 25 or 50 years. Without forgetting the ultimate appeal of interplanetary flight, the rocket experimenters now active in this country and other parts of the world are more interested in developing smaller rockets, unmanned, which will fill present and pressing human needs.

The rocket, unlike other engines, has no moving parts, and consequently offers certain advantages displayed by no other device for turning heat into motion. If a rocket goes fast enough, all of the energy of its fuels theoretically can be changed into motion. Its efficiency would therefore be nearly 100 percent, whereas the best gasoline or steam engines fall below 25 percent. To realize this high efficiency however, the rocket must travel at a speed equal to the velocity of the molecules of the gases being ejected from its nozzle. This velocity varies with the fuels and other conditions, but is of the order of a mile a second.

AT first glance this seems so fast as effectually to bar the use of rockets in any ordinary pursuit. Indeed, it does blast the hopes of those early enthusiasts who sought to tie rockets to automobiles, railroad cars, and airplanes, with the idea of supplanting gasoline and steam engines for this work. At the low speeds traveled by cars and airplanes, rockets are woefully inefficient; the amount of fuel that has to be carried to keep them running defeats the whole idea.

Fortunately it is not necessary to hitch this Pegasus to a wheelbarrow. In the lower portions of the earth's atmosphere speeds of a mile a second would be out of the question, but the density of the atmosphere falls off rapidly, and at an altitude of about ten miles there is only about one tenth as much air as at sea level. Rockets could travel at their full speed in the stratosphere. Thus, if we wished to shoot a rocket from New York to Paris, instead of dawdling along for 26 hours as Lindbergh did, we could make the hop in about 50 minutes, or, allowing plenty of time for reaching the stratosphere at the beginning and maneuvering for a landing at the end, a maximum

[1] After calculations by Hermann Oberth, an Austrian rocket experimenter.



Photos by Alfred Best

Rocket shown on preceding page. *Circle:* Blast chamber and fuel inlet valves. *Upper left* and *upper right:* Bernard Smith with motor assembly. *Lower left:* The unfinished rocket. *Lower right:* Looking into blast chamber toward nozzle

of an hour and one half to two hours.

We could bring San Francisco or Los Angeles within an equal time-distance from New York. Possibly successful rocket shots carrying mail and express—even passengers—could be made between New York and Chicago and other relatively short distances. For cities separated by less than about 1000 miles, however, we shall probably have still to depend on the old-fashioned airplane, automobile, and railroad, for it would hardly be economical to operate rocket routes over short distances. The flight from New York to Chicago would take about 20 minutes to half an hour.

TO modern ears, which have heard the roar of fast airplanes, these predictions should not seem so very fantastic. However, I think we need not look even for New York-Chicago rocket flights for a year or so yet! This will be the running stage of rocket development, and we have not yet learned to walk.

The experiments now being made in this country by the American Rocket Society and its contemporaries abroad look mainly toward the development of so-called altitude rockets. It is the aim of the experimenters to develop rockets that will shoot straight up to a given altitude, carrying various kinds of scientific instruments to gather data in the stratosphere. Such rockets, to be useful, must be thoroughly dependable. They must be capable of reaching the height determined upon, of making a strictly vertical flight, and finally of returning gently to earth with their precious instruments.

The first step in constructing them will be to select the proper kind of fuel and devise ways to control it. One of the fuels must be oxygen, presumably in liquid form. Liquid oxygen boils at an exceedingly low temperature (–182.9 degrees, Centigrade) and is hard to keep, especially in a rocket where only a few feet away combustion is releasing heat rivaling that of an oxy-hydrogen flame. The other fuel now being used in most American and German experiments is gasoline.

This combination, liquid oxygen and gasoline, gives an explosive force approximately ten times as powerful as T.N.T. Rockets so fueled are no toys for children to play with. Rocketry has already had its martyrs—Max Valier in 1930, and only a few months ago Reinhold Tiling and two of his assistants, to name only four of them. Several others have been injured, including Dr. Robert Esnault-Pelterie, the French aeronautical engineer, who lost several fingers in an explosion of rocket fuels.

Nevertheless, the two fundamental problems of rocketry—how to use and control explosive and volatile liquid fuels, and how to burn them properly to produce the necessary thrust, have been solved. A year ago, on a sandy island off Staten Island, New York, the experimenters of the American Rocket Society, then called the American Interplanetary Society, shot a liquid fuel rocket which, despite the fact that its oxygen tank burst at 300 feet because of excess pressure, demonstrated beyond a shadow of a doubt that the motor and fuel supply system devised by the society's engineers was a success. Liquid fuel rockets had previously been shot—in Germany, by members of the *Verein für Raumschiffahrt* and others, and in this country by Dr. Robert H. Goddard, of Clark University—but none had come so near solving the fundamental problems of rocketry as that of the American Interplanetary Society.

THESE milestones, poor and unimportant as they may seem to persons who dream of conquering interplanetary space, are really fundamental to the conquest of a new engine of transportation. Rocketry today is in about the same position as aviation before the flight of the Wrights at Kitty Hawk. Sooner or later, perhaps yet this year, a demonstration will be made of such spectacularity and consequence that the building of rockets will thereafter become as "respectable" as aviation. When that happens, the country's best engineers, many of them now deterred by the faint aroma of ridicule still associated with the field, will turn to and develop rockets as they have developed aviation and automobiles, both of which went through the same long periods of travail and small experiment.

Rapid advancement today is being much delayed by lack of finances, as is many another important field of experimental work. It is for this reason mainly that rocket societies have grown up here and abroad; experimenters are thus able to pool their resources and ideas, and build rockets which would otherwise never get beyond the plan stage. In this way, also, persons who are interested in rockets and questions of rocket flight but not actively engaged in experimenting, can contribute small sums, through membership dues, toward experimental work, and at the same time receive their fill of rocket talk through the publications of the societies. The American rocket magazine is *Astronautics*, an official publication of the American Rocket Society. The new British group publishes the *Journal of the British Interplanetary Society*. In Germany a periodical, *Die Rakete*, has been published for several years and has recently been replaced by *Das Neue Fahrzeug*.

The rocket societies in various countries now probably total two or three thousand members. The German society recently had more than 1000 members. The American society, much younger, has about 300 members; the British society about 100. Membership in all of them is steadily growing.

FLOWERS WITH YOUR CAMERA

THE ability to make pleasing pictures of flowers depends largely on the knack of seeing flowers as pictures. Flower lovers, possessing the ability to acquire the pictorial viewpoint, may now preserve permanently in picture form the beauty of their gardens with a new type of film which was made available for amateur photographers during the past year. Super-sensitive panchromatic film is highly color sensitive throughout the whole range of colors appearing in the garden. With it well-balanced flower photographs are possible.

Actual colors cannot, of course, be rendered but, in tones ranging from black to white, this film reproduces colors much nearer their true relationships to each other and in their correct values as the eye sees them.

SUCCESSFUL photography can be carried on with very little equipment and with limited experience. Excellent pictures have been made by one amateur with a 3A Kodak equipped with an *f*/6.3 lens, a 75-cent portrait attachment, a tripod, two pieces of cardboard, one grey and one black for backgrounds, and several pieces of string, the last named simply for tying flowers in place.

As a general rule light from directly overhead is not desirable. The slanting rays of early morning or late afternoon sun produce the most satisfactory results. Since the blossoms usually turn toward the sun, the camera should be placed at such an angle that shadows will be cast by parts of the blossoms. This will cause each blossom to stand out individually because of the delicate shadow in each. Perhaps the most ideal time for flower photography is on a hazy day when the sun is under light clouds and there are no air currents to disturb the delicately poised blossoms.

Greater care must be exercised in photographing small light colored flowers than for those of larger structure. Direction and intensity of light must be carefully judged when small delicate blossoms are the subject.

Tree peony. Hazy bright spring day, portrait attachment, 1/10, *f*/22

So much for the "posing."

Having selected your flower subjects and set your camera on a tripod in a position to take full advantage of available light, the flowers are grouped by tying with pieces of string into an artistic arrangement. Often it may be possible to make your picture against a natural background of green shrubbery. Sometimes, however, when either a specially small group is desired or the background is not sufficiently contrasty, cardboard backgrounds of white or varying shades of grey may be inserted.

All arrangements being complete, the exposure is made. As you are familiar with the characteristics of your own camera you will be the best judge of what diaphragm opening to use and how long the photograph must be exposed, bearing in mind that the super-panchromatic film is about twice as "fast" as ordinary film in daylight. The portrait attachment simply permits a close-up not possible with the ordinary camera lens. This portrait attachment naturally is unnecessary for cameras capable of being focused down to close-up positions.

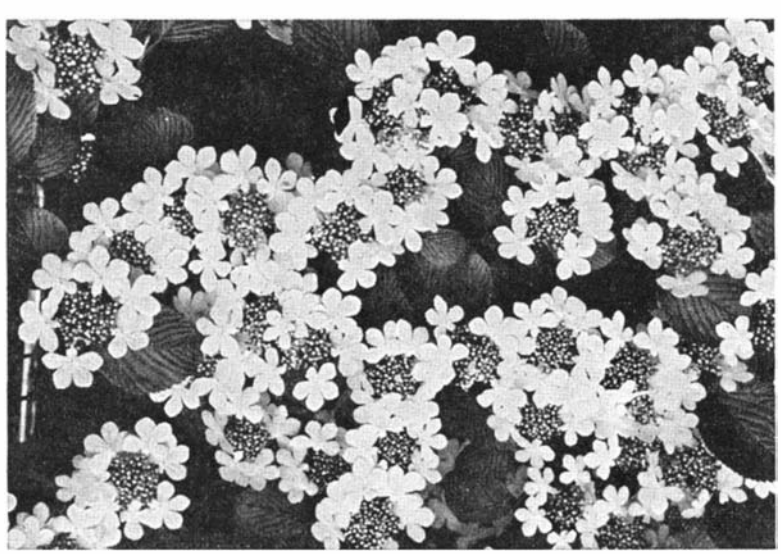
ALTHOUGH panchromatic film is sensitive to all colors, it is more sensitive than the eye to blue and violet light, in comparison with green and red light. The way to prevent blue and violet from having an undue effect upon the film is to use a color filter that will sufficiently subdue them before they reach the film.

For flower photography, the new pale green Wratten X-1 filter, available through dealers from the Eastman Kodak Company, would probably be the most satisfactory to those wishing to do a still more careful job of color rendition than panchromatic film without a filter can do. The X-1 filter gives complete color "correction" with super-sensitive panchromatic film.

Those who already possess a camera color filter would doubtless find it giving a good amount of correction, but the correction would be less complete with panchromatic film than that provided by the X-1.

When the X-1 filter is used, four times as much exposure must be given as for super-sensitive panchromatic film without the filter. When the color filter is used, twice as much exposure must be given.

When a portrait attachment is already over the lens, a filter can be added by reversing it, with the front of the filter against the portrait attachment, and then taping the two elements together.—*Next month: Another article on photography for the advanced amateur.*



Close-up of viburnum blossoms. Hazy light at 11 A.M., exposure 1/10, *f*/22, with portrait attachment over the lens

New Constituents

In the Existing Maze of Lines in the Solar Spectrum, Those of New Elements Are Still Being Discovered, Adding Further to Our Knowledge of What the Sun Is Made of

By HENRY NORRIS RUSSELL, Ph. D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington
Retiring President of the American Association for the Advancement of Science

THERE have been several announcements in the daily press lately concerning the discovery of new constituents in the sun, the stars or the planets. Most of them have been accurate—good evidence of co-operation between investigators and press representatives. But the reader may well be left pondering over various aspects of the matter.

Why is it that, at this advanced stage of physical science, there are new discoveries left to make, especially in so intensively observed a body as the sun? Why have some of the new discoveries dealt with familiar elements such as phosphorous, samples of which can be found in every house where there is a box of matches? And how can the investigator be sure that he is right?

The rudiments of the subject are familiar to us all. The atmospheres of the sun, the stars, and for that matter of the planets, absorb certain specific kinds of light. The spectroscope, by its extraordinary selectivity, separates out the mixed radiation which is fed into it and reveals the gaps. We have then only to find what substance absorbs light of the precise wavelength corresponding to each gap (or dark line) to complete our spectrum analysis. It all sounds very easy, but it is no child's play in practice.

IN the first place, there are enormous numbers of lines to deal with. The solar spectrum, from its ultra-violet limit to the red where Rowland's classical work stopped, contains more than 20,000 lines, some strong, some weak, but all permanently present. The extension into the infra-red with the aid of new types of photographic plates which Mr. Babcock is now making at Mount Wilson, will add thousands more, and still other thousands are found in the spectra of sunspots. All told, the solar spectroscopist will soon have to deal with more than 30,000 lines.

Meanwhile the physicists in their laboratories have been at work on terrestrial spectra, mapping and measuring those of one element after another, down to the very rarest, under varied conditions of excitation. Some elements —for example hydrogen—give simple spectra containing not more than 50 lines. Others, like iron, show thousands of lines, and some heavier elements like the rare earths are even worse. Though the great work of measuring and recording all these spectra is not yet fully completed, the number of lines already tabulated must be more than 50,000.

Only a beginning has been made on the greater task of measuring the band spectra produced by compounds. There are hundreds of compounds which can be set emitting or absorbing light without decomposing them. Every one of them has a spectrum of great complexity, packed so closely with lines in many places that only the most powerful instruments can resolve them. The total number of lines in these band spectra—most of them still awaiting measurement and discussion—may well be a million. It will not be in our days that the spectroscopist need weep because he has no more worlds left to conquer.

ONE might imagine a student set down before two great books, one containing accurate positions of the 30,000 solar lines and another equally good data for the still more uncommon observations of the laboratory, and told to find out what the sun was made of. At first, if he had the spirit of the true investigator, he would rejoice at the wealth of material before him. But very soon he would realize that he was suffering most acutely from the traditional "embarrassment of riches." In every angstrom unit of the spectrum (a tiny bit, only one sixth as wide as the interval between the yellow sodium lines) he would find on the average about five solar lines and as many laboratory observations. There would be fewer in the red, but more in the ultra-violet where the lines are very numerous.

With such a host of lines it is evident that many of them in our list will coincide with some of the others by pure chance. Many of these spurious agreements will be imperfect and can be exposed by more accurate measures, but there will be a considerable residue of cases in which the agreement, though meaningless, is within the error of the best measures. It is possible and, indeed, fairly easy to calculate from the theory of probability how many such accidental agreements within a given limit should be found per thousand lines. Only if, in a given case, we get a decidedly larger percentage of agreements than this, is it worth our while to pursue the subject.

FORTUNATELY, however, we have other tests than this, and simpler ones. The laboratory spectra of any given substance contain lines of very different intensity—some hundreds or even thousands of kinds stronger than others. Common sense suggests that, if we find agreement with solar wavelengths for some of the weak lines while the strong ones are absent, we are deceived by accidental coincidences. But if the strong lines agree with faint solar lines, we need not worry about the absence of weak ones. This obvious test has been applied for decades, but it has some refinements which are not so simple. For example, the spectrum of barium, as observed in the ordinary arc, has strong lines in the red, the orange and yellow, the green and the blue. Three of the orange and yellow lines, and two in the blue, show strongly in the sun. The others, though even stronger in the arc, are not present in the sun at all. This very serious puzzle was solved when it became known that the orange and blue lines were absorbed by ionized barium atoms and the others

OF THE SUN

by neutral atoms. In the intensely heated solar atmospheres, practically all the barium atoms have an electron knocked off them, so that only the first set of lines appear. In the electric arc, though the atoms are ionized in the hot core, they recombine with the free electrons in the cooler "flame" which surrounds it, and both sets of lines appear.

Before we can be sure that an observed coincidence between a solar and a laboratory line has a real meaning we must know not merely the exact position of the two, and their intensities, but also just what the atom or molecule is doing when it produces this line. Is it neutral or ionized? Is it in its normal state, or "excited" by previous loading with a store of energy? And what other stronger lines ought to appear if this one is really what we suspect?

Analyzing the structure of a spectrum itself is curiously like solving a cross-word puzzle, but determining whether an element is present in the sun often requires real detective work.

The obvious cases, like iron and nickel, where hundreds or even thousands of lines agree perfectly, were disposed of long ago. But the hard cases, where only a few of the strongest accessible lines show in the sun and these but faintly, have only been cleared up recently. Sometimes, even now, it is difficult to reach a verdict. For example, two or three of the strongest lines of tin agree satisfactorily with faint solar lines in the ultra-violet. But one other line of about equal strength does not show up. Whether the observed coincidences are mere accidents is not yet certain. We know of no other substance that produces lines in just these positions, but by no means all the possibilities have been exhausted. Osmium is still more annoying. It has several of the strongest lines in the accessible part of the ultra-violet, but every one of these falls so close to a line of iron or some other abundant element that the latter "mask" them in the sun, and we cannot tell whether or not they are there.

SOMETIMES an earlier verdict has to be reversed. Thallium, for example, has two very strong lines (due to the neutral atom) in the green and the ultra-violet. Both agree with very faint solar lines. But the green line is not strengthened in some spots. Now thallium is easy to ionize, and few of its atoms must remain neutral in the sun. In the cooler spots the proportion should increase ten-fold or more, hence if this were really a thallium line it would be notably stronger in the spot spectrum. This coincidence is accidental, and grave doubt is thrown on the ultra-violet line—which cannot be tested like the other, since the spot spectrum has never been observed in this region.

An almost opposite case is that of caesium. This is so easy to ionize that the neutral atoms should not appear, even in the spots. Several strong lines of the ionized atom agree with faint solar lines, but when the spectrum was fully analyzed it was found that these lines were absorbed only by atoms which were not merely ionized but very highly excited. The proportion of atoms which are so greatly stored with energy can be calculated, and comes out vanishingly small, so again a chance agreement has "deceived the very elect."

THOUGH two elements have thus been lost to the list of those recorded as present in the sun when the revision of Rowland's table was published six years ago, five have been added. One of them—platinum—comes in because of new lists of the strongest lines, a few of which were found to be present. Two others, lutecium and tantalum, were added by new and accurate measures in the laboratory which made it possible to be sure of the exactness of agreements that were previously uncertain. Tantalum, by the way, has just been detected by Dr. Kiess of the Bureau of Standards.

Fluorine has been identified in still a new way. The lines of the atoms do not appear, but a compound with silicon gives strong bands which are faintly but definitely present in the sun. Finally, for the moment, we have phosphorus. This is hard to ionize and only the neutral atom and its spectrum need be considered. All the strong lines in this are in the far ultra-violet, hidden hopelessly behind the veil of ozone in the earth's atmosphere of which we wrote a few months ago. Theory indicated that there should be more lines in the infra-red, and these were discovered a year or two ago by Dr. Kiess. Shortly afterward the same spectral region—in the vicinity of 10,000 angstroms—was measured at Pasadena by Mr. Babcock. Miss Moore at Princeton, who has had very extensive experience in these matters, recognized the coincidence of three solar lines with lines of phosphorus. By itself this might be due to accident, but these three lines are the three strongest in the phosphorus spectrum, the next in order having only half the intensity. Moreover, next to the inaccessible ultra-violet lines, they should be the strongest in the whole spectrum of the element. In view of this, Miss Moore's conclusion that the presence of phosphorus in the sun is "reasonably certain," appears to be quite conservative.

Though the lines are weak and there are a few atoms at work absorbing them, the amount of phosphorus in the sun must be very considerable, for the absorbing atoms are in a highly excited state and the number in the normal state (which absorb the ultra-violet lines) is doubtless many thousands of times greater.

FROM the same studies the evidence for sultur in the sun has been greatly strengthened. Three strong lines were discovered some years ago by a German, Dr. Meissner; the latter work has brought the list up to more than twenty.

Phosphorus and sulfur in the ionized state were identified in the hotter stars several years ago. More recently two elements not represented in the solar spectrum have been identified in stars of the same sort. Ionized neon was detected by Menzel a few months ago, and the neutral element at Mount Wilson a little later (in a cooler star). Now comes from the Yerkes Observatory the discovery by Dr. Morgan of a number of lines of ionized argon in the star Upsilon Sagitarii. Comparison with the strongest laboratory lines leaves no doubt at all of the identification, and one more element is added to the list of those whose existence outside the earth has been demonstrated.

One more spectroscopic announcement came by telegraph from the Lowell Observatory to the recent meeting of the National Academy of Sciences. In co-operation with the University of Michigan, evidence has been obtained that the remarkably heavy bands which appear in the spectrum of Uranus and Neptune, and less strongly in Saturn and Jupiter, are for the most part due to methane. The quantity of gas required to produce so great an absorption must be very large. If some benevolent magnate could only lend the spectroscopists a few miles of large-bore gas pipe, and fill it with the natural gas (mostly methane) which is produced in such enormous quantities, it would be possible to determine how much of the gas there is above the planets' surfaces, and then perhaps to find what the temperature of Neptune must be to keep the gas from condensing.—*Princeton University Observatory, April 29, 1934.*

SPLITTING SECONDS*

Quartz Crystals Furnish the Basis for Time Keeping of Extreme Accuracy

OF the many strange devices to be found in scientific laboratories perhaps none is stranger than a certain unimposing crystal ring in the Bell Telephone Laboratories in New York. From this glistening ring go impulses which regulate great broadcasting stations; impulses which measure the flow of time; impulses which clock the planets in their unending gyrations.

The crystal ring plays an important rôle in the forward march of science. It helps the scientists at the Laboratories in their constant quest for greater knowledge; it permits them to peer further into the unknown and to solve the mysteries and secrets of nature. It divides the second, man's smallest named division of time, into 100,000 parts and, therefore, is capable of measuring periods of a few minutes with an accuracy of one part in 5,000,000!

But why divide the second into such small parts? Wherein lies the need?

The answer is that all of science and much of our everyday life depends upon a few definite standards. To the scientist, the fundamental units are those of length, the centimeter; weight, the gram; and time, the second. The unit of length and the unit of weight are definite, man-made blocks of metal. The unit of time, the second, is a much less tangible thing; and the measurement of time takes us back to the very beginning of time itself.

TO trace the evolution of modern time measurement, we must go back to the mysticism, the superstition, and sun-worship of the Chaldeans. These ancient people evolved the seven days of the week from the Sun and Moon and the five planets: Venus, Mars, Mercury, Jupiter, and Saturn. They worshipped the planets as gods and the Sun was their greatest god. The Moon, which ruled at night in place of the Sun, was the god next in esteem. One day each week was set aside for special worship of the Sun and this day became Sun Day or Sunday. Likewise the second day of their week became Moon Day or Monday.

The time required by the sun to traverse its path through the belt of the ecliptic was divided into the 12 constellations of the Zodiac to form the 12 months of the year. The day was divided into 12 hours and for a smaller division of the hour they turned to their mathematical system in which the figure 60, called Sos, was regarded as a mystic

A group of quartz crystals as they are delivered to the cutters' bench

number derived from the five planets and 12 constellations. The hour was divided, by this mystic number 60, to obtain the minute and the minute was, in turn, divided into 60 parts to obtain the second.

The first record of a time machine was that called the clepsydra. The word is of Greek origin and signifies "water-thief." The machine was in reality a water clock which measured time by the ascent or descent of a float on the water in a vessel into which or out of which water slowly dripped.

The first mention of a sundial is found in the Bible (Isaiah, 38:8) in the period of 700 B.C. However, Anaximander, a Greek astronomer (610-547 B.C.) is credited with the invention of the sundial. It is known that the early Egyptians used obelisks as sundials by measuring the time of day according to the length and direction of the shadow cast by the obelisk.

TOOTHED wheels were known about 300 B.C. but it was not until 145 B.C. that they were first applied to clepsydras to cause a pointer to revolve over a dial plate on which hours were marked. This machine was made by Ctesibius in Alexandria. Pope Sylvester made a clock at Magdeburg about the year 996. In 1583, Galileo discovered the principle of the pendulum, and in 1657, Huygens, who was born at the Hague, presented to the government of his native land the first pendulum clock ever made. From then on, the art of clock making evolved rapidly until today our modern ship chronometers are accurate to about one second each day or perhaps 300 seconds a year.

The second, as it is universally accepted today, is in reality 1/86,400 of the mean solar day, or 1/86,400 of the average time over the period of a year that it takes the earth to make one revolution about its axis. Time, therefore, is a substance of astronomy and for its precise and constant determination, we are in the hands of astronomers.

A diamond saw is used to cut the crystal into slabs of varying size

Nightly, in clear weather, time is checked by observing the transit of the fixed stars as they traverse the cross hairs of powerful telescopes. Hundreds of observations at numerous observatories are the basis of our time. Between observations, we trust to clocks.

Most precision clocks depend for their accuracy on the swing of a pendulum. Under conditions of constant air pressure and temperature, and undisturbed by earth tremors, an astronomical clock can be counted upon to tick off seconds of extreme precision. By adjustments from star observations, any tiny errors that might creep into the rate of swing of the pendulum may be corrected.

Astronomical clocks have certain limitations. They are large, they must be mounted in vibration-free vaults and require the utmost in care and protection. The interval of time they originate is usually an even second. Another device, the electrically driven tuning fork,

*Courtesy Electrical Research Products, Inc.

has been employed as a standard of time, sub-dividing the second into reasonably small parts. Many tuning-fork-controlled devices are in commercial use. But what is the scientist to do if his problem requires an exact one hundred thousandth or millionth of a second? His pendulum device or his tuning fork are of small avail.

We speak in these days of a radio station operating on a frequency of 600 kilocycles, meaning 600,000 oscillations a second. The Federal Radio Commission says this frequency must be maintained between 599,950 and 600,050 per second. This is but one of many cases requiring the splitting of the second into an unbelievable number of exactly equal parts.

TO most of us, perhaps, such fractions of a second are amazing. That they can be measured and counted with an accuracy of one part in millions is still more amazing. But with the aid of the crystal ring, it becomes a simple matter.

The principle on which this ring works may be demonstrated with a common lump of sugar. If a sugar lump is broken in two in the dark a small bluish glow may be seen in the fracture. The explanation of this phenomenon is that when certain crystalline substances are subjected to strain, small currents of electricity are set up in the crystals. Science has known this for many years. It has also known that if a crystal is put in the field of a small pulsating electric current it will vibrate mechanically, and conversely, that it becomes electrified, alternately positive and negative, when pressure is reversed periodically.

Here then is one method of obtaining electric currents at high frequencies by using crystal vibrators which maintain their oscillations with a high degree of uniformity. The action is not unlike that of a pendulum which, as it swings one way, becomes positively charged and as it swings the other becomes negatively charged. Instead of indicating seconds or half seconds by its oscillations, however, such a crystal can be made to indicate millionths of a second.

Great possibilities were seen in these vibrating crystals. The crystal finally decided upon was quartz since it is one of the most stable substances known. The final shape became a ring several inches in diameter and about an inch thick. In a room on the seventh floor of Bell Telephone Laboratories are four of these crystals. Three of them divide the second into one part in 100,000. The fourth vibrates at a slightly different rate and is used for checking the other three. In case lower frequencies are required, intricate vacuum tube circuits, known as sub-multiple generators, step down the frequencies of the crystals to lower ranges. This step-down is made in three stages. One stage steps down from 100,000 cycles to 25,000, the next from 25,000 to 5000, and the final from 5000 to 1000.

Although this apparatus was developed primarily as a standard of frequency, it is inherently a standard of time as well. A frequency of exactly 1000 cycles per second is one in which the individual cycles are each accurately a thousandth of a second in duration. By employing some means of counting the cycles, therefore, a clock is secured that is as precise in its time determinations as is the original crystal oscillator in its frequency of vibration. By using a synchronous motor, and allowing this motor, through suitable gearing, to drive the hands of the clock, the required time-piece is available. The clock, thus constructed and in use at the Laboratories, has a mechanism which gives off one-second impulses and is daily checked against the one-second time signal pulses sent out from the Naval Observatory at Washington from star observations. Even unchecked, the error of these amazing crystals would amount to not more than ten seconds a year, or one part in 3,000,000!

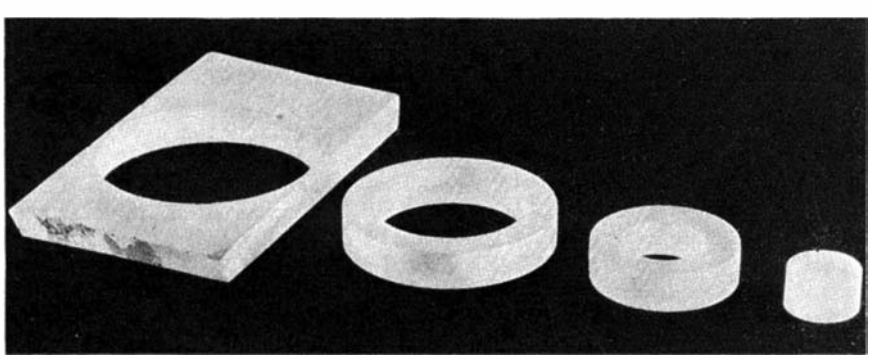
The frequency of the crystal is only to a small degree affected by temperature changes. To eliminate any possible variance, the temperature of the crystal itself is controlled automatically to within a hundredth of a degree centigrade.

THE standard frequency impulses of this crystal oscillator, within the limitations of the transmission system, may be sent by wire anywhere. They may be transmitted over the regular long distance telephone wires. Thus, for instance, high precision electric clocks could be checked from any point in the country by transmitting a standard frequency over telephone wires.

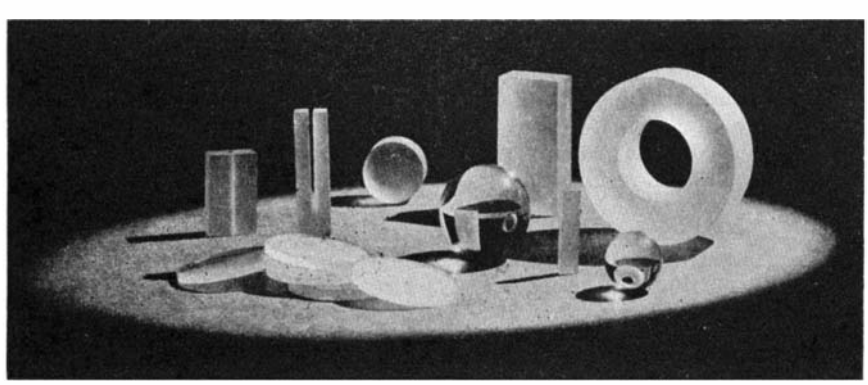
Likewise, wherever a standard frequency is desired, for purposes other than timekeeping, the magic ring stands ready to serve. Many great broadcasting stations now control their transmission frequencies by means of it. Actually, it is possible to control the frequency of every station in the country from this quartz circlet. Indeed, wherever time or frequency measurements are made or compared, this one magic ring may serve as the master for the entire country.

By the use of this master time source, new standards are brought to all users of precision time. Its industrial uses are endless.

It is one of the marvels of our great, modern, mechanical and electrical systems that their control is for the most part centered in devices that are tiny, when compared with the forces they command. The simple little crystal circlet, only yesterday an inanimate thing with unknown potentialities, is today a tool useful for manifold purposes. Through expert scientific research it has become a great controlling force.



After the sawing operation, selected slabs of crystal plate are further cut into rings. The plate, two of the rings, and the core disk are shown above

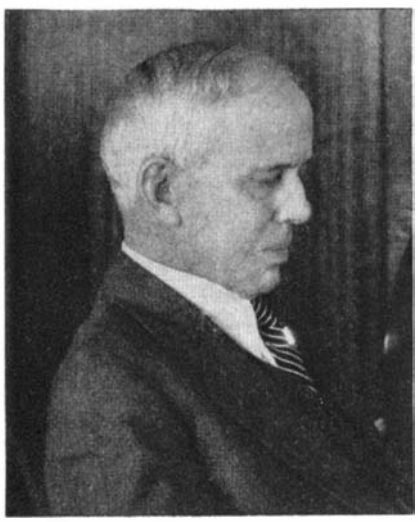


Various forms into which quartz crystals have been shaped during the course of experimental work. One of the rings mentioned in text is at right

EUGENIC STERILIZATION

Human Betterment Demands It

By E. S. GOSNEY
President, Human Betterment Foundation
Pasadena, California



The author

NATURE'S method of insuring the survival of mankind and promoting a certain amount of progress, was to kill off, by severe conditions of life, the weak and unfit (and, incidentally, many others) while the children of the strong, able, and intelligent had a better chance to survive, reach maturity, and become the parents of the next generation.

The progress of civilization has made many changes in this primitive and ruthless but effective program of natural eugenics. The increasing complexity of culture and science has resulted in the failure of the more intelligent part of the population to produce enough children even to replace their own numbers. The reasons for this, found in a great range of educational, social, biological, and particularly economic factors, are too complicated to analyze here in detail.

On the other hand, these factors have not made themselves felt to the same degree among the feeble-minded, the unstable, the restless, the alcoholic, and the chronically dependent paupers. Not only has the birth rate in these groups continued relatively high, but the progress of civilization, human sympathy, and charity have intervened in nature's plan, rescued these weak and defective children, nursed them to maturity, and allowed them to reproduce children who often perpetuated their own type and weakness.

The resulting trend toward race degeneracy is evident in statistics so well known that they need not here be rehearsed. The average family of the college graduate in the United States has been standardized at two children. The average family which sends a child to the home for the feeble-minded in California consists of four children; and the family which has been dependent upon the county charities for five or more years contains five children.

No one will deny that there is in each generation some degree of inheritance of physical and mental fitness. Therefore, on any theory of heredity it is clear that under existing conditions the average level of intelligence and of physical and mental fitness in the American population is declining steadily from generation to generation. The exact rate of this decline is debatable. The fact that the decline exists, is not debatable.

Every civilized country faces a similar situation, and the past two or three decades have seen a vigorous and determined attempt to meet the problem, on a scale which has not been used since the vain attempt of Augustus to prevent the disappearance of the Roman people, more than 1900 years ago.

THE program of eugenics, though not generally understood, is as extensive as civilization itself. Some measures aim at making parenthood more attractive or less burdensome to the fit part of the population. Others aim at reducing the fecundity of the unfit. One of these measures, surgical sterilization, is so radical, so far-reaching in its possibilities, and so humane in its application, that it has attracted widespread attention ever since it was first used officially in the United States 35 years ago.

The progress of eugenic sterilization has resulted from the discovery of surgical operations that would prevent parenthood without unsexing the individual or altering his life in any other way. "Sterilization", to many, suggests the crude, cruel, and mutilating practice of castration, used for one reason or another since the dawn of history. There is no comparison. The eugenic sterilization operations now used do not remove any gland or tissue, or interfere with any flow of blood or nerve supply. They are a means of protection to the patient, as well as to this and future generations. Such sterilizations, when understood, are therefore usually welcomed by the subject, who feels that further parenthood for him or her is not desirable. Our survey in California shows that, on the whole, the best friends of sterilization are the patients and their families, for they, better than anyone else, know what it means to be protected securely from parenthood which they are unable to meet successfully.

Following the initial sterilization operations in Indiana from 1899, which were done without any law but depended merely on the consent of the patient, the results proved to be so satisfactory that in 1907 Indiana adopted the first of the modern sterilization laws. Such laws are now in force in 27 American states, the following list showing also the year in which the first sterilization statute was adopted:

WHAT DR. ADOLF LORENZ THE FAMOUS VIENNESE SURGEON SAYS OF STERILIZATION:

"I BELIEVE in sterilization of the unfit," said Dr. Lorenz, "because it is the duty of medicine to prevent disease and this is one means of prevention, mental and otherwise.

"I believe it should apply to all mental cases, congenital drunkards, criminals, moral defectives. It is to be hoped it will be successful in Germany, and most probably it will be successful. It eventually will come to all civilized countries as a means of getting rid of the scum of humanity."

Indiana	1907	Alabama	1919
California	1909	North Carolina	1919
Connecticut	1909	Delaware	1923
Washington	1909	Montana	1923
Iowa	1911	Virginia	1924
Kansas	1913	Idaho	1925
Michigan	1913	Maine	1925
North Dakota	1913	Minnesota	1925
Wisconsin	1913	Utah	1925
Nebraska	1915	Mississippi	1928
New Hampshire	1917	Arizona	1929
Oregon	1917	West Virginia	1929
South Dakota	1917	Oklahoma	1931
Vermont	1931		

In addition to this, eugenic sterilization is now on the statute books of the Provinces of Alberta and British Columbia in Canada, of Denmark, Germany, the Canton of Vaud in Switzerland, the state of Vera Cruz in Mexico and the free city of Danzig. Half a dozen other foreign countries are apparently about to adopt the measure and some of them may have done so before this article appears in print.

A measure which thus applies to more than 150,000,000 civilized people, and of which there is 35 years official experience in the United States, has obviously gone far beyond the range of novelty or experiment. Nevertheless, adequate information as to the actual results of surgical sterilization was lacking until a few years ago.

CALIFORNIA adopted a sterilization law in 1909 and it has been continuously applied ever since, with about 10,000 operations to date. This experience therefore represents the largest body of available evidence, and since it extends over a quarter of a century, a careful study of it should be sufficient to furnish conclusive proof as to how sterilization actually works out in practice. In order to satisfy myself and make this evidence available to anyone interested, so that he might study it and draw his own conclusions, I organized a group of specialists in various lines nearly nine years ago and undertook the intensive study of the first 6000 cases sterilized.

Most of the research was done by Dr. Paul Popenoe, a well known biologist and specialist in the field of human heredity, but the progress was followed carefully by many others and all of the material was submitted before publication to a group of critics representing every point of view and sometimes numbering as many as twenty or thirty. Due to the care with which the study was made, its results have at no time been attacked, though they have been spread far and wide, and presumably brought to the attention of every possible type of critic, through the distribution of hundreds of thousands of pamphlets as well as through the original publications in a score of technical journals. These pamphlets, which contain the only first-hand study of any large body of evidence on the subject, are supplied to all who request them, and I consider it a testimony to the impartiality and accuracy of our investigation, that its results are cited as conclusive alike by those who favor sterilization and those who oppose it. The results seemed so important, so cogent, and so worthy of widespread dissemination and study that we organized the Human Betterment Foundation and endowed it in order to carry on this educational work.

Dr. Harry Sharp, called "the father of sterilization." While physician of the reformatory at Jeffersonville, Indiana, he began sterilization there in 1899. There was no sterilization law, but he proceeded merely by obtaining the consent of the patients. It soon became known that the results were satisfactory. In 1905 Pennsylvania's legislature passed the first modern sterilization law. This, however, was vetoed by the governor, leaving Indiana, in adopting a statute in 1907, to be the first of the states to put sterilization into force with actual legal authority. Dr. Sharp is still alive and practicing medicine

The California law applies only to the insane or feeble-minded committed to the state institutions and is compulsory in its character. If it appears to the Medical Superintendent of any one of the institutions that sterilization would be desirable for the protection of the individual, of society, and of posterity, he reports this fact along with the evidence on which his conclusion is based. If the recommendation is approved by the Director of the State Department of Health and the Director of the State Department of Institutions, the operation is then mandatory.

In practice, however, it has been the custom to get the written consent of the patient's nearest relative or guardian, and rarely is the operation carried out against their wishes. In most cases they are anxious to have it done and more and more frequently take the initiative in urging that the patient be not released without this protection.

The operation is thus, in the great bulk of the cases, virtually a voluntary one rather than compulsory. But in every state it has been found desirable to have a compulsory feature of the law and a number of the states which began with a purely voluntary and permissive law have later altered their statues to introduce a compulsory provision.

That such compulsory sterilization is a legitimate exercise of the state's constitutional powers was determined by the United States Supreme Court in 1927, ruling on a test case appealed from Virginia. In writing the decision of the Court on this point, Justice Oliver Wendell Holmes referred pertinently to the character of the case by remarking: "Three generations of imbeciles are enough." He pointed out further that when no one contested the right of the state to demand sacrifice of life on the part of its ablest citizens in time of war, it would be strange indeed if it could not in time of peace demand from some of its least useful citizens, for the protection of posterity, a sacrifice much smaller than that of life—one in most instances regarded as not a sacrifice at all, but rather a protection.

The compulsory feature is desirable, even though rarely used, for a number of reasons. In the first place, the patient may have no known or accessible relatives. In the second place, the relatives may be as irresponsible as the patient himself. In the third place, the husband or wife sometimes wants sterilization done but is reluctant to sign an application, not knowing what attitude the partner might take to it later, and therefore urges the institution to go ahead on its own responsibility. Finally, there are occasional cases in which the family takes a view of the matter which can hardly be shared by their fellow citizens.

A CASE illustrating this point, even though extreme, is presented by a woman with manic-depressive insanity, committed to one of the psychopathic hospitals. Her mother and sister had died insane, her brother had committed suicide while presumably insane, her husband was a sickly carpenter. They already had seven children. The Medical Superintendent told her she would probably be in and out of the hospital the rest of her life and suggested that she be sterilized since she could not take care of the children she already had; since any children she had would inherit some tendency to mental disease; and since any future pregnancy would probably precipitate another breakdown. She said she would talk it over with her husband. Later she advised the Superintendent that they had agreed that she should not be sterilized. "You know," she said, "we already have

(*Please turn to page* 52)

Angling Has

How to Take Mean Advantage of a Poor Fish

By J. E. NIELSEN, B.Sc.

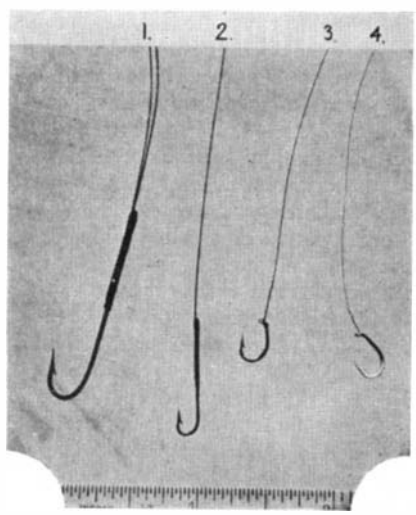
TO one who is not a fisherman, angling appears to consist of endless waiting and watching for a jerk or tremor in a line with a baited hook, requiring patience far in excess of any other sport.

An angler, however, has abundant time to reflect about countless problems and, besides, the open air provides good appetite. Therefore angling is a healthful and interesting distraction. Furthermore, by the use of scientific methods it can be developed into an intelligent, scientific recreation, with a string full of proof to satisfy the acquired appetite.

The average fisherman uses methods and equipment which are based largely on the oratorical gifts of the salesmen in sporting goods stores. It is remarkable how few are the fishermen who really know the scientific reason for success in fishing or the lack of it. *They unwisely put themselves in the place of the fish and assume the fish to react as they themselves would if they were confronted with a baited hook.* This, for example, is why they believe that the most important property of a float line is that it must not be seen. The fact is that, if the fish should rely on its eyesight alone, all fishermen would be successful. However, because of a difference between air and water the sensory organs of fishermen and fish have developed along different lines. Fish do not see or hear or smell—nor do they taste or feel—as we do, and the different sensory organs are of necessity constructed in quite a different manner in a fish.

In order to allure fish it is therefore necessary to know just what are the important senses of the fish, and how it seems when one puts oneself in their place—the fish, instead of the fisherman.

Take first the sense of vision. In the human eye, light rays enter the first lens through the cornea, which contains a transparent fluid of refractive index the same as water, namely, 1.33. Next it passes through the pupil to the second lens, which has a refractive index of about 1.41. From this it proceeds through almost pure water to the retina, where the image is picked up by the optic nerve.

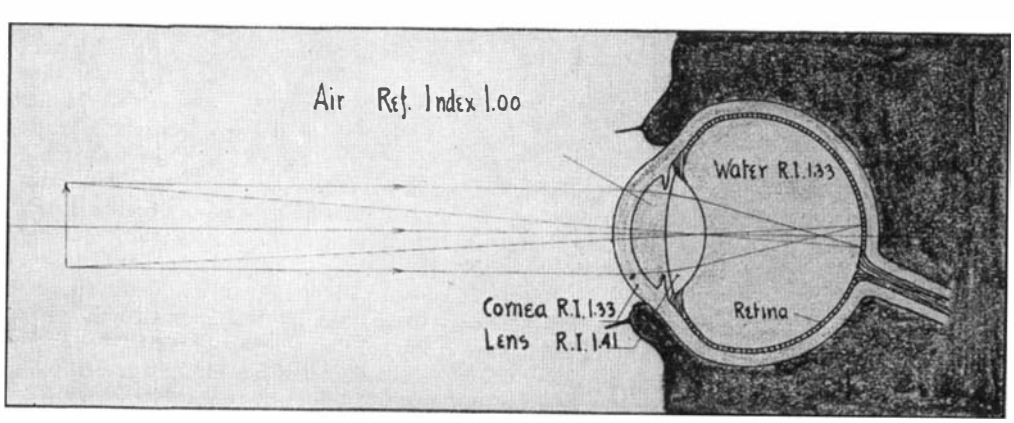


1: Medium sized hook and gut. 2: Fine sized hook, finest gut—good for three pounds. 3: Metal wire, of same strength as last. 4: Metal wire 31/1000 inch diameter, 1¼ pounds

This device of sight is highly efficient in air, which has a refractive index of 1.00, but when immersed in water, which has a refractive index of 1.33, it is very inefficient. The reason for this is that, as is shown by the principles of optics, light rays which enter the eye will then not be refracted by the first lens but will go through to the second lens in a straight line, and this will have a relative refractive index of only 1.41÷1.33, or 1.06, which is too low to make possible a sharp image on the retina.

IN order to improve upon the low refractive power of the eye of a fish, nature has increased the curvature of its only active lens to the maximum possible, which is the sphere. As we know from optics, the disadvantage of a spherical lens is that only the very central rays will give a tolerably clear image. It exhibits marked spherical aberration. This, combined with the low refractive index, makes fish very near sighted animals. They are able to sense changes in light intensity, but are unable to distinguish between the forms of objects. We then draw the conclusion that the visibility of the float line and hook has no influence on fishermen's luck. We may also see that a flash reflected from a shining spoon or wobbler may allure with the same power as the reflection from the side of a fish.

Next, hearing. In fishermen the ear is divided in three parts: The external, the middle, and the internal ear or the labyrinth. Fish possess only this latter part. The reason for this difference is clear. The function of the ear is to collect vibrations of various frequencies. In the case of humans the ear is surrounded by air and the funnel-shaped external organ is an efficient device for collecting these vibrations, because the medium in which they are set up has a



The human eye in air has a high relative index of refraction, and a perfect image of objects looked at is formed on the retina. Contrast with the author's other drawing on opposite page

SCIENTIFIC ANGLES

density of only one thousandth of that of which the ear is built. Fish, on the other hand, are surrounded by a medium having the same density as that of which they are built, and their whole body partakes of the vibrations set up in this medium. The labyrinth is the only organ required to transfer the physical vibrations to the nervous system. As the receiving nerve centers of a fish are built much the same as ours, we may assume that its sense of hearing is similar to ours—possibly better, on account of the high density of water with which the nerve centers are in direct communication.

HEARING and feeling are closely related senses and in the case of fish there is no definite borderline between the two. In addition to periodic sound waves there are other waves—non-periodic pressure waves which humans cannot perceive. A worm wriggling in the water or an insect falling on the surface will set up waves of pressure in the water around them and these will instantly be noticed by the fish. For this purpose, it has an extremely suitable organ, the "lateral line." As we, ourselves, do not possess this organ, it is difficult for us to imagine how its sensations feel, but there is no question that its sensitiveness is far superior to that of fish vision. This fact is affirmed by the strong lateral nerve system connected to it. The best analogy we can give is that of a blind man with his stick, but the fish has long "sticks" in all directions, and every stick has a sensitivity equal to the tip of your tongue—every stick is in fact a "teletoucher." Most fishermen do not pay much attention to this organ, but it is nevertheless the organ which causes more bad luck among fishermen than all the other senses combined. With this organ, fish are able to feel the least "touchiness" in the surrounding medium.

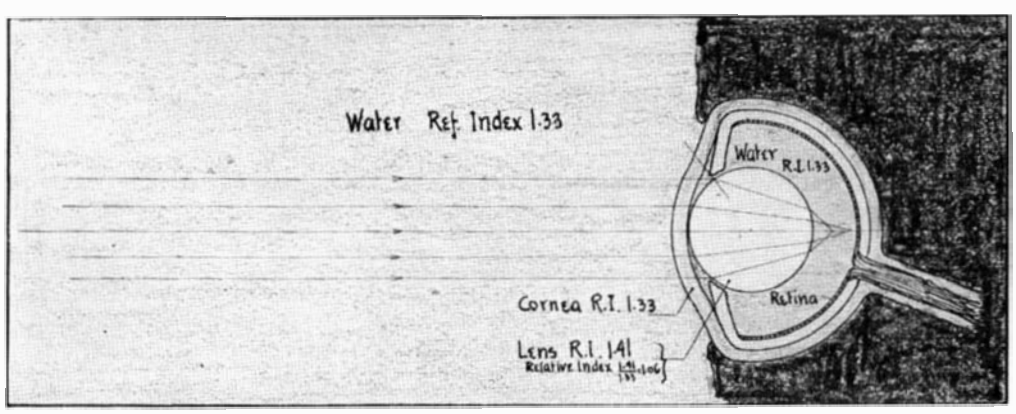
We therefore draw the next conclusion—that fish are more "touchy" than fishermen, and that we should pay closer attention to arranging the float line so that it will be as little likely as possible to excite the special touchy sense of the fish by setting up unnatural vibrations in the water.

The chemical senses, smell and taste, which are separated in fishermen, are combined into one by fish. As the nature of smell is to perceive odorous matter highly diffused in air, and as fish are not surrounded by air, there can be no sensation of smell as it is known in fishermen. There may, however, be a better developed sense of taste, judging from the abundant distribution of taste buttons in and around the mouth and on the sides of the head. It is possible that fish can taste matter highly diffused in water as easily as we smell it in air. Taste and smell are quite different sensations. It is only occasionally that an agreeable smell arouses our desire to eat. Some fine perfumes, for example, have a definitely disgusting taste. The practice of some fishermen of perfuming the bait is useless and unscientific. There is no reason to assume that fish should want violet perfume included in their diet, merely because we like the smell of violets. Most of the "wonder-

THE accompanying article suggests that fishermen should study the special senses of fish and in catching them apply the knowledge thus gained. It mentions the "lateral line" (see sketch of a fish on following page) which apparently enables the fish to feel at some distance the delicate waves of compression set up in the water by a wriggling worm. Many experiments performed on fish by biologists indicate that some of them possess this organ and its "touchy" or teletacting sense.

In a 12-page article published in the *Quarterly Review of Biology* (Vol. VII, No. 3), Lucien H. Warner reviews these many experiments, quoting from 37 articles previously published in biological journals, mainly foreign. He states that "blind fish successfully avoid obstacles, and that blinded fish soon learn to do so. . . . As a fish approaches an obstacle the water disturbance caused by its own motion and other water movement is supposedly reflected from the obstacle, and the fish, detecting this low frequency 'echo', avoids the object." The same author tells how one experimenter discovered that the mere approach of a little glass tube caused a blinded fish to avoid it, the tube being successfully located by the blind fish even when moved slowly toward it. When the water was made turbulent the fish still responded similarly, sensing the approach through this "interference."

According to Mr. Warner, not all fishes are deaf but they do not hear so well as air-living animals. They are most sensitive to low-frequency disturbances. Whether this be called hearing or feeling is immaterial, man's difference in nomenclature being based arbitrarily on his own lower limit of hearing, at 16 vibrations per second. What humans call noises must be of great intensity to be effectively transmitted to fish via the air, though jumping on a stream bank readily transmits low-frequency vibrations to them via the earth and water. Fishes have ears for high-frequency sounds but sense low-frequency sounds better, using their "touchy" sense.—*The Editor*.



The fish's eye is immersed in water, which has a refractive index of 1.33, and the lens, which is spherical, cannot form a sharp image on the retina. Thus fishes have poor sight

ful" prepared baits and prescriptions for baits can be classed as hokum.

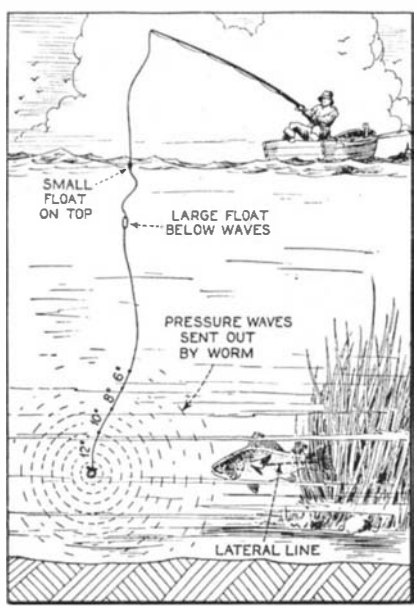
Expert fishermen will tell you that, when it comes to catching fish for the sake of the fish more than for exercise and fresh air, there is nothing more killing than natural bait, preferably live and employed in not too large a quantity. Of this the easiest obtainable is the ordinary pink earthworm, which should be kept in a can with moss. Even on the hottest day there are few fish which will not risk stretching the skin of their bellies a bit more, just to accommodate a nice worm when it starts telegraphing its arrival in the vicinity.

A live bait should always be presented to the fish in as natural a condition as possible. A worm which is threaded on a hook will not be able to broadcast the same pressure waves as a free worm and, by the lateral line previously mentioned the fish will sense danger. Therefore a better way is to hook the worm twice through the skin, about an inch from either end. Other live baits should be presented in a similarly natural way, with as little interference with its broadcasting as possible.

You will often notice that some fishermen, after having waited for some time, pull up the line and change the bait. They may do this repeatedly without the possibility occurring to them that something other than the bait might be wrong. If the bait is properly attached and if the fish refuses to take it, one may make a fair guess that it is the line which is wrong and that its presence is being sensed by the fish—it occasionally happens that they refuse to commit suicide. If the fish senses the float line, the latter must be perfected so that it cannot be detected. Such a line is, however, not to be had on the market, and we must do as real fishermen do—make it up ourselves.

LET us first visualize how we should approach a bait if we were the fish and not the fisherman. First, with our teletoucher, the lateral line, we should feel the wiggling of the worm or the flapping of the fins of a small bait fish at quite a distance, and we should be able to judge the distance and the direction very closely. We might even, if we should stay in one spot for a short time, get a hint of taste now and then from the appetizing bit of nourishment. Still, we do not approach because simultaneously with these pressure waves we feel other vibrations closely associated with the bait which warn us of danger. These vibrations are caused by the float line. We also have the feeling that the bait itself is being moved about in the water in a manner which is not natural for a worm. This is caused by the float following the up and down motion of the waves on the surface. Being a smart fish we do not take the bait, in spite of a healthy appetite. If the surface is quite calm, we may slowly approach it and even touch it, but this touch will instantly tell us that there is something wrong, for the resistance against displacement is different from what we should expect.

AMONG all these appetizing bits that act unnatural, however, we suddenly feel one which acts quite natural, and after a brief hesitation we go straight after it. Coming very near, we taste it more strongly and see its color. We get so close that we can nibble at it, and we



Author's sketch, showing his arrangement of floats and line, also a fish "teletacting" a live bait

see that there is no noticeable resistance. We decide to take it. To our despair we find that we are caught by fishing tackle whose presence we had not been able to perceive, even with our teletouchers and special senses. This tackle is a perfectly balanced float line, its surface friction and volume reduced to a minimum.

In order to reduce surface friction we must discard all float lines of cotton, silk, catgut, and so on, as the fine fibers on the surface of these materials give a high frictional resistance. There remains the choice between horsehair, Italian or Japanese gut of the finest size, and metal wire. Of these, horsehair is too weak, even for small fish, and can be counted out. Italian and Japanese gut has a tensile strength of about 50,000 pounds per square inch cross-section and the finest of this is about nine thousandths of an inch in diameter. This can, therefore, sustain a weight of about three pounds. In metal, only chrome nickel wire is obtainable in suitable sizes. This can be obtained at radio stores, where it is sold as resistance wire. Only gage 40 to 31 is of interest to us as float lines. The tensile strength of this wire is about 150,000 pounds per square inch of cross-section. A 31-gage wire, which is nine one-thousandths of an inch in diameter, will carry about 10 pounds, while gage 40, which is three one-thousandths of an inch in diameter and like a fine hair, will carry a weight of one and a quarter pounds. A 36-gage wire will have the same strength as the finest gut, while its surface will have only about half as great an area. Therefore its frictional resistance in water will be only half, and its volume will be a quarter, of that of the gut line. This line will then be twice as difficult for a fish to detect when nibbling, and four times as difficult to feel by means of its lateral line at a distance. If given a fine coat of black lacquer, it will also be invisible to any fish that does not wear spectacles to correct its poor eyesight.

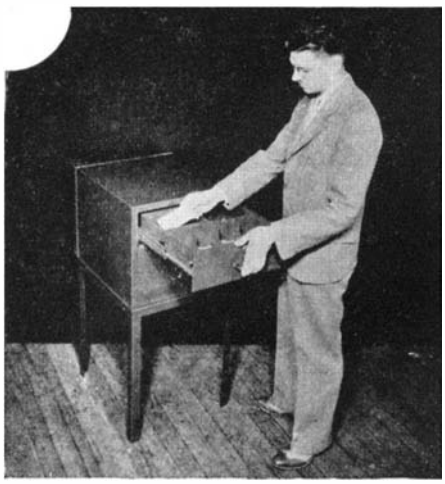
Having made this choice of material, we now build our line on the principles of least resistance against lateral movement. We use as little sinker as possible, dividing it up into small quantities and distributing these along the line. We place the first little ball about 12 inches from the hook, the next one 10 inches farther up, the next again 8 inches, and so on—6, 4, and 2 inches apart if we need that many. It is all a question of how fast we want the line to sink. We now place the float so that the bait will hang at the desired depth—on a hot day quite deep, on a cloudy day higher up, all depending on locality, wind, and weather—and we balance it so that it will just float on the surface, in order that the least additional weight or the least touch of the hook will pull it down under the surface.

Having done this, the float is now divided into two parts, a large part and a small one. We place the large part about 18 inches nearer to the hook than the other. Then it will be totally submerged in the water below the surface waves, while the little float above will remain on the surface and participate in the motion of the waves on the surface.

By this arrangement we shall obtain a perfectly balanced float line with which fish can be caught even under the most difficult conditions. It will be found also that fish caught on such a line are usually well hooked.

OF course, fish can be caught with any kind of line, provided they have a good disposition or are famishing. Unfortunately the latter is not always the case, and at such times he who has the better tackle will usually have the better luck—— Which all goes to show that Pritt was right when he said that one of the charms of angling is that it presents an endless field for argument, speculation, and experiment.

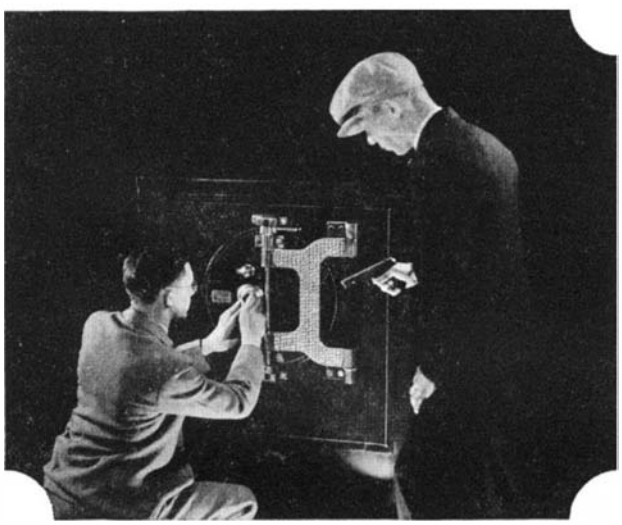
Time Defeats Bandits



IN almost any form of robbery, the element of time is of utmost importance. If money or valuable records can be protected by a time lock, which is operated while a cashier or other responsible person is ostensibly obeying the commands of a bandit, the attempted robbery will be foiled; the bandit cannot possibly wait for the time-controlled mechanism to work. Outstanding devices of this nature are illustrated on this page.

Left: **A cash locker for bank tellers, in which reserve funds are kept in the time-locked lower section**

Above: **The teller dials the combination on the lower section of the locker in advance of his needs and the delayed control time lock holds the cash in security until the time limit elapses. Should a bandit demand access to the reserve, a label on the locker informs him that he cannot get to the money until a certain time has passed. Since, by the nature of his "business," he cannot wait, there is nothing for the would-be robber to do but to attempt to escape empty-handed**



When a custodian of funds is forced at the point of a gun to dial the combination of a safe or money chest, there is nothing for him to do but obey the bandit. In the case of a safe protected only by a combination lock, the robbery is too often successful. If, however, the safe combination is protected by a time lock that starts to function when the combination is dialed, there is no possible way to gain access to the interior until the time limit has passed. A sign informs the robber of the facts. In one type of delayed action lock, a secret signal is sent to a central office when the dial is operated

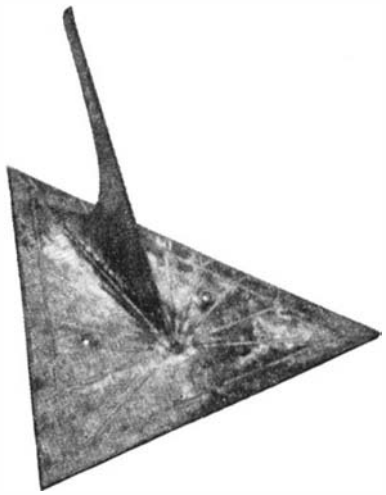
All photographs courtesy Diebold Safe and Lock Company

The problem of keeping records and other valuable papers where they cannot be stolen or used by unauthorized persons is of utmost importance to banks and business houses. In the Rekordesk safe shown open at the left and closed at the right, a combination lock protects such property. After the combination has been dialed, pressing of buttons opens or closes the lid in quick time

SUNDIALS AND THEIR CONSTRUCTION—V

Materials for Construction; Calculating Time

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



A dial fashioned out of sheet lead, by the authors, with tools easily available in the average household

SUNDIALS may be fashioned from almost any material. The most serviceable and preferred materials are hard wood, lead, brass, bronze, and stone. Slate and sandstone are not so serviceable as other stones, because they are more affected by the weather and chip easily. In many cases it is found necessary to use some other material for the gnomon than that used for the dial plate. The most serviceable materials for the gnomon are lead, iron, brass, and bronze. If the dial is to be placed in an exposed place where it will be subject to much handling, lead should not be used for the gnomon, because of its softness.

If a dial is to be cast or cut in stone by one skilled in the art, or if one has the necessary tools, little attention need be paid to the various materials, other than the type desired. A layman will find hard wood, lead, and brass the best materials to use. Many interesting dials have been made of wood. These are usually placed in the wall of a wooden dwelling or other frame structure.

Lead and brass are very suitable for dials which are to be placed in the garden, and their color, if allowed to weather naturally, blends harmoniously into the surrounding landscape.

Bronze and stone are used more for dials which are to be placed where the public has access to them, or for memorials.

In England and Germany there are dials that have been painted on the wall of a building, and the gnomon made of wrought iron. This type of dial is very attractive and especially applicable to a brick or stone building, and it may easily be set up. Most dials of this type have a white background, which may be accomplished by painting.

An accompanying illustration shows a dial made of lead, one-quarter of an inch thick. This dial was made by the authors, and the tools used in its construction were an ordinary cheap hacksaw, jack knife, ice pick, emery cloth, and a small file. The time consumed in constructing this dial, from scratching the lines on the lead to the finishing off, was about four hours.

DIAL "furniture" is a term applied to those additional lines and symbols which are found on many old dials. These lines show the difference between apparent time and mean time; they depict the constellations, points of the compass, equinoxes, zodiacal signs, and so on. Such lines often enhance the beauty, interest, and usefulness of the dials displaying them.

The furniture most commonly found on dials is the lines and figures, which show: (1) the difference between apparent and mean time (equation of time); (2) the sun's declination; (3) the time of sunrise and sunset; (4) the zodiacal signs; and (5) the points of the compass.

In addition to the above, the Babylonian hours (reckoned from sunrise to sunset); the Jewish hours (the old, unequal planetary hours); the Italian hours (beginning at sunset); and meridian lines to show when it is noon at any particular place on the earth, are sometimes placed on the dial plate.

THE discussion which follows next has been written primarily for the layman, in an endeavor to clarify the subject of time, as well as to aid in making sundials more useful and of greater interest to those who possess them.

Timekeeping is based upon the period in which the earth makes one complete revolution upon its axis. For centuries this period, which we call the day, has been divided into 24 equal parts called hours, each hour consisting of 60 minutes, and each minute of 60 seconds. This period may be measured by observing the daily motion of the stars or the sun. The period is determined when the object observed, having completed one revolution, returns to its starting point. For convenience, let us use the observer's meridian as a starting point. Then a solar day would be the interval between two successive crossings of that meridian by the sun.

Because the sun is not fixed, as the stars appear to be, but moves irregularly in a path across the sky, completing a circuit in a year, it is only natural that this interval should vary. Obviously a clock which ticked off 24 hours in the interval of a solar day would be an irregular mechanism, difficult to make.

We look upon a good clock as one that runs uniformly, day after day. For such a clock the day must be uniform in length. If we average the values for the length of the solar days throughout the year a mean (average) solar day will be obtained. Therefore, if a clock is adjusted to tick off 24 hours during this mean interval, it will show what we call *mean solar time*. The irregular solar time is called *apparent* (*real*) *solar time*, in order to distinguish it from mean solar time.

Thus, if we had two clocks (one showing mean time and the other apparent time) reading 0 hours, and if we

Courtesy Odd Fellows of New Hampshire. Photograph by T. F. McCann and Sons Co., art bronze founders

A dial at the Odd Fellows' Home, in Concord, N. H. It reads to the nearest minute. The correction for obtaining standard time is on it

started them off simultaneously, it is evident that in a short time they would disagree. The difference between their readings is called the *equation of time.* The discrepancy between the two clocks is shown in the accompanying table, for every day in the year, where the

equation of time = mean time — apparent time.

Therefore, it is possible to obtain the reading of one clock from the reading of the other for any day in the year, through the medium of the equation of time. For example, from the reading of a sundial, which shows apparent time, it is possible to obtain the mean time of the place or locality in which the dial is situated.

Too much importance cannot be placed upon the determination of the locality of a dial, because a sundial reads noon when the sun is on the meridian of the locality. The reading of a dial in one locality will differ from that of a dial in another locality east or west of it, by an amount equal to the difference in longitude of the two localities expressed in time. (Each degree of longitude is equal to four minutes of time.)

The watch time of everyday life is called standard time and it is derived by referring all observations in certain zones to one meridian near the center of each zone, which is called the standard time meridian. That is, in the United States, they are referred to the meridian of an observer in longitude 75° west of Greenwich for Eastern Standard Time; 90° west for Central Standard Time; 105° west for Mountain Standard Time; and 120° west for Pacific Standard Time. Therefore, in order to convert the reading of a sundial in any locality to standard time, requires:

Photo by S. N. Shurcliff

The sundial on the Bok Tower at Lake Wales, Florida. See the text

TABLE SHOWING EQUATION OF TIME FOR EACH DAY IN THE YEAR
Compiled from the American Ephemeris

Day	Jan. min.	Feb. min.	Mar. min.	Apr. min.	May min.	June min.	July min.	Aug. min.	Sept. min.	Oct. min.	Nov. min.	Dec. min.
1	+ 3.6	+13.7	+12.5	+4.0	—2.9	—2.4	+3.6	+6.2	+0.0	—10.2	—16.3	—11.0
2	4.0	13.8	12.3	3.7	3.1	2.3	3.8	6.1	—0.3	10.5	16.4	10.6
3	4.5	13.9	12.1	3.4	3.2	2.1	4.0	6.1	0.6	10.9	16.4	10.2
4	5.0	14.0	11.9	3.1	3.3	1.9	4.1	6.0	0.9	11.2	16.4	9.8
5	5.4	14.1	11.7	2.8	3.4	1.8	4.3	5.9	1.2	11.5	16.3	9.4
6	+ 5.9	+14.2	+11.4	+2.5	—3.5	—1.6	+4.5	+5.8	—1.6	—11.8	—16.3	— 9.0
7	6.3	14.3	11.2	2.2	3.5	1.4	4.7	5.7	1.9	12.0	16.3	8.6
8	6.7	14.3	11.0	2.0	3.6	1.2	4.8	5.6	2.2	12.3	16.2	8.1
9	7.1	14.3	10.7	1.7	3.7	1.0	5.0	5.4	2.6	12.6	16.1	7.7
10	7.6	14.4	10.5	1.4	3.7	0.8	5.1	5.3	2.9	12.9	16.0	7.2
11	8.0	+14.4	+10.2	+1.1	—3.7	—0.6	+5.3	+5.1	—3.3	—13.1	—15.9	— 6.8
12	8.4	14.4	9.9	0.9	3.8	0.4	5.4	5.0	3.6	13.4	15.8	6.3
13	8.7	14.4	9.7	0.6	3.8	0.2	5.5	4.8	4.0	13.6	15.7	5.9
14	9.1	14.3	9.4	0.4	3.8	—0.0	5.6	4.6	4.3	13.9	15.5	5.4
15	9.5	14.3	9.1	+0.1	3.8	+0.2	5.8	4.4	4.7	14.1	15.4	4.9
16	+ 9.8	+14.2	+ 8.8	—0.1	—3.8	+0.4	+5.9	+4.3	—5.0	—14.3	—15.2	— 4.4
17	10.2	14.2	8.5	0.4	3.7	0.6	6.0	4.0	5.4	14.5	15.0	3.9
18	10.5	14.1	8.3	0.6	3.7	0.9	6.0	3.8	5.7	14.7	14.8	3.4
19	10.8	14.0	8.0	0.8	3.7	1.1	6.1	3.6	6.1	14.9	14.6	3.0
20	11.1	13.9	7.7	1.0	3.6	1.3	6.2	3.4	6.5	15.1	14.4	2.5
21	+11.4	+13.8	+ 7.4	—1.2	—3.6	+1.5	+6.2	+3.1	—6.8	—15.3	—14.1	— 2.0
22	11.7	13.7	7.1	1.4	3.5	1.7	6.3	2.9	7.2	15.4	13.9	1.5
23	11.9	13.5	6.8	1.6	3.4	1.9	6.3	2.6	7.5	15.6	13.6	1.0
24	12.2	13.4	6.5	1.8	3.4	2.2	6.3	2.4	7.9	15.7	13.3	— 0.5
25	12.4	13.2	6.2	2.0	3.3	2.4	6.4	2.1	8.2	15.8	13.0	+ 0.0
26	+12.6	+13.1	+ 5.8	—2.2	—3.2	+2.6	+6.4	+1.8	—8.6	—15.9	—12.7	+ 0.5
27	12.9	12.9	5.5	2.4	3.1	2.8	6.4	1.5	8.9	16.0	12.4	1.0
28	13.0	12.7	5.2	2.5	2.9	3.0	6.3	1.3	9.2	16.1	12.1	1.5
29	13.2	— -	4.9	2.7	2.8	3.2	6.3	1.0	9.6	16.2	11.7	2.0
30	13.4	— -	4.6	2.8	2.7	3.4	6.3	0.7	9.9	16.3	11.4	2.5
31	+13.6	— -	+ 4.3	- -	—2.6	- -	+6.3	+0.4	- -	—16.3	— -	+ 3.0

(1) The reduction of the dial reading to the mean time of the locality, by the application of the equation of time.

(2) A further reduction of the mean time of the locality to standard time, by the difference in longitude between the locality and the standard time meridian. This difference must be subtracted if the locality is east of the standard time meridian, and added if west.

The formula for finding the correction to be applied to any dial is:

correction = equation of time + or — (difference in longitude x 4).

The following table shows the correction, to the nearest minute, which is to be applied to dials situated in longitude 78°, 75°, and 72°W, for a portion of the year, as found by the foregoing formula.

Month and Day	Correction for 78° min.	Correction for 75° (Stand. Time Merid=Eq. of Time) min.	Correction for 72° min.
Feb.			
10	+26	+14	+ 2
15	26	14	2
20	26	14	2
25	25	13	1
Mar.			
1	+25	+13	+ 1
5	24	12	0
10	23	11	— 1
15	21	9	3
20	20	8	4
25	18	6	6
Apr.			
1	+16	+ 4	— 8
5	15	3	9
10	13	1	11
15	12	0	12
20	11	— 1	13
25	10	2	14
May			
1	+ 9	— 3	—15 etc.

It is evident that the formula for finding standard time from a dial is

standard time = apparent (dial) time + or — the correction.

Assume a dial on each of the meridians used in the foregoing example, which reads 3h 30m P.M., on March 20. Then, by using the corrections tabulated above, for those meridians, the standard time for the

78th meridian will be 3h 30m + 20m, or 3h 50m P.M.

75th meridian will be 3h 30m + 8m, or 3h 38m P.M.

72nd meridian will be 3h 30m — 4m, or 3h 26m P.M.

If proper attention is paid to the + and — signs preceding the figures in the tables and in the formulas, one should have no trouble computing the correction to be applied to a dial in any particular place, or converting the dial reading to Standard Time.

The correction may be placed upon the dial plate in various ways; for example, in tabular form, arranging the figures around the dial. Another method, which has been used on large dials, is that of inscribing it in chart form, similar to that published in the second article of this series. A good example of this is on the Bok Tower dial at Lake Wales, Florida.

THE authors wish to take this opportunity to express their appreciation to Dr. Loring B. Andrews, Executive Secretary of the Harvard College Observatory, for giving so freely of his time in reading these articles, particularly the one above and the one which is to follow, in manuscript form, and for his interest and many helpful suggestions.

The construction of the lines which show the sun's declination will be the subject of the next article.

CANCER

How the Scientific Method is Being Applied in One Attempt to Isolate the Ultimate Cause of this Disease

By T. SWANN HARDING

IN two small, most unimposing laboratories in Massachusetts, a vivacious and incredibly mentally active biological chemist, Dr. Frederick S. Hammett, performs and directs some of the most fundamental research on the cancer problem now being carried on in this country. The modest buildings that house the laboratories prove that basically important research does not have to be performed in marble halls. The inadequate physical body, prey to a chronic and dangerous disease that would incapacitate other men, which houses the mind of Dr. Hammett, proves that it takes a great deal more than mere physical disability to conquer the zest of your true scientist.

The two small laboratories are located on the tip end of Cape Cod. One, which is used in the months from May to October, lies in an isolated spot far from the main highway, so that the workers will not be interrupted. It is a small building, 15 by 30 feet, yet it easily accommodates eight research workers in biology. Here tiny sea organisms are brought from the shore not a hundred yards distant and kept thereafter in finger bowls containing sea water drawn right from the very spot in which they naturally chose to live.

The second laboratory is located back of Dr. Hammett's Provincetown home—over his garage, in fact. It is still smaller but is windowed on every side and has a generous skylight as well, through which the sun pours. It is set well back from the street in a grove of Cape pines, and looks out on the bay. Here, during the winter months, the results of the previous summer's experimentation are examined in great detail. Moreover here, and at the big base laboratory in Philadelphia, the chemical foundations are placed for the work of the following summer.

IN this work a group of 14 busy themselves—the others being in Philadelphia. This work we owe to the generosity of the International Cancer Foundation and to fellowships provided by various philanthropically minded individuals. The workers migrate back and forth between laboratories according to the season, and all come under the scientific direction of Dr. Hammett who is a year-'round resident of Cape Cod. But what can all this fooling with sea organisms have to do with cancer?

Pure research, the most valuable kind of science there is, never begins upon an immediate practical problem. It never concerns itself with what can be directly put to practical use. In order to accomplish anything of lasting and fundamental value the research worker must run back some distance before he makes his leap into the unknown. He must be freed from the shackles of practical application and immediate monetary consideration. So, when he hopes to solve even part of the enigmatic cancer problem, he leaps back some distance, far away from practical methods of cancer treatment, and finds himself among sea organisms.

Dr. Hammett, who does his research far from madding crowds

The Research Institute of the Lankenau Hospital in Philadelphia was presented by Mr. Rodman Wanamaker some years ago. Mr. Wanamaker wanted basic scientific studies to be made on the subject of cancer. The only restriction on his grant was that the approach to the problem be not made by any method that either had been or was being tried. He gave the job of making out the program to Dr. Hammett who, being a biological chemist, naturally drew it along chemical lines. Dr. Hammett's idea was that, since cancers represent growth on a rampage—young undifferentiated cells growing regardless of the body as a whole—he should therefore seek, if he could, what agencies in nature make cells grow and what other agencies, if any, prevent growth.

Growth represents increment in number and complexity, as well as in mass. The organism or unit that has grown is not only larger and heavier; it is also more complex and contains more individual cells than it did originally. The chemical factors that govern mass growth are pretty well known—such things as hormones from the ductless glands, minerals and vitamins in the diet, and so forth. But what factors governed growth as to the number of cells produced? No one knew.

Growth in number is commonly called proliferation, the proliferation of a cancer meaning that the actual number of individual cells it contains has increased. In September 1928, Dr. Hammett started to find out, if he could, why cancers proliferate.

HE did not know where to begin. He had to follow a hunch. He decided first, then, to study the relation between the rate of cell growth in number and cell growth in size in producing a cancer. A cancer grows both because it contains more cells and because those cells increase in size. How does the cancer, therefore, attain its mass size, and how can you stop it?

At the time a great deal was being said about lead stopping the growth of cancers. If so, why? Did it retard growth by preventing the number of cancer cells from increasing, or by preventing increase in mass? The best material for study seemed to be the growing root tips of such things as onions, corn, and beans grown in laboratory beakers. So, just to see what would happen, Dr. Hammett one night dropped a tiny crystal of lead nitrate into one of his cultures. The next morning he found the tip ends of the rootlets discolored.

This was the part of the plant where the cells were dividing themselves up in order to form new cells. Hence lead had some special effect on dividing cells. Trials were then made with many rootlets and the most minute measurements were carried out. Counts were made of over a million cells, in order to determine the number of cells dividing and those failing to divide, in roots exposed to lead and in those not so exposed. It was found that fewer cells divided when lead was present. The cells were no smaller; there were simply fewer of them. Hence lead stopped cell growth because it prevented cells from dividing

to form new cells. But lead did not stop the cells from adding mass to themselves and increasing in substance.

But the lead formed a precipitate or cloudiness in the plant roots at the exact point where they were dividing most rapidly before lead was added to the culture. Since lead hindered the roots from growing, it was reasonable to suppose that it precipitated something out of the roots that was necessary to them if they were to proliferate. What was that? The precipitate was examined under the microscope and it was found to be a compound of lead with a sulfur group in the organism called the "sulphydryl" or, more briefly, the SH group —sulfur and hydrogen. Therefore it seemed that an unusual quantity of this SH material must be present in organisms at points where cells were most active in dividing. It reasoned out that way.

That is what you call scientific logic, and it was working remarkably. It appeared conclusive that the sulphydryl or SH group caused cells to divide rapidly because of its presence near the points of growth. Then you ought to be able to add this chemical group to cultures and make them start dividing like mad.

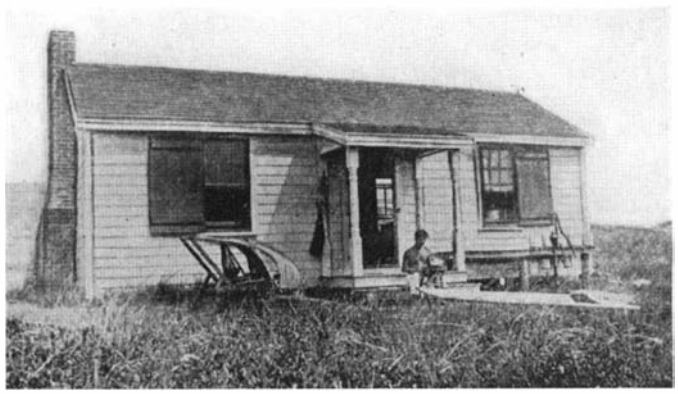
THAT is what Dr. Hammett did next. He first used root tips, but later single-celled animals like paramecia, and in every trial the addition of SH made more cells divide.

But these were all very simple little things; what would happen in a more complex organism—say a rat? Wounds were therefore made in rats. These wounds were then treated with the SH group in proper chemical compounds. They healed much more quickly than wounds in untreated control rats. But suppose ulcers or bed sores were concerned? Could they be healed more quickly? The hypothesis was now tested out with human beings afflicted with ulcers and sores that would not heal. Here, too, cell proliferation was stimulated and healing took place rapidly.

The first practical results of the search have appeared, then. Dr. Hammett did not start out to heal bed sores. That was very remote from his thought. He started out to discover, if he could, why cancers grew so rapidly, and to do that he had to undertake a basic study of growth. But such searches always result sooner or later in valuable by-products because that is the way science proceeds. No matter how remote it appears to be from practice, something helpful always turns up sooner or later.

Ulcers of more than 18 years duration have been healed and the patients restored to comfort and activity. There have been more than 500 such successes, and a recent report of like tenor was made by Simonsen in the *Journal of the American Medical Association*, in an article illustrated with striking pictures.

Even when this SH group, constituting part of the organic compound called "parathiocresol," is rubbed on the skin of a mouse, it makes the skin thicker because the number of cells is increased. Hence benefit to mankind has accrued already from this piece of basically fundamental, so-called "pure" research in biology. This is because the search was made, not for some artificial substance, but for the actual substance which in nature itself makes cell proliferation take place.



The little summer laboratory is an old house. Dr. Hammett is shown at once using a typewriter and absorbing sunshine

But there is more to the story than that. In nature—say in the human body —all cells cease dividing after a time. This is a natural event in their existence. Hence nature must provide some chemical means of stopping cell division. In chemistry we have what is called the law of mass action. For the present purpose it may be said to mean that the products of any chemical reaction always tend to retard the progress of that reaction. Now the body excretes its old used-up sulfur in the form of sulphates. That is the way sulfur leaves our system, though actually in that system it occurs in the sulphydryl or SH form, or in the closely related SS form. Again why?

The body has to oxidize the sulfur after it is through with it and before discarding it. If the body excretes sulphates, it stands to reason also that it has no more use for sulfur in the form of sulphates. Hence it must be some other form of sulfur, not the sulphates, which retards cell division. Where and how does this change from SH to sulphate —this oxidation—take place? Possibly it occurs by a series of steps and perhaps, thought Dr. Hammett, one of these steps might be the retarding agent for cell division.

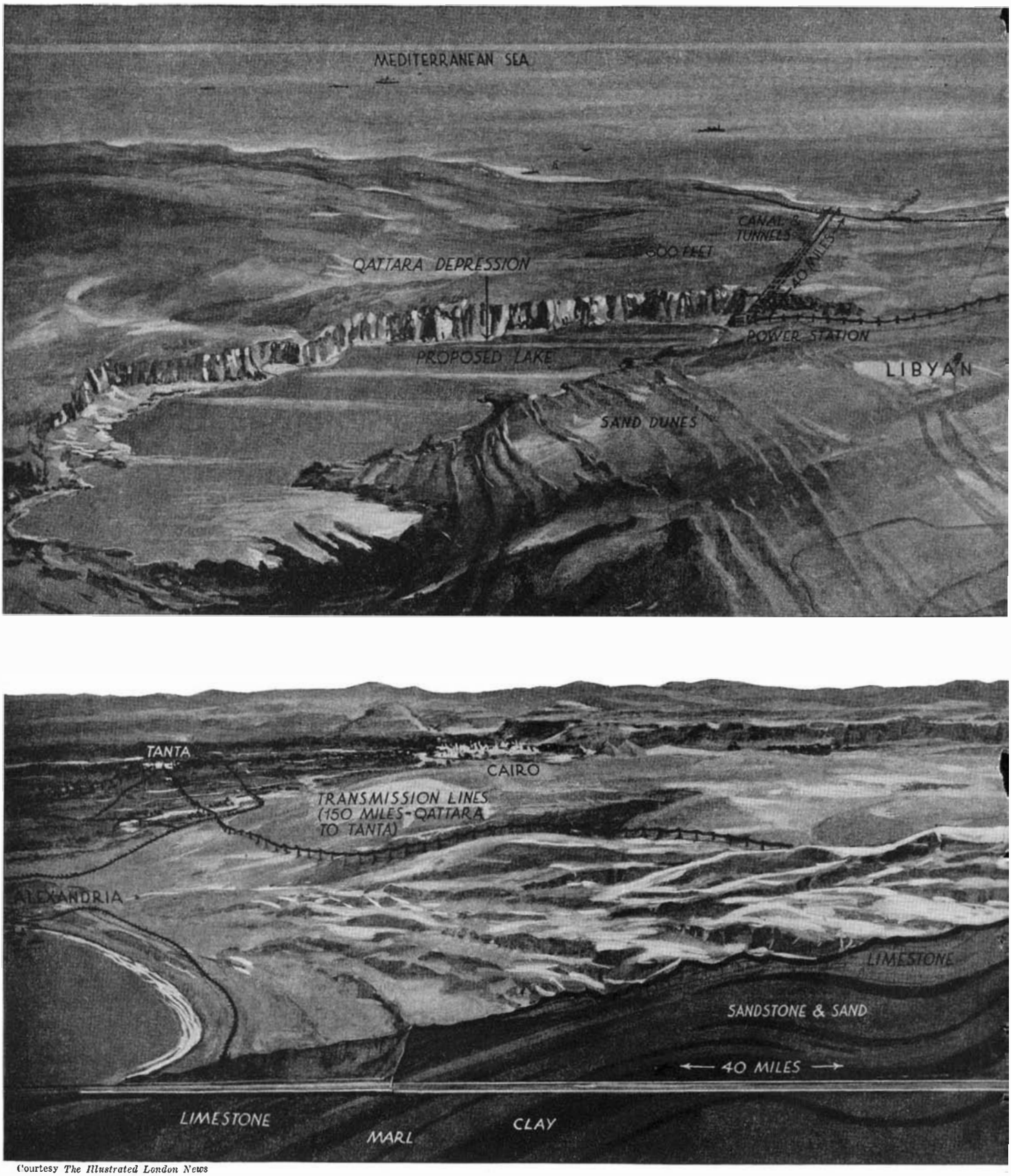
Again trials were made on root tips, paramecia, snails, hermit crabs, marine worms, and the like. In every case cell division was stopped. Hence one and the same organic compound in the body could stimulate or it could retard cell division or proliferation, depending on the state of oxidation of the sulfur it contained. Such a compound was the amino acid, the only one containing sulfur, called cysteine, and its oxidized form called cystine. But it is very hard to discover organic compounds that contain only partially oxidized sulfur derivatives, for natural, readily soluble, non-poisonous compounds are needed. Work was undertaken to prepare a compound half way between cysteine and cystine, but the process was endlessly difficult. It will be long before sufficient is available for further experimental work.

Even with the finding that cell proliferation can be controlled at will, this does not mean that cancers can likewise be controlled. The partly oxidized compounds must somehow be gotten into direct contact with the tissue in which the cells are dividing, before they can perform their work. The compounds so far known are unstable and, if injected or taken by mouth, would disintegrate long before they reached the malignant tumor.

BUT a solid foundation has been placed upon which others may perhaps build, long after Dr. Hammett's time. For one thing, cancer is not alone a matter of riotous cells madly dividing and proliferating. There is another biological disturbance here. For cancer cells have the virtue of perpetual youth. They do not mature as do normal cells. They do not grow up and become usefully functioning parts of the body. They grow wildly and heedlessly, like all young things, and obstreperously defy restraint.

So, even if the proliferation of these wild young cells could be retarded, cancer would not thus be cured. The evil would merely be held in check until the time it could manage to get the better of its host and, in killing that host, likewise achieve its own suicide. Hence scientists must search also for the naturally occurring substances that make body cells grow old—that make them lose their adolescent characteristics and their unrestrained tendency to reproduction. That chemical substance must be found which will restrain them regardless of their location, age them, and compel them to organize themselves for the performance of useful functions.

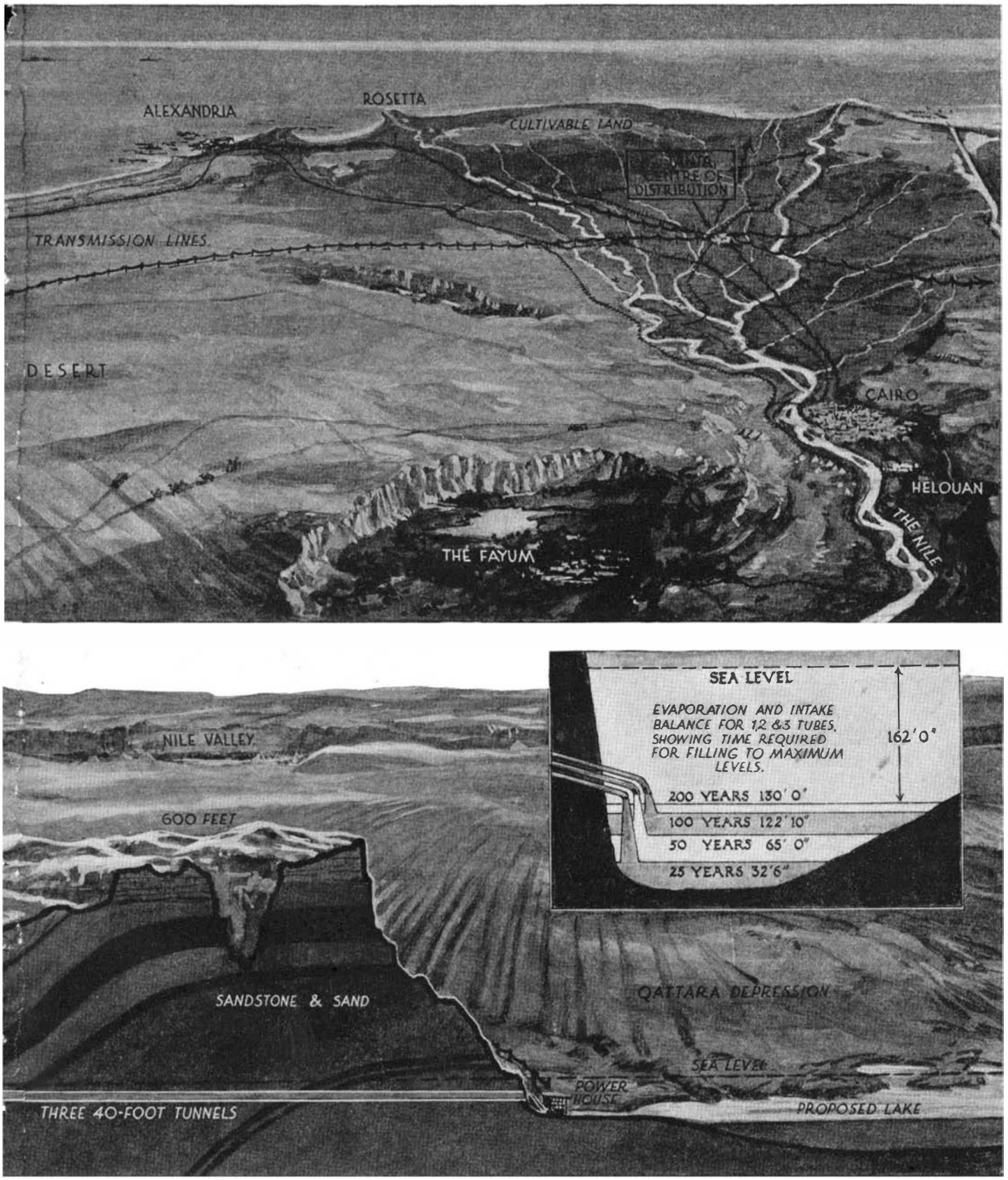
That is the present problem. It is a long and a tedious job.



Courtesy *The Illustrated London News*

Water Power and Salt Lake for Egypt?

IN recent years engineers have worked out plans, at least theoretically feasible, for utilizing the waters of the Mediterranean in stupendous engineering schemes. One of these contemplated construction of a canal somewhere in northern Algiers—if memory serves correctly—to carry Mediterranean waters inland to a depression in the desert. Rapid evaporation under the desert sun was to create a humid atmosphere which would result in sufficient rain in that region to reclaim a large part of the desert. Another scheme called for a dam at the Strait of Gibraltar and the installation of a huge power plant to be run by the flow of the water from the Atlantic as the level of the Mediterranean drops due to very high evaporation over the great area of this Sea.



The latest plan of this sort, depicted above, consists of a suggested hydro-electric power scheme for lower Egypt which would involve bringing the waters of the Mediterranean by canal and tunnel into the Libyan Desert. A vast salt water lake would thus be formed in an area that averages 195 feet below sea level and that has a total area of 19,500 square kilometers. The ocean water, brought a distance of 40 miles, would pass through turbines to generate electric power for use in the Delta. The lake would never actually fill up because of the rapid rate of evaporation which has been carefully calculated; consequently there would be a continuous flow of water to drive the turbines.

This idea which was first originated about six years ago by Dr. John Ball, Director of the Desert Surveys of Egypt, would render Egypt independent of imported fuel for irrigation and drainage; for running railways, trams, and factories; for illuminating towns; and for reclamation of waste lands.

THE LENGTH OF

By DONALD A. LAIRD, Ph.D., Sci. D., F.R.S.A.
Director, Colgate University Psychological Laboratory
Hamilton, New York

DR. STANLEY PORETUS recently brought back from his mental studies of the aborigines of Australia—living Neolithic men—amazing accounts of tests of the skill of these primitive people in tracking others, just as a dog follows a trail. Less qualified observers have brought back similar stories from their travels to secluded parts of our whirling sphere, and it has been difficult for many people to believe that mankind actually had a sense of smell that would respond to anything other than a pleasant perfume or an overwhelming stench.

Scientific studies which have just

Sir Francis Galton, who could use smells as symbols for numbers and do arithmetic by means of them! Camphor—1, jasmine—3, and so on

been completed show, however, that an astonishing proportion of persons in the most civilized parts of the globe can actually do remarkable things with their sense of smell. Two hundred and fifty-four Americans who are well-known and highly accomplished, co-operated with Harvey Braden Fitz-Gerald in the Colgate psychological laboratory in these studies which revealed, among many other interesting things, that our modern sense of smell is acute and capable of phenomenal practical discriminations.

It is not just the nose of the savage that is capable of tracking persons and animals by scent. We found that nearly 10 percent of our highly civilized subjects could do almost the same thing, and with great accuracy. What is more, they were habitually tracking people and things with their nostrils. We do not know how many more could have readily learned how to use their sense of smell in this keen fashion if they had only been given the necessity for cultivating this use. The savage has, of course, had to depend largely upon his sense of smell, while few civilized people have to depend so entirely upon this racially-old sense.

The city dweller, for instance, watches for careening automobile headlights coming down the street toward him; he does not pay attention to the odor of alcohol which might inform him that there was a drunken driver in his vicinity. But, in spite of this apparent neglect of odors every day, the sense of smell still retains a vastly greater acuity than 99 percent of people would ever dream possible to have.

Once one has to make some use of his nose, then he comes to realize that this apparently unused sense is most certainly not an idle sense. Ellis Parker Butler, for instance, tells us: "I am peculiarly sensitive to odors. Because of an illness in her youth my mother had no sense of smell, and as I was the eldest child I was continually asked 'Do you smell anything?' My nose had to do double duty and I suppose its keenness was increased."

BUT our large number of records show plainly that such extra incentives are not needed for one to make astounding use of the olfactory sense. A few people, of course, can be recognized by their own individual and characteristic odor, but have you realized that most people can be recognized by their "nose prints"?

"I often know whether a person has been in a room within the past hour or so by the odor," Dr. Bruce V. Moore the psychologist reported to us. "Often I can tell to whom an article of clothing belongs by the odor, even though in both cases the persons are cleanly about their person."

One woman, whom we will not mention by name, told us: "I can locate people by their perfume, and my good husband has found it embarrassing when I tell him where he has been by the odor he has retained on his clothes or skin." Under those circumstances, we can safely bet that her husband has to be "good."

Ann Hard, whose Washington broadcasts have a large following, may have a literal foundation for her nose for news, for she tells that "as a child I used to amuse myself by recognizing various people with my eyes shut, purely by the sense of smell. I have always enjoyed trying to analyze the ingredients in a nasal impression, much as I enjoy placing the instruments in an orchestra of men or of insects or of birds."

Dorothy A. Wayman, the author of "An Immigrant in Japan," informs us that she distinguishes " 'racial' scents—while Americans, Portuguese, Negroes, Scandinavians to me have personal odor—aside from uncleanly smell, be it understood. Many Japanese have told me all foreigners have a disagreeable odor to their sense of smell. Orientals to me, have a characteristic, not unpleasant, odor that clings to silks, jades, and other materials they have handled."

A retired army ordnance officer reports: "As a boy I was occasionally allowed to spend the night with some playmate. I was in several instances impressed with the 'family odor' which later I detected every time I came in the presence of any member of that family. In one case I have sensed this odor even in the third generation—long years afterward."

"Houses have definite scents for me," the wife of a trustee of Brown University tells us. "I recall even the smell of the houses of some of my grandmother's

Ill humor may give off an odor of its own. Accordingly in a prison, might a keen olfactory sense not smell out a riot before it came?

YOUR NOSE

friends. Foreign cities have vivid scents for me—the smell of Paris is a maple-like scent blended with wood smoke. London smells damp—with a flavor of old box. Spain smells like a mixture of orange blooms and boxwood in the sun, which always makes me feel romantic." In view of the last phrase, we are considerately leaving this interesting account unnamed.

Roy Mason finds: "Odors have always seemed to me to be definitely associated with households. I have a cousin whose house always smells just as his mother's house used to smell."

Many physicians use their sense of smell to aid them in the diagnosis of disease, not merely in detecting instantly on entering a room the presence of pus or putrefactive processes, but the sweet odor of the breath of a diabetic, the vinegar-like breath or buttery smell of the skin in uremic poisoning, or the well-cooked sauerkraut smell in diphtheria. One surgeon tells us: "I use my nose to some extent in determining the condition of surgical wounds, as to whether we have a normal serious outflow or whether there are putrefactive processes at work. I can recognize the presence of certain organisms by their characteristic smell."

A FOOD chemist has raised an interesting question along this line. "Is there an odor characteristic of a mood or temper of people?" he asks. "Does anger cause an individual to throw off a certain odor; does fear; does dejection? I have been through a number of prisons and detention homes, and have noticed an odor in each different from the others and seemingly characteristic of the mood or temper of the inmates."

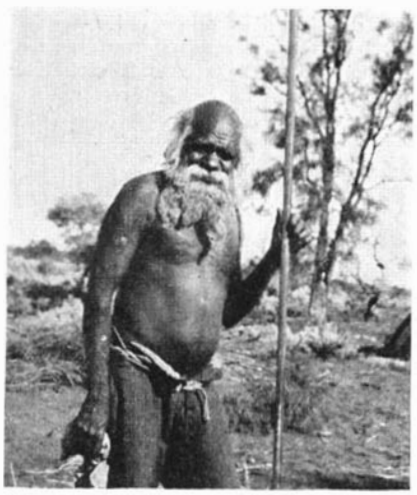
Places, as well as people, have their characteristic aromas which the untrained nose of highly civilized persons can detect. We even discovered an interesting small social group in California that breaks the tedium of automobiling with a blindfold game in which they try to recognize places they are passing along the highway by the odor.

Margaret Fuller, author of "Her Son," writes us: "Driving, even with my eyes shut, I can smell the newly ploughed fields, the bog, marsh; I can usually tell the trees by smell—of course flowers, some insects, most animals, different woods, in fact everything, more or less. I can smell smoke in the woods when I cannot see it—that is, when a faint trail is brought on the wind.

"My sister," she continues, "this instant stepped to the door sill and remarked, 'Funny, but I seem to smell smoke!' My sister Louise said, 'That's all right—I simply lifted up and put down again a pail that had ashes in it from the open fire.' "

And Ann Hard says "there are certain regional variations in natural odor —country odor—which I believe I feel so keenly that I would almost know with my eyes bandaged where I was in the summer time."

Rex Brasher, the painter of more than 3300 bird plates, throws light on how keenly alive our noses are even while we are asleep. "One night about 2 A.M.," he says, "while asleep in a camp in



Maine, I was awakened by a strong whiff of smoke. The camp fire had been carefully guarded with logs but a vagrant wind had blown an ember into some dried sweet ferns and the pungent odor aroused me in time to prevent the blaze spreading. While sailing among Maine islands the scent of pine and balsam has often indicated promontories of land when darkness obscured vision."

Not only skill in blind navigation can be better understood by a realization of this subtle keenness of the sense of smell, but even our passing moods may be related to this, at times, unconscious acuity. Our noses, apparently, are eternally sniffing, whether we are conscious of it or not; yet these often fleeting olfactory stimuli—which we may never consciously note—can still leave their mark and alter our entire train of thought. Take the following, for example, which came from the principal of a girls' finishing school:

"On the train once, in the midst of happy conditions, I suddenly felt discouraged, awkward, unhappy. As soon as I recognized the perfume used by a fellow traveler, I saw very vividly a large dancing class, a French dancing master, and felt again my girlish dismay at his attitude toward my poor attempts to learn the steps he was trying to teach me. As soon as the memory-picture came I knew why I had suddenly felt unhappy, and, of course, came back to normal, and this experience occurred some 15

Australian abori[redacted]ted for their ability[redacted]wn a man, using a[redacted]f keen observation[redacted]ry sense

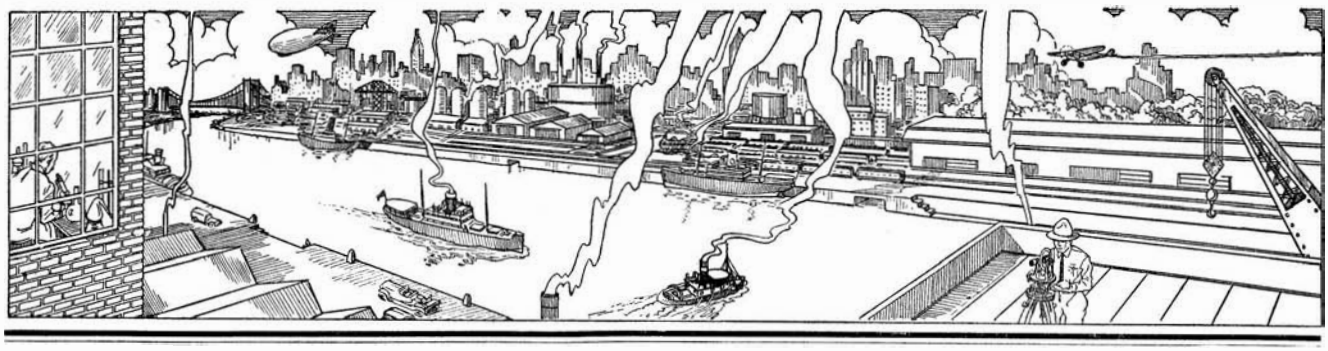
or 20 years[redacted] time I had seen the dan[redacted]

The s[redacted]ell is obviously still an active, [redacted]living sense, even with the failure of most of us to cultivate it. There is doubt that savages have keener noses—they have simply learned better how to make most use of the first cranial nerve, just as the blind do not have more sensitive ears than seeing persons, but have learned how to listen and thus discover obstructions.

A little rumaging among our thoughts, or attempts to sense hitherto unperceived odors, may provide surprising revelations of our own savage sensitivity to scents. The psychologist, Professor F. Kiesow, has recently shown that tastes and smells play a large part in dreams.

Keen as our sense of smell has remained through thousands of centuries, it is fortunate that many manufacturers are now using perfume materials to make otherwise unpleasant products smell clean and respectable—fortunate for the manufacturers as well as for the customers. If only a few individuals would take a suggestion from these manufacturers!

Remember—nose rubbing is more widely used as a greeting than are handshaking and kissing, combined.



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN
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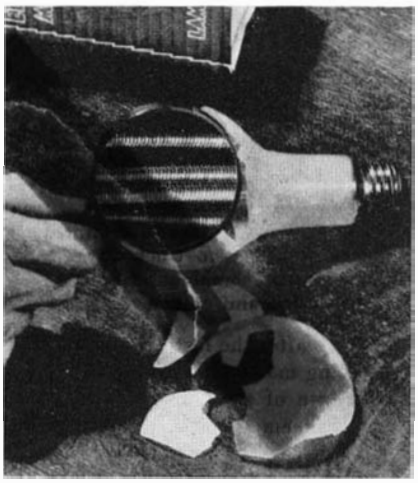
A. E. BUCHANAN, Jr.
Lehigh University

Lamp Filament a Coiled Wire

WHAT looks like an ordinary piece of wire in a 40-watt G-E Mazda lamp is actually a coiled filament resembling a spring. This piece of wire, apparently but 1½ inches long and scarcely visible, is 14½ inches long, coiled 460 turns to the



Magnifying glass shows the coiled wire filament of a 40-watt lamp

inch. The wire, finer than a human hair, is but a thousandth of an inch in diameter. Being coiled, the filament is more rigid and can withstand the tremendous heat of 4400 degrees, Fahrenheit.

X Ray Diagnoses Elephant's Arthritis

TOO many peanuts and not enough hay and other roughage proved to be a bad policy for Nizie, a highly trained dwarf elephant. The elephant's part in the performance of Nicola the Magician consists of a disappearing act, requiring some agility, and when his left foreleg stiffened up for no apparent reason, the veterinarian was at a loss to know what treatment to prescribe. The situation seemed to call for an X-ray examination, but even a dwarf elephant is a little bulky for hospitalization.

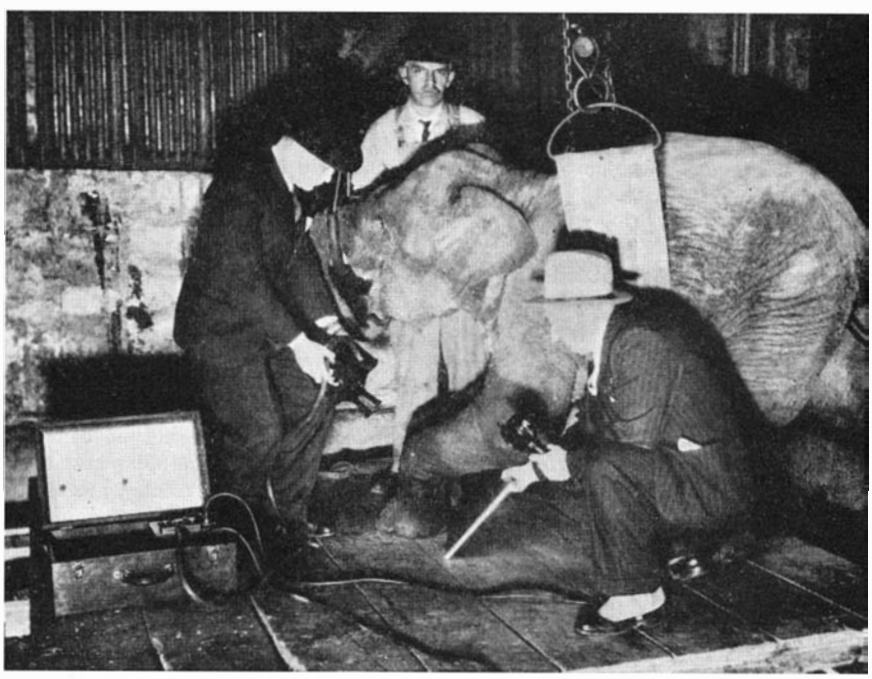
Engineers of the General Electric X-Ray Corporation had solved a similar problem for C. V. Whitney's famous horse, Equipoise. Armed with a newly developed small portable shock-proof outfit, they paid a visit to the elephant's stall. Whereas it took but five seconds to make an exposure of Equipoise's leg, the thick elephant hide required 45 seconds, during which time Nizie was kept in place by chains and promises. The X ray recorded every detail of stiffened joints and bone formation, and a verdict of arthritis, or rheumatism, was handed down by Dr. F. M. Kent, together with a prescription for a change in diet.

Flaked Coffee

BARRAGES of ballyhoo have made something of a national issue of the relative "freshness" of various brands of coffee. One claims that the only way to guarantee freshness is to deliver the coffee promptly from the roaster to the consumer. Others rely on hermetically sealed containers to preserve the flavor. Still another school recommends buying whole-bean coffee and having it ground just before using. Now a new wrinkle appears on the horizon—flaked coffee, packed in carbon dioxide gas—which is said to keep "fresh" for a couple of years and to produce a better brew from less coffee.

Research workers at the Mellon Institute of Industrial Research who developed flaked coffee have made a thorough study of the changes that take place in ground coffee as it ages. While green coffee may be kept for long periods of time if protected from mold and bacterial growth, roasted coffee immediately begins a gradual deterioration that is more rapid when it is ground. Coffee aroma is a complex mixture of volatile compounds formed by pyrolysis of the components of the green coffee bean. The soluble non-volatile principles of the bean likewise undergo pyrolysis, resulting in the production of caramel-like substances that give body to the brew prepared from the roasted coffee. Coffee also contains a fatty oil that undergoes some alteration during roasting.

The changes that produce stale coffee are, in decreasing order of importance, volatilization of aroma, oxidation of aroma, and oxidation or rancidity of the coffee oil. During the roasting of coffee there is a



Nizie's pain is diagnosed by means of portable X-ray equipment

copious production of gas in which carbon dioxide predominates. In addition to the gas that escapes during roasting, a considerable portion is retained in the roasted bean by occlusion. Ground freshly roasted coffee contains approximately five times its volume of this gas, which slowly departs as the coffee ages, sweeping out a large proportion of the aroma. When attempts are made to preserve the freshly roasted coffee by immediate hermetic sealing, the accumulating gas produces such a pressure as to rupture the container unless one of special strength is provided. If, on the other hand, the container is vacuumized, the occluded gas is by no means completely removed during the operation, permitting the building-up of some gas pressure within the container, which escapes upon opening the container, carrying with it at the same time the aroma with which it has become saturated.

Produced by passing ground freshly roasted coffee through a roller mill under high pressure, the coffee flakes have about 90 percent of the occluded gas expelled from them with practically no loss in aroma. And in this form, coffee has been kept fresh two years by sealing in carbon dioxide. As they come from the mill, the flakes are thin and flat, averaging about 0.06 in. in diameter and having a thickness of approximately 0.003 in. This flaking operation makes the soluble constituents of the coffee instantly accessible to the extracting liquid, and extraction not only is more rapid but it is also more uniform and complete. The flakes are said to yield approximately 50 percent more extractive than the customary drip grind and from 75 to 100 percent more than the ordinary percolator grind.

The research leading to the production of the new flaked coffee culminates from a broad study of the packaging of coffee begun in 1929 under the Can Fellowship sustained by Continental Can Company, Inc., New York. Patents cover the process.—*A. E. B.*

Non-Fouling Spark Plugs

AUTOMATIC cleaning of spark plugs has been developed and patented by a German chemist, H. Narratiel, according to *Chemical and Metallurgical Engineering.* The cleaning is accomplished by providing catalytic surfaces to prevent deposition of carbon at all points which come in contact with the combustion products. These surfaces consist of metals of the earth or rare earth groups, or metal oxides, such as copper oxide.—*A. E. B.*

Dangerous New Reducing Drugs

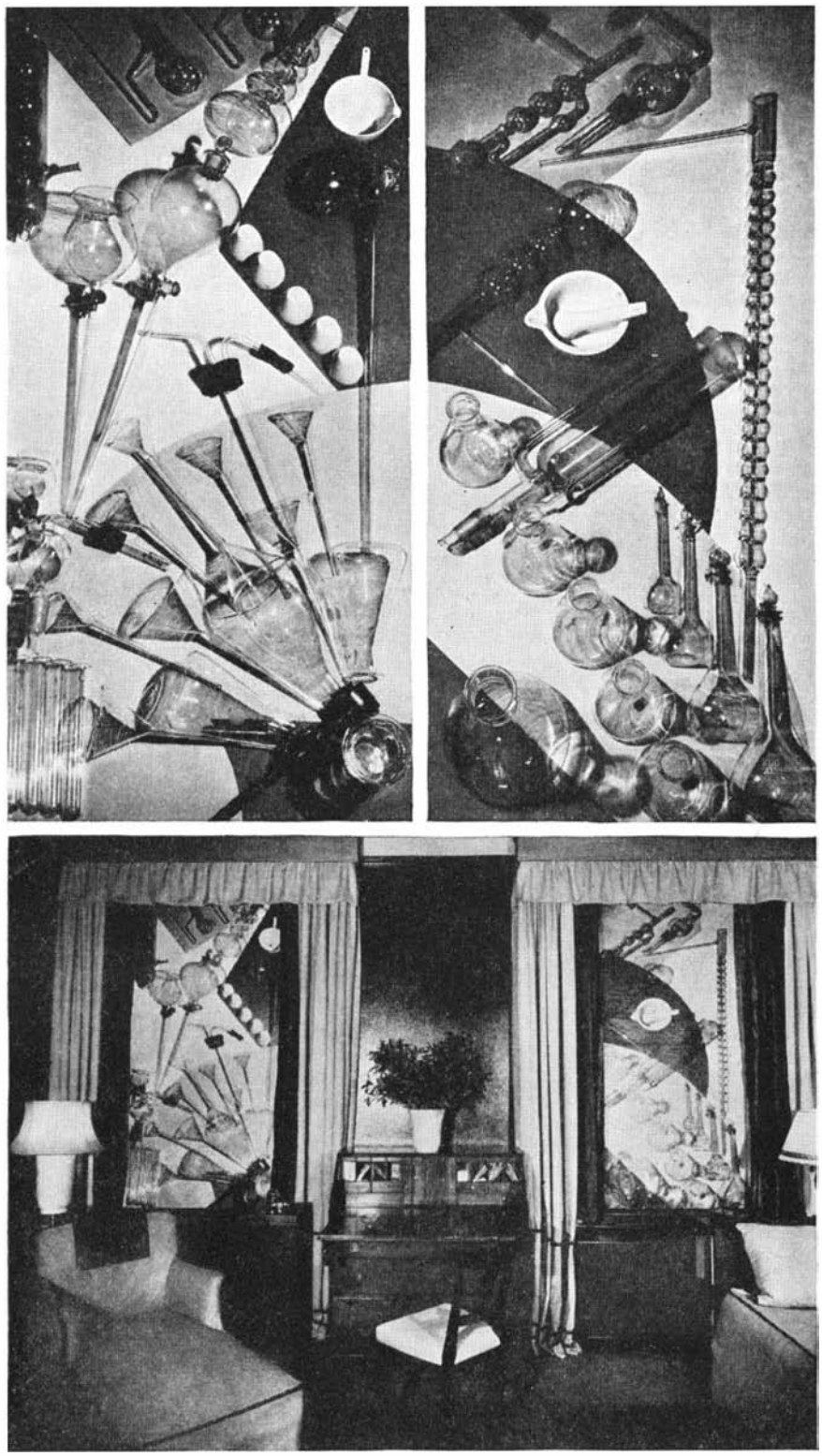
THE danger as well as the usefulness of certain new reducing medicines, among them sodium dinitrophenol, were vividly pictured by Dr. Edward L. Bortz of Philadelphia at a meeting of the American College of Physicians.

So dangerous are these medicines if carelessly used that an eminent jurist urged Dr. Bortz to recommend their inclusion in the list of dangerous drugs whose use is governed by the Food and Drugs Act.

Three deaths have been reported in medical journals from the use of dinitrophenol, according to Dr. Bortz. In every one of these cases and in certain others, not fatal but in which other untoward effects occurred, the dosage was too strong or the drug was not correctly given.

"One wonders how high the toll of deaths is going to mount when the beauty parlors and physical culture emporiums begin to pass it around," Dr. Bortz commented.

Sodium dinitrophenol and allied drugs were described by Dr. Bortz as accelerants of metabolism, the change whereby foodstuffs, water, and air are adapted to the needs of the body for growth, maintenance, and repair and the production of energy. This change is accompanied by heat production. When metabolism is speeded up,



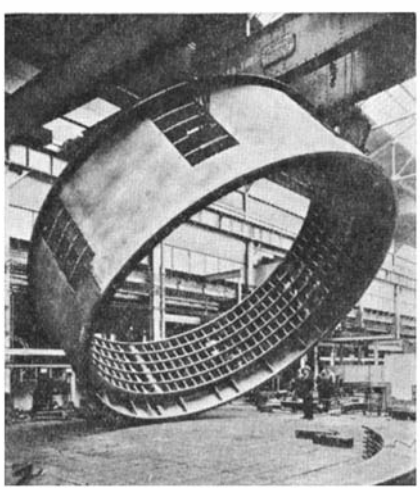
Cabalistic symbols of the chemist's art are a thing of the past, but a New York City photographer, Stella F. Simon, has found striking decorative values in the glassware of the modern chemist. From photographic studies of funnels and flasks, retorts and mortars, she has produced unusually attractive window shades. Strips of shade material were coated with sensitized emulsion on which the enlargements were made, and developed and fixed in the regular manner. After a year of use, the photographs show no signs of cracking. The two upper illustrations show the unique designs, and the lower one the shades in use.—*A. E. B.*

under the influence of dinitrophenol, for example, more heat is produced, the surplus fat of the obese person's body furnishing the additional fuel. This results in the desired loss of weight.

With overdosage of the drug, heat is generated faster than needed and faster than the heat regulating center of the body is able to dissipate it through stimulation of the respiratory apparatus and sweat glands. The body temperature rises, up to 115 degrees Fahrenheit or higher, and death occurs from heat rigor. The body almost literally burns itself up. This was the fate of the unlucky victims of overdosage of dinitrophenol. To protect others from a similar fate, Dr. Bortz believes sale of this drug should be regulated so that it can only be used under a physician's directions.—*Science Service.*

Boulder Dam Generators

WHEN the waters impounded behind Boulder Dam are finally turned through the Boulder power station, the world's largest hydroelectric generators to date, born in the General Electric shops at



One of the huge stator frames to be used in a generator at Boulder Dam

Schenectady, will convert the mighty power of the Colorado River into electricity for transmission to Los Angeles, 265 miles away.

The photograph shows just the stator frame for the first of these huge machines, rated at 82,500 kilovolt-amperes. The complete generator will be 40 feet in diameter, 32 feet high (above the floor), and will weigh over 2,000,000 pounds. Disassembled into sections small enough to be shipped by rail, at least 40 freight cars will be necessary for the transportation of each generator to Boulder Dam.

Canned Cheese

THE age-old method of making natural American or cheddar cheese in gigantic loaves weighing as much as 70 pounds may be revolutionized by a new method of canning natural cheese just perfected by the Department of Agriculture. It employs a new kind of can which is round in shape to hold 12 ounces or more, enamelled inside, and equipped with a valve in the top which permits readily the escape of the natural carbon dioxide gas thrown off by the cheese during the maturing period, but prevents ingress of air.

At the beginning of the process the new method of making cheese in cans does not vary much from the old. Fresh milk is given the right acidity by adding a minute portion of soured milk or culture to act as a starter and give the right degree of acidity. Brought to 86 degrees, Fahrenheit, a few ounces of rennet is added to each ton of milk,

New can for cheese, with a one-way "flap" valve in center of the top

which causes it to curdle and coagulate within 40 minutes. The curd is then sliced and cubed by hand knives, and allowed to cook a few minutes at a temperature of 100 degrees, Fahrenheit. The whey or liquid is drained off, and the curd then chopped into minute particles. After the addition of salt it is pressed into print forms in sizes from ten to seventy pounds, remaining in the press about 24 hours.

At this point in the old method the loaves are bandaged with cheese cloth and stored at 70 degrees, Fahrenheit, for a week or more, then coated with paraffin and allowed to mature in a cold room at about 50 degrees, Fahrenheit, for four months, being turned daily so that the maturing process will be even throughout the loaf. A shrinkage in excess of 5 percent invariably occurs in the process, and rind formation and surface hardening later cause further wastage. The loaves are boxed before shipment.

In the new canning method, after the curd is finally pressed, it is cut into the required size and weight, each piece rolled in Cellophane and sealed into the valve-vented can, ready for shipment after the four months curing period. No shrinkage occurs. The cheese has no rind, and each package is like a fresh cut from the center of one of the large loaves.

Scientists of the Department of Agriculture and of the Continental Can Company spent three years in perfecting the valve-vented can and the new method of canning cheese.

Reports New Cure of Tetany

TETANY, the severe nervous and muscular disease featured by painful muscular cramps and caused by an insufficiency of calcium in the blood, can now be cured or greatly relieved without delay, even in the worst cases. Tetany should be distinguished from tetanus, or lockjaw.

The new treatment, described by Dr. I. Snapper, professor of medicine and general pathology in the University of Amsterdam, in *The Lancet*, medical journal published in England, is the giving of a substance known as "A.T. 10."

"A.T. 10" is a fraction of the well-known irradiated ergosterol which is rich in vitamin D. Prolonged dosage with ordinary irradiated ergosterol, in conjunction with oral doses or injections of calcium, has previously been used as a treatment for tetany. Though in some cases it was fairly successful, in others disagreeable and even dangerous symptoms were produced. From "A.T. 10," however, the vitamin D is absent, and there are no unwanted symptoms provided that the doses are stopped as soon as the blood's calcium content has been brought to normal. This is usually achieved within a comparatively few days.—*Science Service.*

Potash Mineral in Kansas

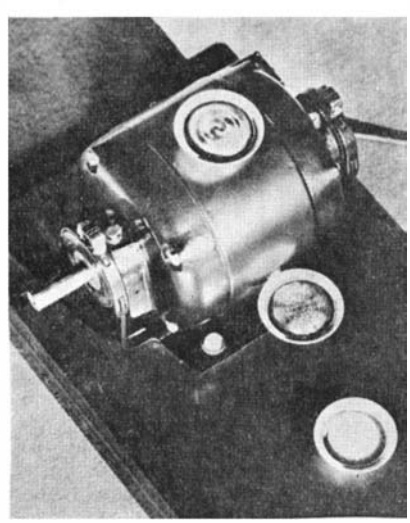
THE United States Geological Survey has announced the discovery and identification of the potash mineral polyhalite in a sample of well cuttings from western Kansas. This is the first recognition of this mineral in that state. F. C. Calkins and R. K. Bailey of the Geological Survey staff found it in cuttings submitted by the Central Commercial Oil Company. The cuttings came from a well in Trego County about four miles south of Riga, from a depth of about 2000 feet, which in that locality is approximately sea level. The polyhalite made up only about 5 percent of the sample and hence has no commercial interest in itself, but the discovery suggests that further exploration in Kansas might lead to the discovery of richer bodies of potash salts of possible commercial value. The finding and identification of polyhalite in cuttings from an oil well in Texas was the first step leading to the development of the present potash industry in New Mexico.

Salt deposits have long been known in eastern Kansas, but the salt is practically free of potash. Very small percentages of potassium, however, have been reported in some mineral waters of the state.—*A. E. B.*

Rubber Motor Mounting Proved Effective

THE effectiveness in damping out vibrations, of the rubber mountings used by General Electric on its latest appliance motors, is shown graphically by three little pools of mercury.

Two of the shallow cups containing the mercury are secured to the motor itself.



Cups of mercury demonstrate effectiveness of new motor mountings

The third mercury cup is fastened to the board to which the motor is bolted. In the two upper cups, there is visual evidence of the slight vibration inherent in the motor, but the lowest cup shows that none of this is transmitted to the support to which the motor is attached.

If the rubber cushioning is "short-circuited" by jamming a screw-driver or other object between an end-shield and the supporting cradle, the pool on the board will immediately show vibrations of a magnitude equal to those seen in the two pools on the motor.

Four Dozen Teaspoons in a Woman's Stomach

RIPLEY might say "Believe It Or Not" but the records of the State Hospital at Central Islip, New York, show that from the stomach of a woman recently admitted there suffering from melancholia with suicidal tendencies, there were extracted 48 teaspoons, 1 teaspoon handle, 3 bolts, 1 prune pit, 1 nut, 1 small piece of glass, 1 button, 2 pieces of spring wire, 1 needle, 1 piece of cinder, 1 hairpin, and 1 lead pencil. John Hix might say "Strange As It Seems" but the hospital records show that the patient recovered.

Type Without Type

OLD readers of SCIENTIFIC AMERICAN will remember that during the printers' strike early in the 1920's a makeshift method of producing the magazine was used in which typewriting and longhand manuscripts were reproduced by an engraving process and used for making up the magazine. Although not anticipating another printers' strike which would make it impossible to have type set in the ordinary manner, a new invention makes possible the production of perfectly aligned type matter with an ordinary typewriter. A sample of work so produced is shown in these columns, reproduced by the half-tone process.

This system of obtaining "type without type," invented by Joseph SpielVogel, uses a sheet of finely corrugated paper having horizontal parallel slits at intervals equal to the distance between lines on the typewriter, which paper is cemented to a backing sheet. The typist writes the manuscript on the corrugated side between the slits in the conventional manner, without any effort at alignment. The copy is aligned at the right-hand margin after it is taken out of the machine by lifting the ends of the lines from the backing sheet, stretching them to the required uniform width, and then reattaching them. The special cement used remains permanently plastic.

There is no apparent distortion of characters when the lines are stretched because

produced with the patented paper. Distortion can be positively controlled in any direction. Startling illustrative effects may also be secured in this easy way.

Another feature of Mr.SpielVogel's invention makes it possible to get various sizes and styles of type on the ordinary typewriter, by simply typing on his patented paper and then stretching it to the desired size or shape. The following are a few examples of types produced with the regular typewriter keyboard:

Vogel-Type Condensed
Vogel-Type Italic
Vogel-Type Extended

Justified (aligned at right) typewriting obtained with special paper

the spaces between each letter and word are enlarged proportionately. Copy of this kind, after it is aligned, can be reproduced in any one of several manners. As shown in the accompanying illustration, special features can also be obtained from ordinary typewriting.

Flakes of Aluminum

HOW thin is a flake of aluminum bronze powder? This question, an important one in the paint industry, has been answered by Aluminum Research Laboratories, New Kensington, Pennsylvania. In average size, such a flake of powder is not much thicker than the wall of a soap bubble. It would take more than 100 flakes, laid one on top of another, to make a pile which would reach as high as the thickness of the paper on which this article is printed.

When aluminum became commercially available, its powder was known as "aluminum bronze powder," which is a misnomer because it is not a bronze. It has an aluminum purity content of more than 99 percent and is used as the pigment portion of aluminum paint. It is different from other pigments, in that the individual particles are flaky instead of granular.

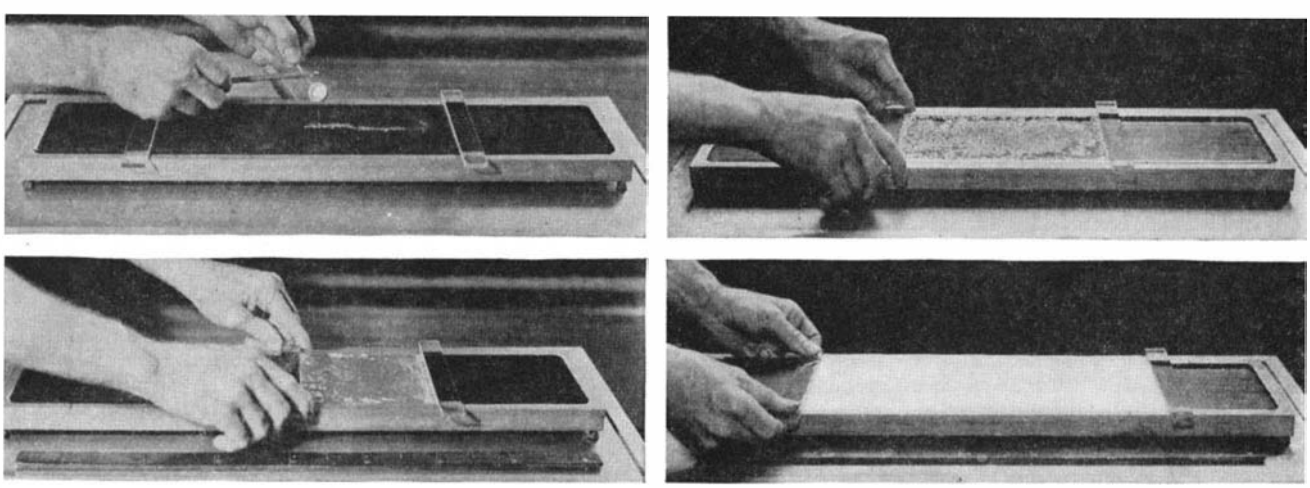
The effectiveness of aluminum paint as a protective covering for surfaces outdoors and in, comes from the minute metal flakes, impervious to light and moisture. The microscope reveals the fact that the flakes overlap in layers in the dried paint film, actually forming, in effect, a very thin layer of metal over the painted article.

Thick flakes affect the leafing characteristics of the powder and the covering quality of the paint. It is therefore important that the flake thickness be controlled in manufacturing processes. But how can these infinitesimal particles be measured?

The measurement of flake thickness is peculiarly difficult because the aluminum flakes are too small to handle, even under the microscope. An ingenious method has been devised, however, which requires as measuring instruments only a balance and a common ruler or yardstick. In using this method, Assistant Director of Research Junius D. Edwards and Dr. Ralph B. Mason, of Aluminum Research Laboratories, employed a flat-rimmed, shallow, rectangular pan filled with water to just above the brim, surface tension keeping the water from overflowing. Two flat strips of glass, each an inch or so wider than the pan, were laid on the rim across each end to act as barriers and to help "coax" the powder into the desired film, one flake thick.

Windows are closed and doors are shut, for the room in which the measurements are taken must be draft-free. An accurately weighed sample of powder—one tenth of a gram, for convenience—is dusted from a small container onto the water surface. The flakes, only partially wet, float upon the surface. One of the glass plates is pushed towards the other, sweeping the floating powder before it for about two thirds the length of the pan, Then the glass is pulled back again. This pushing and pulling operation is repeated until the powder film is uniformly smooth. The film of powder wrinkles much like a piece of cloth, when the flakes are all touching and are further compressed by the pushing of the glass plate.

The barriers are then adjusted just sufficiently to eliminate the wrinkles, and the powder film becomes absolutely uniform. The length and width of the film are then

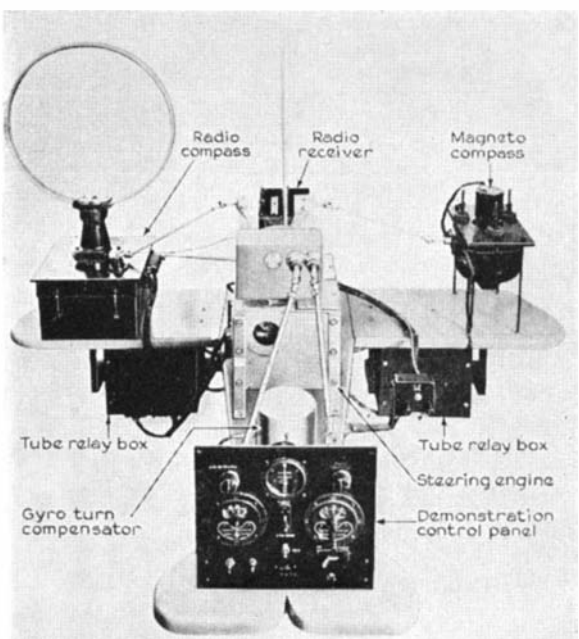


How the thickness of flakes of aluminum bronze is measured. ***Upper left:*** **Placing a measured amount of powder on water.** ***Upper right:*** **Spreading the flakes.** ***Lower left:*** **Smoothing out the layer.** ***Lower right:*** **The final "sheet" to be measured**

measured with the ruler and the area which one gram of powder will cover is calculated. From the area and volume (which is calculated from the density—2.5 grams per cubic centimeter) the thickness is simply calculated. The results of such calculations show the average thickness of flake to vary from about .00005 to .000012 of an inch with different grades of powder.

Automatic Steering Control for Airplanes

EXPERIMENTS in "Radio Aids to Air Navigation" have recently been described before the American Institute of Electrical Engineers by Dr. C. F. Green and H. I. Becker, of the General Electric Company. They have developed a system by means of which it is hoped to achieve completely automatic steering of a plane, utilizing radio for the purpose of correcting wind drift. The principal components of this system, as shown in the photograph, are: Magneto compass, turn compensator, radio compass, steering and loop engines, course setter, and radio receiver.



Photograph showing the essential parts of the new automatic steering control for airplanes described in these columns. With this system, which is still in the experimental stage, it is hoped to reach completely automatic steering. Drift caused by wind, which has been one of the major difficulties of such automatic steering, is to be overcome by the use of the radio compass

The motor-driven magneto compass can be mounted at any point in the fuselage, preferably at its tail, where it is least effected by the magnetic properties of the airplane structure and equipment. A motor-driven turn compensator corrects for the north-turning error, which is present in all magnetic compasses.

The purpose of the radio compass is to determine whether or not the plane is flying directly towards a radio transmitting station. This information may be visibly obtained from a zero-center right-and-left reading meter. If automatic operation is desired, the current to the meter may be used through associated apparatus to move the rudder of the plane to right or left and thus maintain the desired heading.

The steering and loop engines are combined in a single-unit construction and driven by a dynamotor. Electrically operated clutches, when energized, permit the rotation through any desired angle of the compass and loop simultaneously, or of the compass alone. Connection is also made from this unit to the rudder cables, and the plane is thus steered to right or left.

The flexibility of this system permits three different methods of automatic steering to be employed. First, automatic steering by magneto compass; second, automatic steering by radio compass; third, full automatic steering with automatic drift correction by radio.

In the first method the pilot sets the magneto compass to the correct bearing for the point towards which he desires to fly. After taking off, the plane is headed in the approximate direction of the objective. The pilot switches on the automatic system, which takes control of the rudder and steers the plane on the selected course. The magneto compass is the heart of this system. As soon as the plane starts to deviate from its correct heading, the magneto compass begins to generate electricity. This current operates a relay, which, through amplifiers in a control box, energizes the motor-driven steering engine and corrects the rudder position. If a cross-wind is blowing, the pilot must watch his landmarks and make corrections in the compass setting, until he is following the desired flight path.

In the second method there is automatic steering by radio. When the radio compass loop is normal to the radio waves, there will be no current flowing in the radio compass circuit. If the plane deviates from the line of flight, a polarized current flows in the compass output circuit. Then by means of a relay and auxiliary tube circuits, the steering engine is actuated and the rudder is again brought into play. In practical operation, the pilot, by means of the course setter, turns the loop until it is at right angles to the long axis of the plane. After taking off he flies in the approximate direction of the desired radio station and engages the automatic control. The radio compass and its controls now keep the plane always pointing towards the broadcasting or beacon station, and while a cross-wind may drift the plane from a direct line of flight, it will be brought back over the transmitting station.

The third system involves automatic drift correction by radio. In this system the desired course angle, using the magnetic north as a reference point, is used as a basis for establishing the relative positions of the magneto compass and the radio loop. This relation then remains fixed and the radio compass controls the rudder. Current from the magneto compass, due to deviation to the right or left, causes a simultaneous rotation of both compass and loop until the poles of the compass are again pointing east and west and no more current is flowing.

When the plane tends to drift from its course due to a cross-wind, the loop ceases to be normal to the radio waves from the station towards which it is flying, and current starts to flow from the radio compass. This operates the steering engine and the rudder comes into action, bringing the plane back toward its correct flight path. This movement, however, changes the position of the magneto compass poles with reference to their original east and west position, and now the compass comes into action, and both the compass and the loop are simultaneously rotated until the compass poles are again east and west.

The plane is now not pointing directly toward the radio station, but is headed into the cross-wind at an angle to correct for the drift. It will maintain this position on its original course as long as the intensity of the wind remains the same. Any increase or decrease in wind velocity will be automatically compensated for, and the plane will continue to fly on the direct course to its destination. This is specially important for night operations, for flying through clouds, in thick weather, or over areas where no landmarks are visible.

The effective range of this control equipment is only 150 miles and it is not yet completely developed.—*A. K.*

When the Motor Drops Out

THE following paragraphs are taken from a terse report by a pilot who heard a rending crash, found his head down to his knees, his eyes closed, and his ship whipped up into a vertical climb, as the motor dropped out of the nose of the ship.

"I could not open my eyes for the moment and first reaction was to shut off valve. This and releasing hatch was done before I could straighten up. As soon as the hatch lifted and there was a rush of air into cockpit, full muscular control returned to body. My eyes opened and altimeter was first thing noted. The reading was 6500 feet. The ship had reached the peak of its climb and was falling off to right, went into half turn with tail down and right wing pointing down. I was loose in belt. Grabbed control stick and as ship picked up speed in falling, I felt pressure on controls. These soon took hold and I righted the ship into a dive. With heavy pressure on stick I rolled stabilizer all the way up (which did help). As I let stick back, nose came up and I found I had control of the ship. I unbuckled belt to jump when I thought—'I've righted a ship from inverted outside spin and I seem to have control of same with plenty of time to still jump. I'll just see what I can do in controlling ship in flight.' This I started to do. I soon found that with nose down too far the ship would rock in the forward motion. When I let nose come up too far with reduced speed ship fell off to right. This happened twice. I then noted that

best control was with the airspeed showing 110 M.P.H. This gave me directional control and all.

"I knew I had about a 20 mile north wind on ground and I noted just before motor tore off where an emergency field was. As I again looked around said field lay up ahead of me. I quickly made survey of fields sonth of same. Noted they were open and by this time I felt fully confident that I could land ship with better than 50-50 chance and not hurt self nor ship.

"The ship was now acting much the same as a glider that I had flown a few years ago. I rebuckled my belt determined to set ship down in the middle of the field. As I came nearer the ground and field I had to manouver in figure 'S'. This I did with rudder only. Passed over road and fence about 20 feet high. At this point I depressed nose of ship a little more—leveled flat and held this till ship touched ground."

A "Suspension-Bridge" Airship

A NOVEL type of airship, designed by Mr. Roland B. Respess, has recently attracted much attention. Mr. Respess had in this project the valuable advice of Mr. Robert T. Pollock, consulting engineer and the American collaborator in designing and building the British airship *R-100*.

Prior to its submission to governmental authorities, the Respess airship was carefully studied and analyzed by a number of consulting engineers, whose findings were supported by a water model test at the Daniel Guggenheim School of Aeronautics.

In this airship the suspension bridge principle has been ingeniously employed. The structure consists primarily of a rigid central member in the form of a tube which extends from bow to stern. Attached to the central member are a series of transverse wheel-like frames between which the gas bags are mounted. The diameter of each frame is determined by the contour of the airship at its particular position.

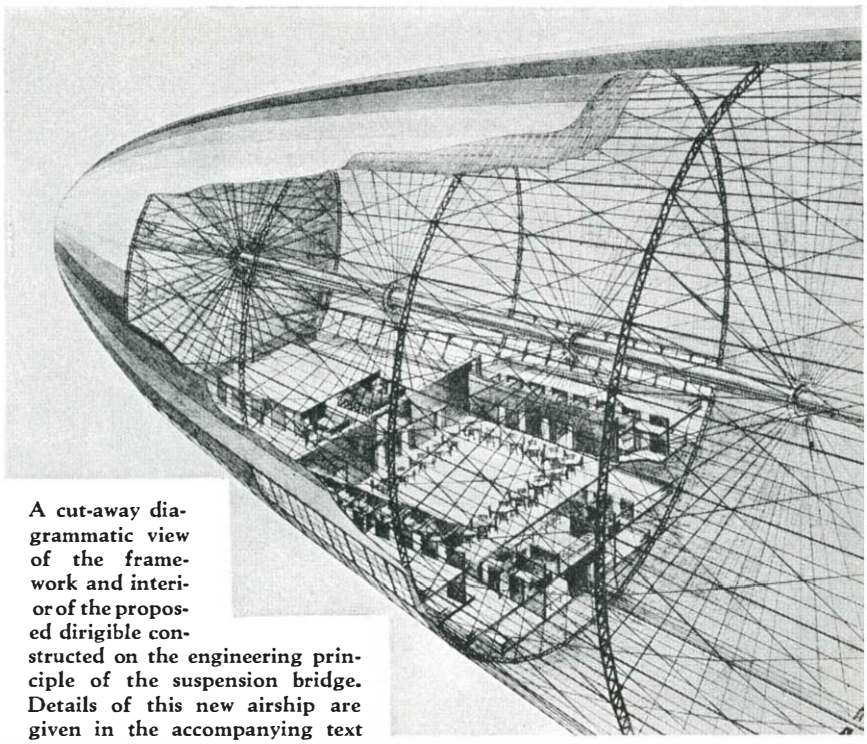
Flexibly mounted on the transverse frames and connected with them are longitudinal steel wires which are continuous from bow to stern and are fastened to the ends of the central member. A similar set of wires are attached to the circumference frames at an angle and serve to take up the shear loads. The wires are of high strength steel suspension-bridge type, carefully tested and specially treated to resist corrosion.

The advantages claimed by the designer for this type of airship are as follows:

The airship will be somewhat more flexible than the conventional rigid frame airship and will therefore take up sudden gusts and loads with less danger and damage. This is because the strength lies mainly in the wires and cables which have more give than rigid members. Further, from an engineer's point of view, another advantage lies in the fact that the airship structure is entirely determined in that all members can be calculated by simple engineering principles. It is also hoped to attain a structure of lesser weight, which is important from the point of view of pay load, simplicity, and cost of construction.

The design submitted to the government presupposes a ship 147 feet in diameter and 785 feet in length. While its main purpose is for use in transatlantic service, provision has been made for gun installation and other steps for conversion to naval uses.

The plans call for the construction of two airships, a new type of hangar and establishment of a regular transatlantic service.—*A. K.*



A cut-away diagrammatic view of the framework and interior of the proposed dirigible constructed on the engineering principle of the suspension bridge. Details of this new airship are given in the accompanying text

Test Flights of the S-42

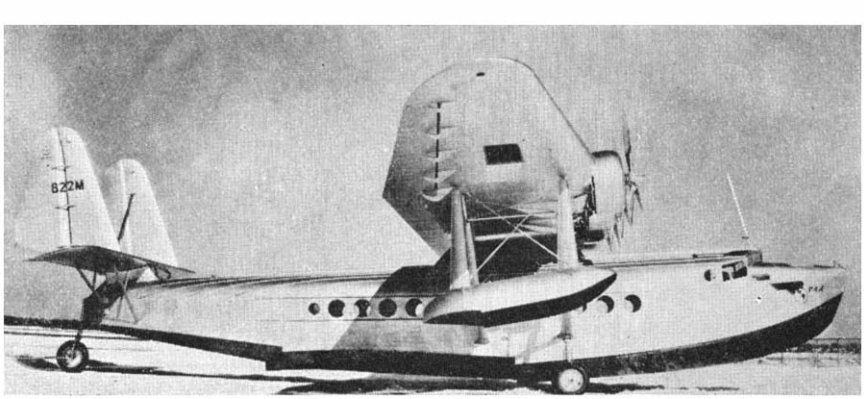
THE Sikorsky S-42, first of a new fleet of giant Clipper ships which will be used by Pan-American Airways to cut down flying time between North and South America, is the final step in a long series of developments by the Sikorsky company. This began with the historic S-36 created in 1928, which was equipped with a 500 horsepower motor, had a gross weight of 8000 pounds, and a top speed of 90 miles. Then followed in logical evolutionary steps the S-38, a twin-engine 8-passenger amphibian, and the S-41, a 1100-horsepower 12-passenger amphibian, with increased carrying capacity and speed.

The S-42 is the largest flying boat ever built in the United States, although its proportions are so well balanced that it does not give the impression of huge size. It has a gross weight of 19 tons, an estimated cruising speed of 150 miles per hour, and a comparatively small wing area of 1330 square feet. The wing span is 114 feet and the overall length is 68 feet 8 inches. As a passenger airliner, the new Clipper will provide accommodations for 32 passengers, a crew of five, a thousand pounds of mail and express, and will have a range in excess of 1200 miles. Four supercharged, geared-down "Hornets" give a total of 2600 horsepower.

Our photograph shows the well streamlined design, the motors nestling in the leading edge of the wings, and the carefully balanced controls. The hull is of the two-step type which facilitates the pilot's work in take-off.

One of the most interesting features of the new flying boat lies in the instrumentation and its arrangements. As our seaplanes grow in size, so do the pilots' and mechanics' quarters grow in resemblance to the navigating deck and engine rooms of ocean liners.

The actual flying instruments are in duplicate on either side of the cockpit, a set for each pilot. On these panels are a compass, a directional gyro, an altimeter sensitive to ten feet, and a rate of climb indicator. In a center panel are located four tachometers, and four manifold pressure gages. In the center provision is also made for an automatic pilot which will be installed when the new ship goes into service.



Side view of the new S-42 to be used in the South American service

There is a definite "engine room" between the pilot's compartment and the passenger cabin. Here the mechanic is seated with a multitude of dials and instruments in full view. The electrical system controls and light switches are mounted on the bulkhead beside the radio operator's seat. The mechanic has close to his hand an emergency lever by which the engines, in case of fire, can be smothered with extinguishing gases. The gasoline tanks are mounted in the wing, immediately behind the engines.—*A. K.*

Warm Above—Cold Below

UNITED Air Lines report to us a curious atmospheric oddity. During two years of weather observation their Meteorological Department has found that inversion of temperature is common throughout the winter months. Warm air lanes are then present over cold surface temperatures.

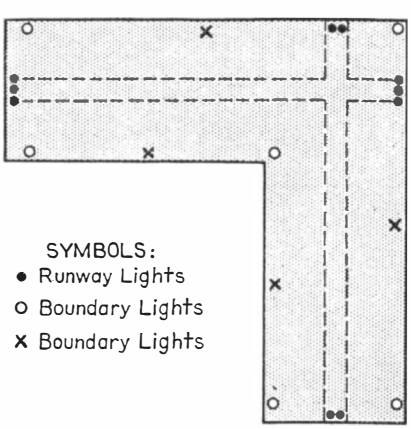
Hitherto it has been believed that the temperature dropped at the rate of 30 degrees, Fahrenheit, with each 1000 feet increase in altitude. Yet pilots have taken off from wintry airports and encountered relatively mild weather at higher elevations. Sometimes they have noted as much as 40 degrees temperature inversion between the ground and altitude.

A systematic study of upper air climatic conditions is now being made. The information will be relayed to pilots via radio telephone, and advantage will be taken of temperature inversions.

This inversion of temperature may be caused by warm air moving in from the south at high elevations, a cool stratum of air near the surface, or it may occur due to the cooling of lower lanes of air by radiation.—*A. K.*

Flasher Lights for Airports

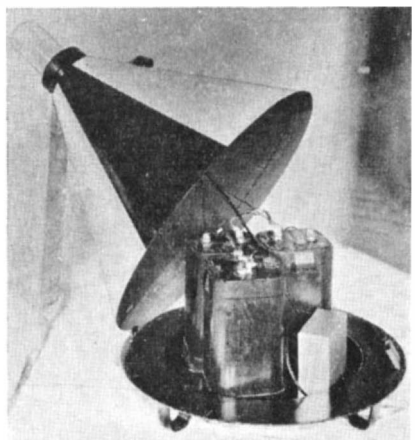
THE Department of Commerce is making a great effort to provide a large number of small airports or landing fields all over the country. Such airports, however small, must be amply lighted. Our sketch



An L-shaped airport and the location of guide lights for landing

shows an L type field, 2000 feet long, 700 feet wide on each leg, with runways 100 feet wide. This L field is well lighted because it has six green lights for one runway, four green lights for the other, six red boundary lights at extremities of the field, and four red boundary lights at intermediate points. Such a lighting system is ample, but it is also apt to be expensive and involve much underground wiring.

Since minimum expense is a vital feature in the extension of the small airport system, a simple self-contained safety flasher light has been developed by the Lakewood Engineering Company and approved by the Department of Commerce. This device is illustrated in one of the photographs. The small Neon tubes employed are distinctive in color, and the fact that there are 55 to 60 flashes per minute prevents confusion with any other ground lights which the pilot may encounter. The flashing lights are operated by special motors supplied with current by a 6-volt storage battery. Under average conditions the unit operates without attention or recharging for six months. The fact that neither cables nor conduits are required makes possible the transfer of the units to new positions as desired. There is added safety that electrical storms or break down of the general electric supply need no longer be feared.—*A. K.*



One of the new battery operated flasher lights for use at airports

Aviation Crash Rescue Boats

RECENTLY a noted Marine Corps pilot was drowned off Pensacola, although he had jumped from 3000 feet and his parachute had opened up in a normal manner. Wherever naval aviation forces operate intensively such accidents as well as crashes into the water occur from time to time.

The Bureau of Aeronautics has now secured some very fine and well equipped rescue boats. These boats are 45 feet in length and, equipped with two converted Packard aircraft engines of 650 horsepower each, can make 45 miles an hour in waves of two to three feet in height. They are V bottom boats and must stand a three-hour endurance test at 85 percent of their top speed. They will carry a crew of six—coxswain, engineer, doctor, hospital corps man, and an aviation carpenter's mate. Since flier's lives as well as valuable planes are involved, the constant efforts of the Bureau of Aeronautics are fully justified. —*A. K.*

Non-Shatterable Spectacles

FOR use by sportsmen, motorists, and workers in occupations where protection of the eye is of utmost importance, unshatterable spectacle lenses have been placed on the market by a British concern. These lenses were recently seen in the store of Aitchison & Company, New York.

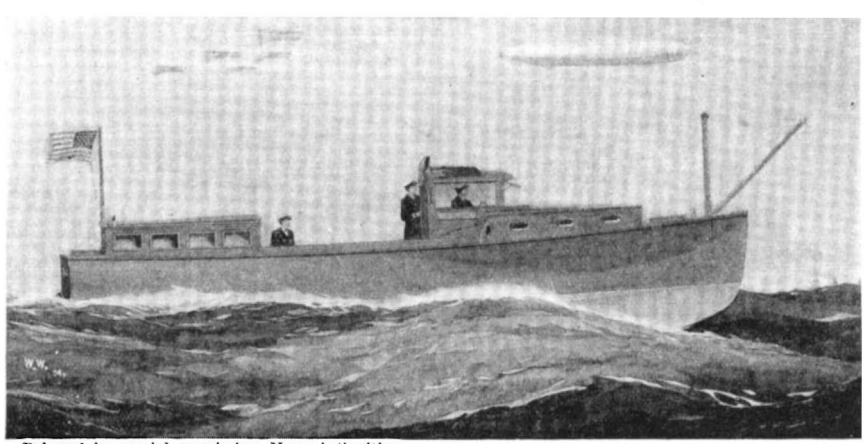
The material used in the lenses is the familiar shatter-proof glass, being made of two layers of glass with a layer of celluloid or some similar composition sandwiched between them. The lenses are blanked and ground in the usual manner.

Volcanoes and Tulips

WEATHER changes that visit blessing or bane on the tulip bed in your front yard and the sprouting radishes in your back garden sometimes receive substantial contributions from the remotest causes. A major volcanic eruption in Java or Alaska may fill the upper air with dust so fine that it will float 'round and 'round the world for two or three years before it settles out, and while it is aloft it helps to produce persistently chilly, often rainy weather—and your garden feels the consequences.

This and other effects of great volcanic explosions, such as that of Katmai in 1912 which kept the Iowa corn crop from ripening one or two seasons later, were discussed before a meeting of the American Geophysical Union in Washington by Prof. W. J. Humphreys of the U. S. Weather Bureau.

Volcanic dust in the upper atmosphere, Prof. Humphreys said, heralds its presence by strange effects on the sunlight as well as on the weather that follows disturbances in the radiations that reach and proceed from the earth. At such times the sun becomes surrounded with peculiar rings or haloes, resulting from the scattering of its rays by tiny dust particles. A large pro-



Released by special permission, Navy Authorities

One of the crash rescue boats secured by the Bureau of Aeronautics

portion of these seem to be actual microscopic bubbles with shells of stone, puffed out like the much-advertised "grains shot from guns," and in exactly the same way, by the sudden expansion of internal steam.

We might even get the paradox of a frozen earth produced by too much activity by fire-mountains. To reduce the intensity of direct solar radiation by 20 percent, probably not more than one fifteen-hundredth of a cubic mile of volcanic dust, hurled into the upper air every couple of years and kept going a long enough time, would quite suffice. It would not matter even where the volcanoes were situated, so long as they blew their dust high enough to set it afloat around the world. Thus the northern lands might conceivably become ice-blanketed through an active conspiracy of a ring of tropical volcanoes.—*Science Service.*

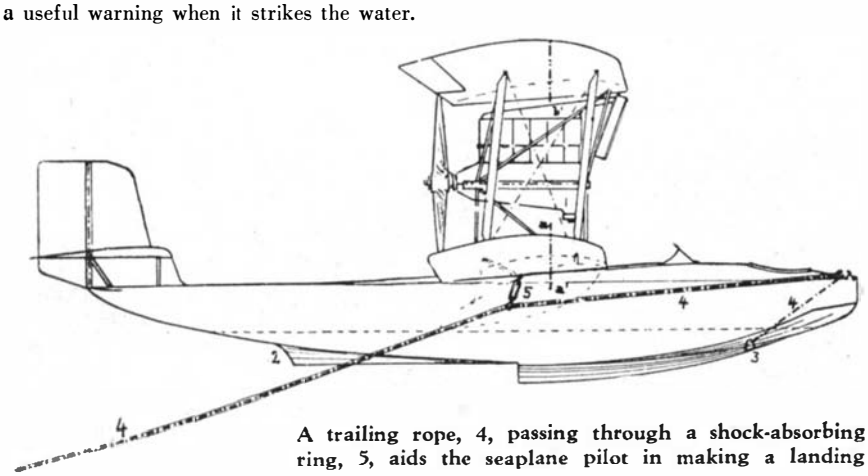
More Explosives in 1933

THE quantity of explosives manufactured in the United States and sold during 1933 for use in mining and quarrying, and for other industrial purposes, amounted to 255,989,391 pounds, according to reports from companies engaged in the manufacture of explosives. This figure represents an increase of 9 percent over the quantity sold in 1932. Sales during 1933 included 64,210,675 pounds of black blasting powder, 33,927,443 pounds of permissible explosives and 157,849,273 pounds of other high explosives. (Permissible explosives are high explosives that have passed certain tests by the United States Bureau of Mines for use in coal mines.)

When compared with 1932, the quantities of explosives sold in 1933 represented an increase of 5 percent for permissible explosives, 14 percent for other high explosives, and less than 1 percent for black blasting powder. Mining and quarrying operations used 99 percent of the total quantity of permissible explosives, 51 percent of the total quantity of other high explosives, and 92 percent of the total quantity of black blasting powder.—*A. E. B.*

An Aid to Seaplane Landings

A GERMAN flying-boat pilot describes in *Flugsport* a useful wrinkle for seaplane work. A stout manilla rope is led through the keel ring 3 (see drawing) and through the shock absorbing ring 5. If the flying boat is to be landed at night in complete darkness the rope will give the pilot a useful warning when it strikes the water. Furthermore, if knots are tied at the end of the rope it will act as a brake and bring the boat to rest quickly—just as do the brakes on airplane wheels. Flying-boat pilots have a technique all their own and there is as much seamanship as airmanship required for successful seaplane operation. —*A. K.*



A trailing rope, 4, passing through a shock-absorbing ring, 5, aids the seaplane pilot in making a landing

Would You Be An Engineer?

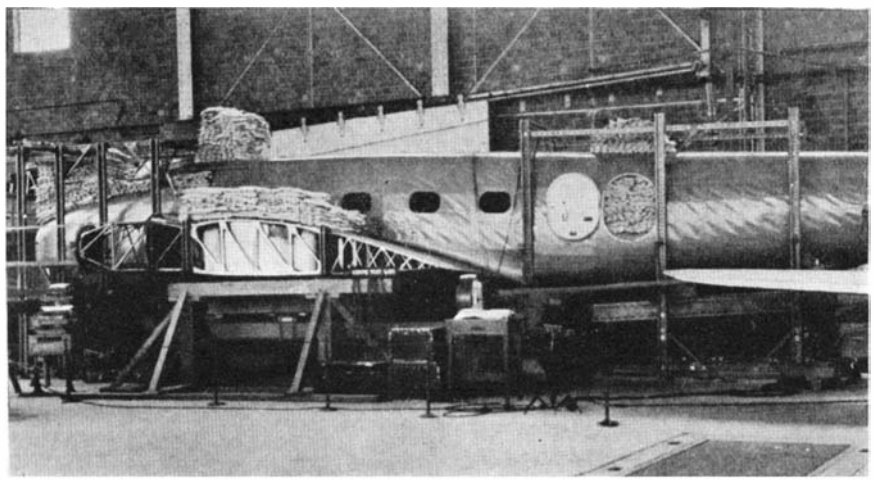
THE boy who has his heart set on being an engineer can now find out whether he has a gift for engineering, before spending long years of college preparation.

New scientific tests which measure aptitudes for engineering were described recently before the Midwestern Psychological Association. Prof. Clair V. Mann of the Missouri School of Mines and Metallurgy is author of the tests, on which he has been experimenting for nearly 10 years.

The tests are designed to appraise a freshman's possession of qualities actually used in engineering. Among these Professor Mann mentioned co-ordination of hand and eye, visual perception of spatial relationships, form discrimination, and other aptitudes on which the raw recruit must rate well if he is to win success in this line. —*Science Service.*

Testing Planes to Destruction

IN designing an airplane, the structural strength has to meet certain specific requirements of the Department of Commerce, and engineers have to make most accurate calculations. Some parts of the calculations, however, although thoroughly made, leave uncertainties. To meet such a situation the most expensive plane structures are frequently tested to destruction by piling huge quantities of bags, filled with lead shot, on the plane under test in such fashion as to simulate the air loads imposed in flight. One of our photographs shows the fuselage and stub wing of a Boeing 247 transport plane being submitted to this expensive form of experimentation at the army field in Dayton, Ohio. The bags, it will be noted, are not uniformly distributed. They are concentrated at those points where the maximum loads appear in the air or on landing. This particular ship withstood a loading at least 20 percent in excess of the requirements, an excellent guarantee of structural safety.—*A. K.*



Testing an airplane to destruction. Bags filled with lead shot are placed on the wings and fuselage to determine the stresses which the plane will resist

Movies of Boulder Dam

TO make available the newly edited official Government progression motion pictures of the Boulder Canyon Project to a larger percentage of those requesting dates for exhibition, the Bureau of Reclamation, Department of the Interior, has recently issued a permit for a business enterprise which is now known as the Boulder Dam Film Library. Stipulations of the permit require the Library to stock sufficient prints of the complete progression film in both 16 mm. and 35 mm. to meet the demand. The Library, which is located in the Boulder Theater Building, Boulder City, Nevada, for a nominal charge, forwards the prints anywhere in the United States that they are desired for showing.

The edited feature, known as the Boulder Dam Progression Motion Pictures, tells in film the complete story to date of the building of Boulder Dam. The film at present is four thousand feet long. It is estimated that the feature will exceed eight thousand feet in length when work is completed on the project.

Hard Copper Alloys

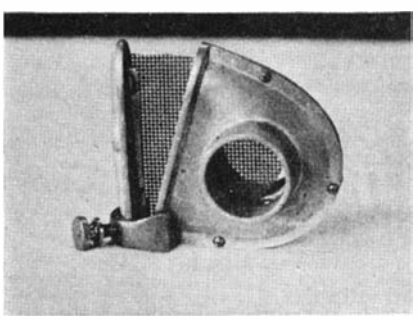
COPPER alloys three times as hard and twice as strong as ordinary copper alloys have been developed under the trade name of Kunial alloys. These improved metals can be extruded, rolled, drawn, and cold worked exactly in the same way as ordinary brass, for the production of rod, wire, tubes, strip, and sheet.

Kunial brass is an alloy of copper and zinc, together with other added elements. The copper and zinc contents may be varied within wide limits, but in all cases the unique property of hardening and strengthening by suitable heat-treatment is retained. By heating the soft quenched alloy to 500 degrees, Centigrade, the hardness is increased, the tensile strength is increased by 14 tons per square inch, while the elongation is only halved. If the cold-worked alloy is heated to 450 degrees, Centigrade, the hardness is increased, but the increase in strength is accompanied by an increase in elongation.

Kunial brass is an ordinary commercial alloy, and while the raw materials used in its composition are more expensive than those in ordinary brass, for products of equal strength, it may be possible to produce the finished article cheaper by this method than ordinary brass. This entire range of alloys possesses high resistance to corrosion by sea-water, and possible applications are wide.—*A. E. B.*

Radiator Rust Screen

RUST scale is the greatest cause of motor-car radiator overheating. The modern gas engine has long been equipped with an oil screen and an air screen to protect it, and a gasoline screen to protect the



carbureter, and now comes a screen to protect the radiator.

Because the radiator is made of brass and solder, it does not produce rust. The rust that clogs the radiator comes from the cast-iron water jacket of the engine. When enough of this rust gathers in the radiator, it cannot be removed, and in hot weather the water in the radiator boils.

This new device inserted in the upper rubber hose, connecting the radiator and engine of the car, will stop all rust scale from entering the radiator.

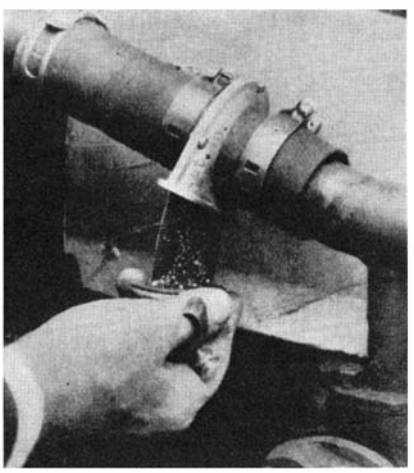
The area of screen openings is three times the size of the hose; therefore, the screen does not interfere with the flow of water. The screen is smooth and polished, and the vibration of the engine causes the rust particles to drop to the bottom of the screen. To clean the screen, loosen the thumb screw and withdraw the screen.

The screen is applied in a few minutes by cutting through the hose and clamping in place. It is supplied in different sizes according to hose diameters.

Left-Handed Children *Do Not* Read In Reverse

LEFT-HANDED children are no more likely to see "was" as "saw" than are right-handers when learning to read, a study of the reading habits of 2000 children in early grades indicates, according to the University of Michigan Bureau of Educational Reference and Research. This finding upsets a theory held by psychologists of the Adler school and others, who believe that a "southpaw" naturally tends to look at a word from the wrong end, just as he writes and draws "in reverse."

In naming familiar objects pictured in a square, 93 percent of the right-handed naturally worked from left to right, in customary fashion, but 88 percent of the left-handers did also. Similar tests showed that a left-handed individual has no more trouble



Left: **Rust screen for automobile radiator systems.** ***Above:*** **Removing a quantity of rust from one of the screens. Operation described in text**

in operating his eyes in the usual fashion than his right-handed brothers.

"In the first steps in reading, when a child is introduced to the alphabet and its arrangement into words, 'saw' might as well be 'was,' or 'are' 'era,' since the arrangement of letters is largely a matter laid down dogmatically in advance by adults, on the basis of adult experience and custom," says Professor Woody.

"A right-handed child is as likely to perceive wrongly these abstract adult symbols as is a left-handed one. The reversal of a word, or letters in a word, is a natural response in the early reading attempts of a normal child, and such behavior is not necessarily a symptom of special disability, the habit usually disappearing with increased experience in reading," he states. "In drawing or writing the left-handed individual normally handles his pen or pencil in reverse because the right hand grip and operation actually prevent his seeing a part of what he is drawing or writing."

Perfume from Waste Grape-Fruit Rinds

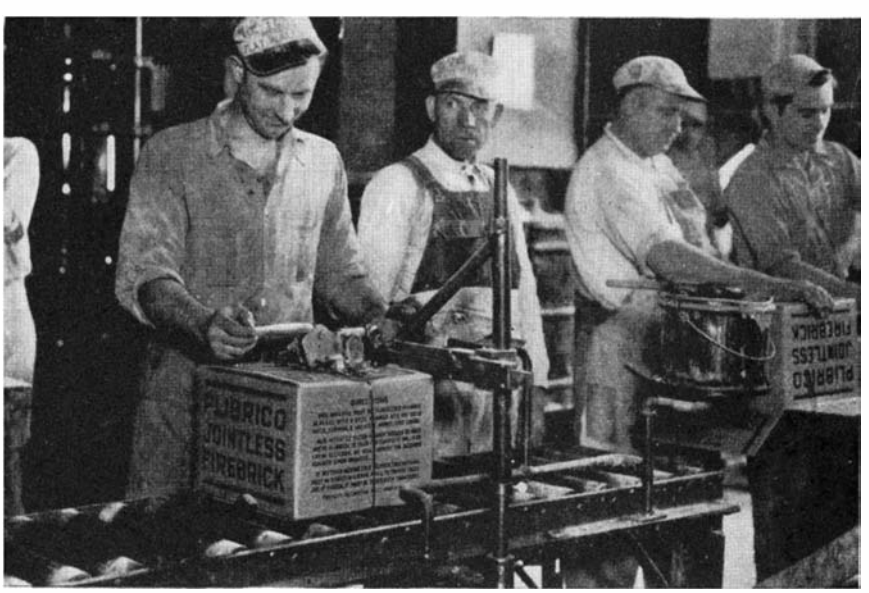
GRAPEFRUIT rinds, discarded by Florida canners, can be used as raw material for valuable essential oils used as flavors and perfumes, declare E. K. Nelson and H. H. Mottern, chemists of the United States Department of Agriculture. About 100,000 tons of grapefruit are processed annually by the canners and at least half of the rinds could be profitably collected. This amount of rinds should produce about 50,000 pounds of essential oils, Mr. Nelson informed the American Chemical Society at a recent meeting in St. Petersburg.

The Government chemists have found that the grapefruit oil contains 90 percent of limonene, or oil of lemon, 2 to 3 percent of volatile constituents and 7 to 8 percent of non-volatile, waxy constituents. Oil of lemon is used in many perfumes and the other ingredients are used for sharp odors and flavors. In the terpene-free oil of the Florida grapefruit, Mr. Nelson reported, the following constituents were identified —octyl and decyl aldehydes, geraniol and octyl alcohols (both free and combined), cadinene, and small quantities of citral and methyl anthranilate. The latter is the flavor of grapes and is manufactured synthetically to flavor some grape juices.—*A. E. B.*

Speeding Up Packaging

NEW equipment for the packaging production line is said to assist greatly in speeding up operations of binding with steel straps. A new tool mount holds the Acme strapping tool always in position, ready for use, and is instantly adjustable to packages of various heights.

A package guide and stop, which contribute to the speed and ease with which the strapping operation is performed, may be obtained to meet particular needs. It is



Equipment for speeding up packaging in use on a production line

said that this new equipment can be easily installed in existing conveyor systems or can be furnished attached to a roller conveyor. For anything from small bundles to huge crates, there is a correct type of improved strapping equipment.

White Light from Carbon Dioxide

"BY bottling carbon dioxide, the air we exhale, in a glass tube and passing an electrical charge through it, the resultant light is almost a perfect white in color," according to Dr. Harvey C. Rentschler, Director of Research of the Westinghouse Lamp Company, in a recent address to the Lighting Institute of the Electrical Association of New York. "The nearly perfect white light obtained by passing an electrical charge through carbon dioxide gas makes this source of illumination particularly desirable for color matching work, as in printing plants, textile mills, or in any industry where the container or package must be matched for constancy of color," Dr. Rentschler said.

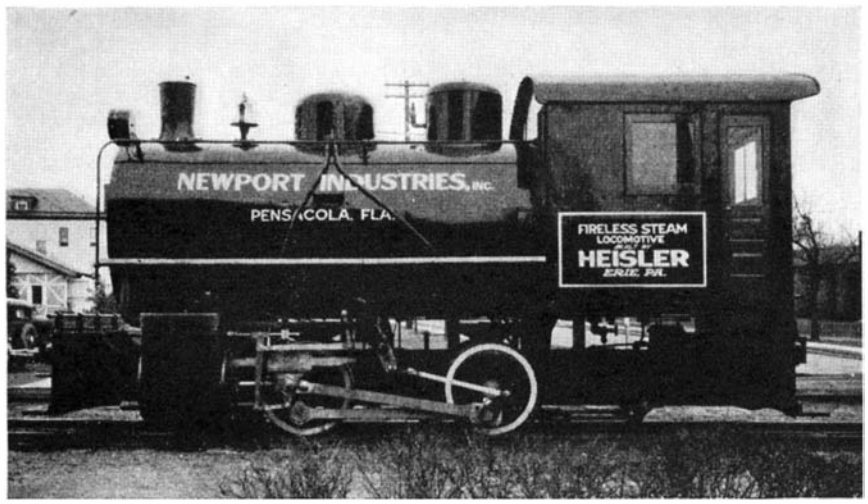
Low operating efficiency was cited as the reason why this lamp was not used more extensively. It converts electricity into light at an efficiency varying from three to five lumens per watt. The cost of operating this lamp at such a low efficiency would run too high to be practical. A standard tungsten filament incandescent lamp is about three times more efficient.—*A. E. B.*

Fireless Locomotive With Arc Welded Tank

THE first known locomotive to use a fusion welded tank is a new fireless steam locomotive built by the Heisler Locomotive Works. Without boiler or firebox, the steam locomotive hauls a train of freight cars at rapid speed. The secret of the economy and unique advantages of this different type of motive power lies in the steam charged arc welded tank, 69 inches in diameter and built for a working pressure of 215 pounds. It was built by the Struthers-Wells Company, using the shielded arc process.

This tank, which is heavily lagged and jacketed to prevent loss of heat, is filled with water to about four fifths of capacity. Then, by a steam pipe run from a stationary boiler to a point below the level of the water in the tank, the water is heated until the pressure and temperature in the locomotive tank are the same as in the stationary boiler from which the charge is being taken. It is from this heat stored in the water that the locomotive gets its power. For example, the tank on a 60-ton fireless locomotive, charged to 200 pounds pressure, stores sufficient energy to run the locomotive by itself over straight level track, a distance of about 95 miles, or to haul a train of three loaded freight cars weighing 210 tons a distance of 21 miles or more.

Advantages claimed for the fireless locomotive are low initial cost, reduced maintenance, one man operation, longer useful life, and 60 percent to 90 percent greater hauling power. Since there are no smoke or fumes, the locomotive may be operated inside buildings.



The fireless locomotive will run 95 miles on one "charge"

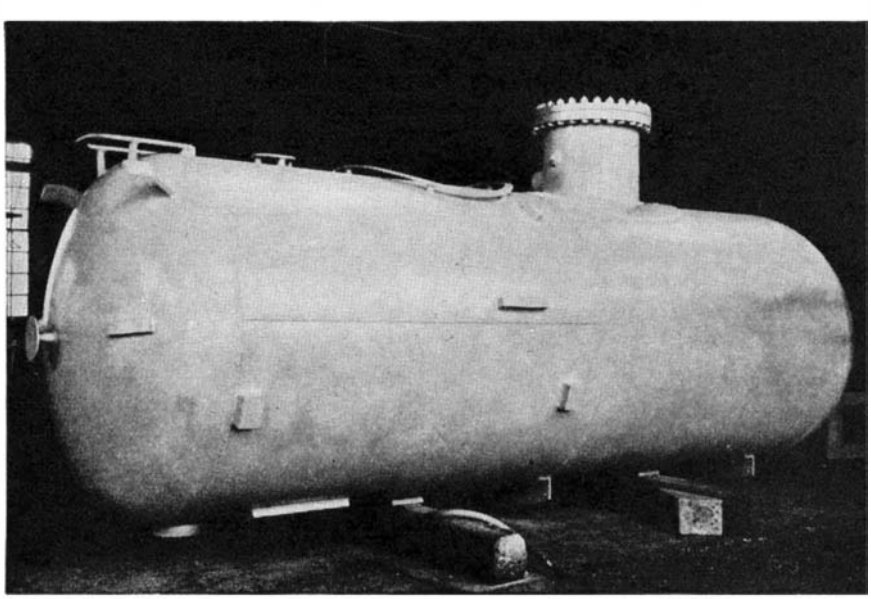
Infra-Red Rays Aid in Diagnosis of Varicose Veins

PHOTOGRAPHS taken through the skin by means of the invisible infra-red rays of the spectrum are now helping physicians to detect varicose veins and obstructed veins. They are expected to prove even more valuable in determining the success of treatment in these conditions.

Pictures taken with photographic plates not sensitive to infra-red rays show the skin approximately as the eye sees it. But when infra-red sensitive plates are used, a very distinct pattern of the veins under the skin appears in the finished picture. On this type of photograph physicians can see varicose veins or obstructed veins, when they are present, and can watch directly the effect of treatment by taking more of these infra-red photographs during the course of treatment.

The results with infra-red sensitive photographic plates are due to the fact that the skin is somewhat transparent to these rays. As they penetrate the skin and the tissues just beneath it, they become scattered and are reflected back to be picked up by the lens of the camera. Where there are blood vessels just below the skin, near the surface, the intensity of the rays reflected back is less than in the parts where there are no blood vessels. The superficial veins, therefore, show up in contrast to the rest of the flesh, looking on the finished picture as if they had been traced with a heavy pencil.

The infra-red sensitive photographic emulsions being used in medical diagnosis have previously been used to take pictures in darkness, at great distances (331 miles), for important astronomical observations, and are used in the "fog navigation camera" aboard the S.S. *Manhattan.*—*Science Service.*



The arc welded tank used in the fireless locomotive

Absorbent Cotton in Home Shop or Laboratory

ABSORBENT cotton is usually thought of by the average person as a useful accessory in medicine or surgery. However, there are many hundreds of other uses to which it can be put, and these have recently been sought out by the Consumer Research Department of Bauer & Black. A few of those which will interest home work-shop and laboratory workers are suggested below:

To absorb fluids accidently spilled, place a tuft of cotton in the puddle. Often damage to surfaces can be prevented and perhaps some of the spilled fluid recovered by squeezing over a suitable receptacle; Filtering all sorts of fluids by placing a film of

cotton over wire gauze in a funnel; Drying out molds by packing with cotton and then removing; Picking up fine fragments of broken glass which defy ordinary cleaning methods, by using moist absorbent cotton; Insulating containers for experimental work; Germinating seeds in a bed of moist cotton; Polishing, drying, and cleaning especially where delicacy is required; Retaining moisture in home-made or ready-made humidors; Retaining oil in oil cups and the like.

Salt-Ice for Extra-Cold Refrigeration

ICE that is "colder than ice" is the latest stunt for certain types of refrigeration —notably for the shipment of perishables by truck or railroad. But the new ice won't do for ice-water for it is made from very salty water, the proportion being 23 percent salt and 77 percent water. This mixture has the lowest melting point of any salt solution—that is why it is used for this extra-cold ice. Salt ice is being made in two forms: small, loose, broken ribbons and compressed blocks weighing about 30 pounds.

According to Arthur D. Little's *Industrial Bulletin*, the frozen brine melts at a temperature lower and more uniform than can be obtained with mixtures of salt and crushed ice, and its heat-absorbing capacity is considerably greater. Convenience in use is another advantage; no mixing is necessary. Small quantities are required.

Refrigerating units have been designed for salt ice, which, it is claimed, make possible the production of a temperature of 0 degrees, Fahrenheit, in ice-cream delivery trucks, even on hot summer days. Uniform temperatures up to 36 degrees Fahrenheit may be maintained by adjustment of conduction surfaces. Besides ice cream, commercial lots of frozen foods, fish, meat, and vegetables have been successfully refrigerated with frozen brine.

In the process of manufacture, a metal cylinder with calcium chloride brine at —30 degrees, Fahrenheit, on the inside rotates slowly in the sodium chloride brine to be frozen. Heat is rapidly extracted through the thin wall of the cylinder. As the ice forms in thin sheets, it is peeled off and dropped into storage bins.—*A. E. B.*

A New Balance of Gland Power

THE campaign to wipe out diphtheria has made the word antitoxin familiar to nearly everyone. Diphtheria antitoxin is the substance produced in the body to neutralize the injurious poison or toxin of the diphtheria bacillus.

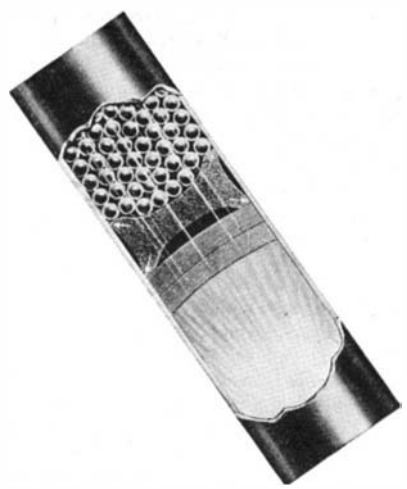
Now scientists have discovered that the body produces similar substances called antihormones. An antihormone checks or neutralizes the effect of its hormone just as antitoxin neutralizes the effect of toxin. The big difference between them is that the toxin is produced by a bacillus or germ, and the hormone is produced by a gland of internal secretion, such as the thyroid or pituitary glands.

Between the hormones and the antihormones there seems to be a newly-discovered balance of power. When this balance is upset by disease or injury of the glands, various distressing symptoms and conditions appear. It is apparently the fine adjustment of this balance that determines whether you will be a giant or a dwarf or a normal-sized individual; whether you will suffer from hyperthyroidism, familiarly known as Graves' disease, or will be fat and sluggish in both mind and body, as a result of suffering from the opposite condition of hypothyroidism.

Overproduction or underproduction of hormones by overactive or underactive glands has until now been considered the cause of these various conditions. The discovery of antihormones offers a new explanation. Not alone that, but it suggests that present methods of treating these conditions will have to be revised. Dr. J. B. Collip of McGill University suggested that the solution of this latter problem may depend on the ultimate ability of chemists to separate the hormones from the antihormones. —*Science Service.*

Expanding Shot-Gun Shell Wad

A NEW type of wad to be placed between the powder and shot in a shot-gun shell and which has several advantages over older styles has recently been developed by the Western Cartridge Company. This wad, called the Seal-Tite, is of such



The new shot-gun shell wad, behind the shot, showing how it expands

form that the pressure of the powder gases on one side and the resistance of the shot on the other expand the wad tightly against the wall of the barrel and thus definitely prevent the escape of gas into the shot column and its consequent effect on the pattern.

The material used in making this new wad is non-hygroscopic and therefore will neither take moisture from the powder nor give it moisture. It also can have no chemical effect upon the powder.

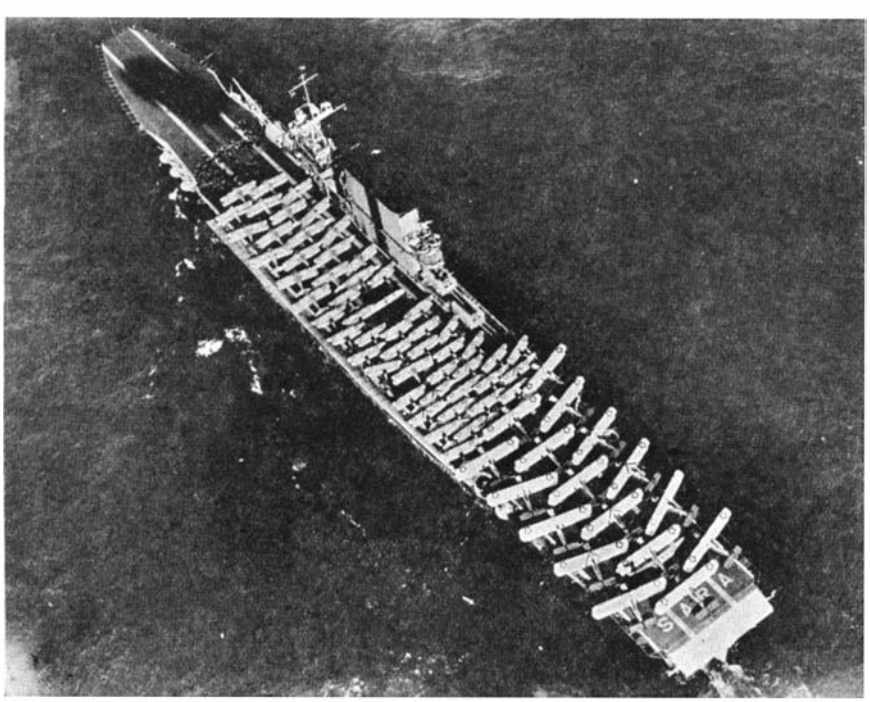
New Ink to Permit Reclamation of Paper

WHAT becomes of all the out of date telephone books? You may have noticed how insistent the telephone company's representative is about getting the old book when he calls to leave a new one. His anxiety to carry away the out-of-date directory is due primarily to the telephone company's desire to save operators the time-loss resulting from the accidental use of old directories. Staggering quantities of these books are accumulated each time a new directory is published and the question of what becomes of them leads up to a very interesting story of modern chemistry.

For many years, paper makers have tried to develop some satisfactory process for removing printers' ink from old papers. Reasonably successful processes have been developed from time to time but in general, the problem of removing the finely divided carbon black, which constitutes the basis of most printers' ink, involves such expensive washing treatments that it hardly pays to reclaim the paper fibers.

Then somebody got the bright idea that it might be possible to use another kind of ink which could be bleached by a simple

(*Please turn to page* 47)



An unusual photograph of the United States Navy airplane carrier *Saratoga* with a group of planes on the flying deck. A large part of these planes, grouped amidships and toward bow of the ship, are Boeing single-seater fighting planes

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

AMATEUR telescope makers and astronomers within a radius of one light-year of *Stellafane*, near Springfield, Vermont, are invited to attend the Ninth Annual Convention of their fellow enthusiasts, which will be held there on Saturday, July 21. Mr. A. D. Baker, secretary of the "Telescope Makers of Springfield," the hosts, states that among other attractions this year there will be a spectrohelioscope which the members of that organization are putting on all steam to finish in time. Come.

In the number for last February we opened up the subject of automatic guiding of telescopes, pointing out the great need for it among astronomers, and in the May number we hinted at it again. It now appears that several have had this idea on their mind for some time, and one of these is Wilbur Silvertooth of 273 Ximeno Avenue, Long Beach, California. He writes:

"My interest in astronomy has led me to make several telescopes, among which were a six-inch reflector, made when I was 14, and an 11-inch Cassegrainian, completed last fall. [See cut, opposite page.—*Ed.*]

"Your column in the February issue now prompts me to send a sketch of a device I experimented with some time ago. Referring to this sketch, the photographic plate was fastened to a circular aluminum plate, which was in turn suspended by three heavy springs. The 'electric eye' was the same diameter as the eyepiece, and replaced it when a suitable guide star was located. The photo-cell used contained copper nitrate, sealed in. The surface of the triangular glass prism was coated with cupric oxide. This, with the carbon, was sensitive to light. However, except on bright objects (2nd mag.) the action was poor even with '210 amplifiers. Since then I have tried selenium, which seems more sensitive.

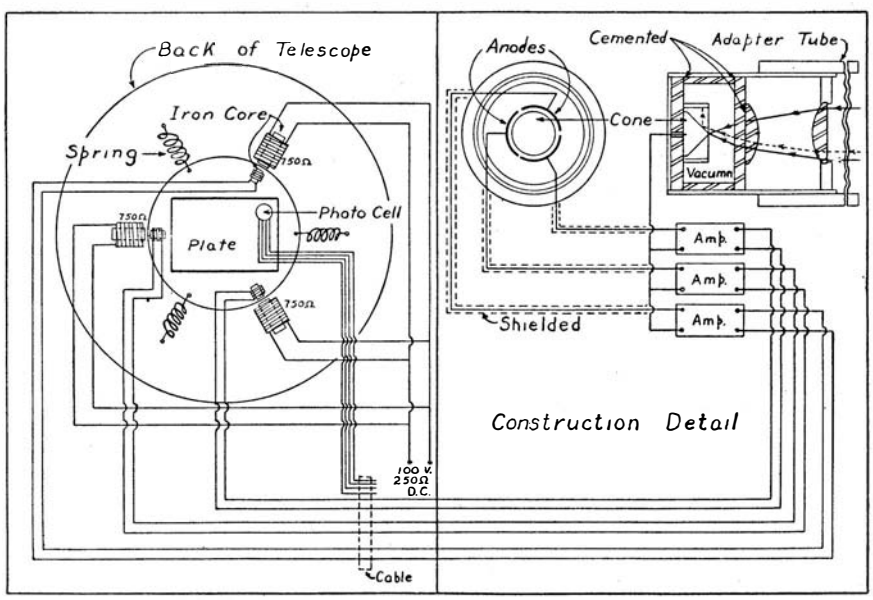
"The advantages of this device are obvious, in that it requires no partitions between the elements, no mechanical relays to make the motion jerky, and has freedom of motion on an infinite number of diameters. The correction is made almost before the shift occurs."

WE invited Mr. Silvertooth to expand the above note, and the following is what he then wrote:

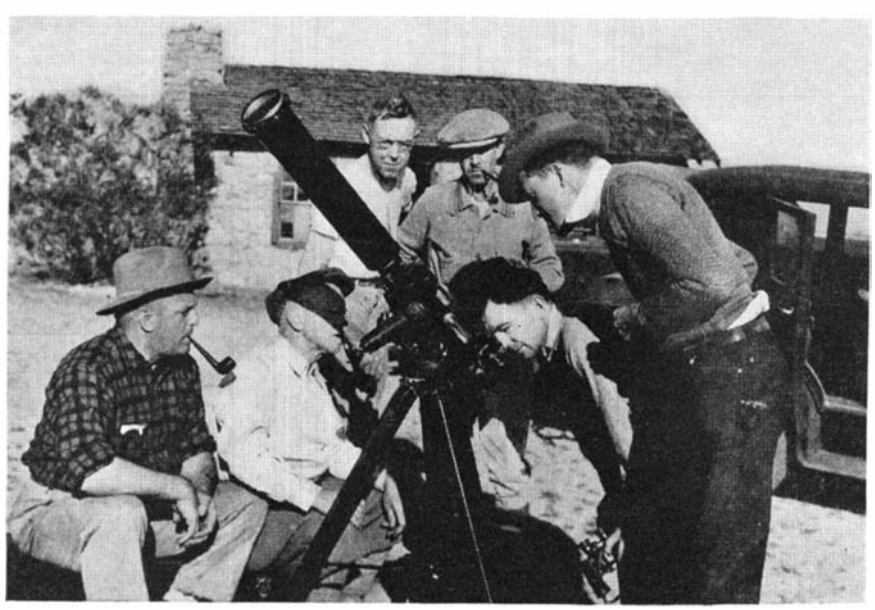
"The cupric oxide in conjunction with the copper nitrate is photo-sensitive, the carbon having no effect other than as the second terminal, or anode, to complete the circuit. Any other electrical conductor would serve equally as well. Since some photo-cells require a series resistance, the carbon acted in this capacity.

"The plate (see drawing) is fastened to a circular aluminum (or other non-magnetic material) disk, which is in turn suspended by three heavy springs, leaving it free to swing on any lateral diameter. The photo-cell is located in one corner of the plate, according to conventional practice. An ordinary eyepiece is first used to locate a suitable guide star, later being replaced by the photo-cell. All connections from the cell and magnets are contained in one flexible cable. The magnets which move the plate are similar in principle to the dynamic speaker in a radio, viz: the large outer magnets are rigidly attached to the telescope proper. They create a strong magnetic field. The smaller magnets on the movable plate vary in strength and thus cause the plate to shift. In this manner there are no moving parts other than the plate itself. This eliminates friction and reduces failure in operation to a minimum. The anode leads from the three segments must be shielded to avoid mutual conductance.

"In reference to the drawing, the solid rays represent the position of no movement. However, if the star image should shift (see dotted line), the resistance of the cell would be reduced in that direction, causing a current to pass from the central cone to one or two of the segments, depending upon the direction of the shift. It is evident that the greater the shift, the shorter the distance will be between the cathode and anode, causing a greater decrease in resistance and a consequent increase in the amount of current passing through the par-



Lay-out of Silvertooth's scheme for automatic guiding



A group of California TNs looking at Venus in the daytime with a 4-inch refractor designed by R. W. Porter. *Left to right:* Byron L. Graves of Los Angeles (see A.T.M., pages 136, 358); R. W. Porter; Oscar S. Marshall, formerly of the Telescope Makers of Springfield; James T. Barkelew (whose paper on automatic guiding will appear next month); Hart, expert mechanic at "Cal Tech" shops; Dr. John Strong, who invented and developed aluminizing by evaporation

ticular magnet, with a proportionate effect.

"The cone, or cathode, is first silver plated and a lead is then fused on. The anodes are set up around the cone, as pictured. A small capsule containing calcium and caesium oxide is placed on one side, and the device is evacuated and sealed. It is then placed in a high frequency furnace which heats the capsule and the anodes.

Silvertooth and his Cassegrainian

The caesium formed condenses on the cool cone and glass container. After that, with the aid of a small gas flame, in conjunction with the furnace, the caesium is persuaded to condense entirely upon the cone. I believe the introduction of three anodes in one cell is novel.

"The resistance type amplifier was used to minimize distortion, even though more stages were required. No attempt was made to employ alternating current, as this would be fatal to successful operation.

"A few minutes study will show that a single star is not necessary as a guide. A planet, a cluster, or any other such object would serve equally as well, as it is the *relative* intensity of light in each of the three segments that is the determining factor, and not the sudden presence or absence of light. As long as some object is present in the field the plate will immediately adjust itself so as to divide the light equally in three parts, and will then maintain this position throughout the exposure."

NEXT month we hope to publish a longer contribution on the same subject, sent in by James T. Barkelew of Los Angeles.

Several astronomers with whom we recently discussed automatic guiding shook their heads. One stated that he would like to see the idea tried out, while another seemed to think that nothing could replace the human factor in following a star image around when it was moving rapidly and irregularly. A third emphasized the extremely high criterion for his own work on parallax plates: while most of the experimenters have aimed at one 10,000th of an inch as their criterion for precision, this astronomer demanded one 50,000th of an inch.

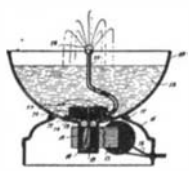
This matter of automatic guiding provides an excellent opportunity for the inventive amateur telescope maker to donate something really worth while to astronomy —since it is fairly evident now that he will not contribute real astronomical work, preferring to center his interest on the mechanical aspect of the hobby. A solution of this practical problem would constitute a major contribution to science.

RECENTLY PATENTED INVENTIONS

Conducted by A. P. PECK

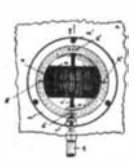
Fountain

Patent Number 1954704. Joseph H. Kraus. A fountain that may be used for either artistic or utilitarian purposes or both is the subject of this invention. As shown in the drawing, a watertight bowl is provided, the lower part of which is pressed in the form of a sump or well. Within this well and supported on a bearing, is an electric motor rotor of the conventional squirrel cage type. The shaft of this rotor is fixed to a vane which functions as the rotating member of a water pump and which forces water out of the tube shown, from which it emerges in the form of a fountain. The water then falls back into the bowl to be used over again. The field coils of the electric motor are mounted outside of the well and operate the rotor magnetically through the wall of the well. This fountain may be used for purely decorative purposes or for somewhat humidifying the air in a room.



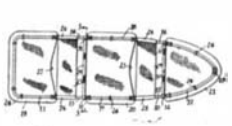
Inclinometer

Patent Number 1954998. August Hoffmann. The primary object of this invention is to provide an instrument for measuring and indicating the tilt or angle of inclination of aircraft. The instrument embodies a gyroscopic rotor mounted on a globular or ball member so that the rotor is capable of turning with the greatest ease. The rotor is surrounded by a partly transparent casing and is furnished with means for visibly indicating the position of the rotor relative to the casing. Thus when the casing is mounted in a fixed position on the aircraft, and accordingly participates in all movement thereof, the rotor maintains a horizontal position and indicates through the opening in the casing the angle of inclination of the aircraft.



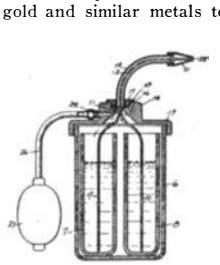
Collapsible Boat

Patent Number 1953059. Alfred Berendt. Several buoyant floats secured at intervals around a boat-shaped frame, the floats being so constructed as to make overturning of the boat practically impossible, is one of the main points of the invention illustrated in the drawing. The frame of the boat is so arranged that sections can be dismantled and stacked together in a compact package. By means of cleverly designed interlocking joints, the boat-shaped frame will hold in proper form when assembled yet can be quickly and easily taken apart.



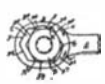
Coating With Metal

Patent Number 1953330. Felix O. Andres. It is the principal object of the present invention to dispense with the necessity of applying gold and similar metals to glass surfaces in leaf form and to provide a new process for applying such metals in a liquid form. This is accomplished by using solutions which when applied to a glass surface will produce an even unbroken film of metal of uniform color and texture. The object is attained by the use of two solutions which are simultaneously sprayed out of a nozzle under air pressure. One solution is a mixture of metallic salts with potassium or sodium carbonate. The second or reducing solution causes a reaction in the metalling solution so that when the two solutions mix, a metallized surface results. By use of certain ingredients in the reducing solution, it is possible to produce in the final results shades from deep gold to green yellow.



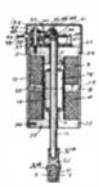
Wrench

Patent Number 1954141. Edward Z. Miquelon. In the novel wrench which is the subject of this invention, the effect of a ratchet wrench is obtained without the usual complication. By means of the specially designed opening shown in the accompanying drawing, which may be applied to either the so-called end or box wrenches, it is possible to obtain a ratchet effect. A small lug grips one corner of a nut or bolt head but the grip may be loosened merely by turning the wrench in the opposite direction.



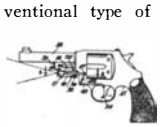
Grinding Device

Patent Number 1954575. George Pearson. Satisfactory operation of gasoline engines depends to a great extent upon the breaker points of the ignition distributor meeting with full face-to-face contact. Pitting of these points makes it necessary that the surfaces be ground frequently if best results are to be obtained. The present invention relates to a grinding device which will do this particular job quickly, easily, and efficiently. Grinding is accomplished by a vertical reciprocating action obtained by means of a solenoid actuating a shaft on the end of which is carried an abrasive element. A flexible coupling between the shaft and the abrasive element makes it possible to obtain accurately ground faces on the ignition points even though the grinding mechanism may not be held perfectly vertical to the points being ground.



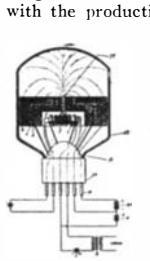
Camera Gun

Patent Number 1955300. Abraham Kurnick. The purpose of this invention is to provide a small easily operated camera in connection with a conventional type of fire arm. The object thus attained is to obtain a photographic record of the target, which record is made at the instant the gun is fired. The small camera with its operating mechanism is mounted under the barrel of the gun, as shown, and levers connect the shutter release with the trigger of the gun. Suitable means are provided for reloading the camera with film and advancing the film after each exposure. It is contended that an invention of this type will be of value particularly to police officers.



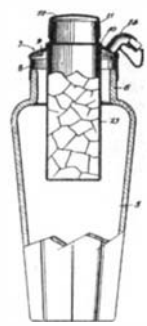
Lamp

Patent Number 1954231. Julius Weinberger. In the conventional types of glow of lamps now in general use for television and in connection with the production of sound records on motion picture film, a potential is applied between two electrodes in an atmosphere of gas and the well known discharge phenomenon takes place. The primary object of the present invention, illustrated in the drawing, is to provide a glow lamp in which it is necessary to use only a small amount of energy for efficient control. This is accomplished by utilizing two elements other than the usual electrodes, one of which is for the purpose of emitting electrons and the other for controlling the electronic flow. Thus by impressing a control potential on the grid, the flow of electrons and hence the intensity of illumination may be accurately controlled with a comparatively small amount of power.



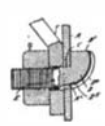
Beverage Shaker

Patent Number 1954369. Morris B. Solomon. Of particular interest in these post-prohibition days is the novel form of cocktail shaker which is the subject of this invention. The ice used as a cooling medium is placed in a separate chamber in the lid of the shaker so that the cooling medium inside never comes in direct contact with the ingredients being mixed. Thus no dilution can take place. The primary purpose of this invention is to provide a detachable cover unit for the container, the cover unit having the ice chamber depending therefrom and being provided with a spout for pouring out the mixed beverage. A cover unit of this type may be interchangeably used in connection with containers of various shapes and sizes. The ice container is so constructed that it may be removed from the cover unit, partially filled with water and placed in the freezing compartment of an automatic refrigerator so that the water becomes frozen.



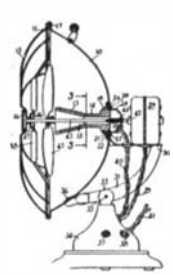
Bolt

Patent Number 1955353, William R. Wiley. One of the difficult problems of fabricating complicated machinery, automobiles, and so on is the placement of bolts so that later these bolts may be used even though it is impossible to get at the heads. The present invention relates to a type of bolt which overcomes this difficulty in a novel manner. In place of the conventional bolt head, the body is bent at an angle as shown in the drawing and the curved part is slotted with a groove. Bolts of this type are used for fastening parts to sheet metal wherein has been punched or stamped a hole of special shape. At one side of the hole is a small tongue which engages with the head of the bolt and thereby holds it in position and prevents it from turning while the nut is being tightened.



Air Circulator

Patent Number 1954872. Alfred C. Gilbert. This invention relates to improvements in air circulating devices and more particularly to a device comprising a combination of an air heater and an air disturbing medium. The heating unit as shown in the drawing herewith is of the general type found in ordinary electrical heaters. This is mounted within a reflector of the conventional type and immediately in front of it is placed the rotating member of an electric fan. In back of the reflector is an electric motor, the shaft of which projects through the heating unit to the hub of the fan. Connections through switches to the source of electric current make it possible to use either the heater or the fan alone or both of them in combination. With a device of this nature, it is possible to obtain the effect of cooling in warm weather by disturbing the air with the fan alone or to have a heating effect by the use of the heating unit either by itself or in combination with the fan which serves to circulate the warmed air to all parts of a room.



The above information has been taken from copies of patent specifications. No further details are available except as can be obtained from such specifications.

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page 42*)

chemical treatment. Before starting on the development of such an ink, however, it was necessary to investigate the possibilities for using such ink in some field of publication that uses sufficient tonnage of paper to furnish an adequate supply of printed paper and which printed paper could be readily collected and assembled at a central point. The most ideal publication for the purpose proved to be telephone directories. Arrangements were therefore made with the telephone companies to print their directories with a special ink developed by the Hilton Davis Company of Cincinnati, which contained no carbon black and which could be bleached with hypochlorite solution and "discharged" with reducing agents such as sulfur dioxide.

The process used for de-inking the pages of used telephone directories is described by Sidney D. Wells in *Chemical and Metallurgical Engineering*. The antiquated books are first fed into a machine which rips off the covers, tears apart the pages and separates the white paper from the colored. The paper is then ground up to fibers in rod mills, which it leaves in the form of a pulp suspension. This pulp is then treated with sulfur dioxide gas which discharges the ink, leaving a clean white pulp which can be fed directly to the paper machines to produce new paper of perfectly satisfactory quality.

This process is adapted primarily for the reclamation of wood-pulp papers whose permanency is not important.—*A. E. B.*

The Farmer Is Right

EVER since the beginning of time the farmer has believed in the value of sunlight. He has seen his livestock grow strong and healthy in the warm sunlight of spring and summer. He has watched the bursting of buds and the popping of seeds as the sun grew higher in the sky.

The farmer knows that during the winter months he has to be ever watchful of health regardless of the fact that his livestock is housed in warm comfortable buildings. He has observed that a sick animal turned out into the open will seek a sunny protected shelter and oftentimes get well. He has noticed that a plant grown indoors without adequate sunlight hasn't the color, growth, or strength of a plant grown outdoors.

To show the value of sunlight to animal life and growth, the Ohio Experiment Station recently carried on a series of experiments with chickens. Three brooder houses were built. These houses were so constructed that the growing chicks received sunlight in one of three ways. First, direct through open windows; second, through ordinary glass which does not allow the important ultra-violet rays to pass; and third, through a glass-like material known as Cel-O-Glass. One hundred baby chicks were put in each lot. The chicks were fed and managed alike.

Doctors Bethke and Kennard who carried on the experiment made the following

statement at the end of their work: "The chicks were all subjected to the same routine management. The chicks in all groups grew at a normal rate to the fifth week when approximately one third of those in the window glass group showed signs of failure, attendant with a slower gain in weight. By the eighth week all the chicks in the glass group, which was then discontinued, exhibited severe signs of leg weakness. The other two groups continued to make normal growth to the close of the experiment or the tenth week, with no evidence of nutritional failure. No outstanding or apparent difference was noted between the group that had access to direct sunlight and the one which received sunlight filtered through 'Cel-O-Glass.'"

This test and many others of similar nature carried on by various biological chemists at different experiment stations has shown the value of ultra-violet rays on poultry health, growth, egg production and hatchability.

These tests have resulted in a general adaption on the part of poultry raisers, in place of ordinary glass in poultry houses, Cel-O-Glass or similar materials which will let in these valuable rays of sunlight.

Where before the farmer instinctively knew that there was something about sunlight which he felt benefited his livestock, he now knows what it is and why.—*W. H. Allen.*

New Camera Resists Tropical Climate

CHOSEN for its lightness in weight, tensile strength, and durability under all climatic conditions, Textolite, manufactured by General Electric, is used for the body of the Univex camera. This miniature camera consists of but three molded parts. The lens is held in a recess inside the body by a special spring washer clamped by a nut on the end of a screw holding the shutter assembly. The molded part for the loading end snaps into place. Tolerances on the molded parts are so well controlled that no machining is required and the perfect fit allows no leakage of light.

Several hundred of these tiny picture-takers were taken by Captain R. Stuart Murray, famous explorer, on his trip into the wilds of Honduras, to be distributed among the head men and devil doctors of the various Indian tribes.

The metal parts of this camera are rust-proof, and it can easily be carried in a coat pocket. Taking roll-film pictures 1⅛ inches by 1½ inches in size, the camera sells for 39 cents.

Lobster Claw Muzzle

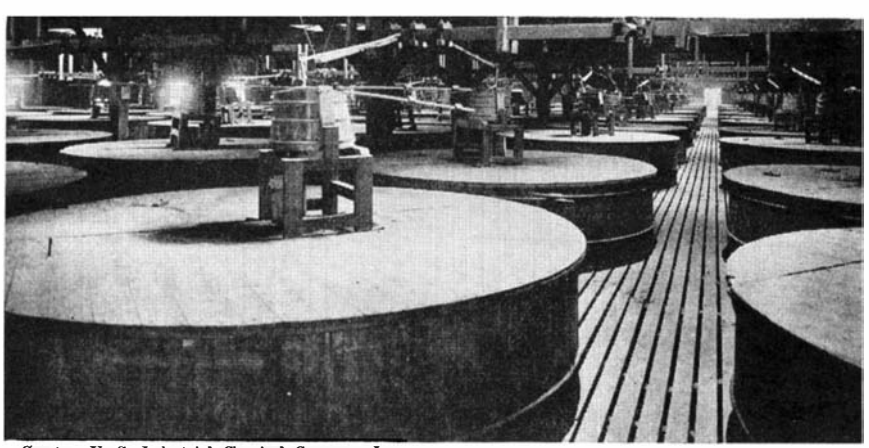
A NEW sea food application for aluminum is a lobster claw muzzle. At present live lobsters are shipped with their jaws pegged by a wood wedge which is driven into the claw. This device prevents the jaws from opening, thus making things pleasant for everybody but the lobster. But the wood wedge injures the meat and likewise causes a certain monetary loss ensuing from lobsters which expire in shipment.

A Boston man has invented a new and humane halter-type muzzle made of coiled sheet aluminum, with a tie of aluminum wire which, when slipped over the lobsters' jaws, prevents biting, damaged tissues, and untimely demise.

Forecasting By Weather Cycles

FACTS brought out in a series of comprehensive comparisons of weather records recently compiled in the Weather Bureau show that no weather cycle, aside from the annual cycle, is of any particular value in forecasting the weather in this country, J. B. Kincer, in charge of the Division of Climate and Crop Weather of the Weather Bureau, United States Department of Agriculture, said at the last meeting of the American Meteorological Society.

Many so-called weather cycles, ranging from a very short period to 260 years, and related to sun-spots, tree rings, earthquakes, wheat prices, Nile floods, lake levels, and the position of the planets, Mr. Kincer said, have been proposed as the key to Nature's secret of what the weather will be next winter, next summer, or even on any given day 10 or 20 years from now. If the weather cycle theory were correct, he continued, forecasters today would need only to turn back to the records of any particular season, month, or day.

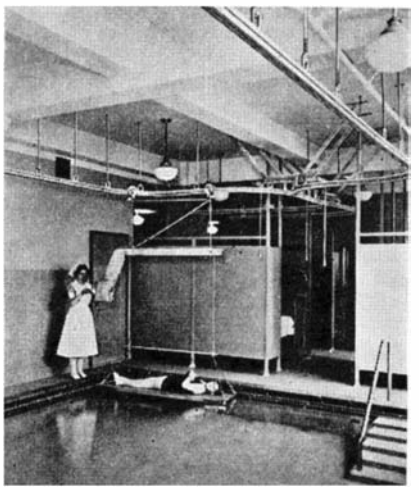


Courtesy U. S. Industrial Chemical Company, Inc.

The largest vinegar plant in the world—but not a drop of the vinegar reaches the public. All of it is used in the manufacture of industrial chemicals. In the photograph, the tubs on top of the huge vats contain alcohol which is distributed over beechwood shavings impregnated with bacterial catalysts. Air entering the bottom of the vats completes the process of converting the alcohol into dilute acetic acid (vinegar) which is practically chemically pure and ready for use

Hospital Monorail Patient Carrier

AN ingenious monorail carrier system, constructed of light aluminum alloys, is used to transport patients in the Infantile Paralysis Department at the University of California Hospital in San Francisco. It consists of a 130-foot rail runway, from which is suspended a movable platform or stretcher. This may be raised or lowered by means of mechanism operated by the nurse.



The monorail carrier in a hospital transporting a patient to the pool

Patients are carried on the platform from dressing room to pool. At the pool they are lowered into the water and in some cases are transferred to special swimming apparatus. After the bath, the patient resumes his place on the platform and is lifted out of the pool and carried back to the dressing room. The apparatus is very light in weight and a nurse propels it with ease.

Care in Cooking Prevents Loss of Vitamins

LOSS of vitamins during cooking takes place in several ways. They may be destroyed by heat and oxidation, or they may dissolve out in the cooking water which is later discarded. The exact extent of these losses depends upon the length of time of cooking, upon the presence of air, and upon the solubilities of the vitamins concerned, says the Bureau of Home Economics, United States Department of Agriculture.

Vitamins B, C, and G are readily soluble in water. Vitamin C is easily destroyed by heat and oxidation. Vitamin B is destroyed by long-continued heating but undergoes little destruction when heated at the boiling point of water for as long as one hour. Both vitamin B and vitamin C are more rapidly destroyed in an alkaline medium than in an acid medium.

Vitamin A is only slightly soluble in water and is not readily affected at the ordinary temperatures of boiling and baking. It is destroyed, however, at higher temperatures such as those that obtain in frying. It is also destroyed when heated in the presence of oxygen. Vitamins D, G, and E are fairly stable to heat and are not destroyed at ordinary cooking temperatures.

The value of any cooked food as a source of vitamins depends largely, of course, on its original value in the natural state.

Tomatoes are an excellent source of vitamin C even after they have been cooked. This is explained by the fact that during cooking the acidity of the tomato preserves to a great extent its naturally high vitamin C potency.

In general, the destruction of vitamins is less when foods are heated at high temperatures for short periods, than when they are heated at low temperatures for long periods. There is also less loss when a small quantity of water or no water at all is used. For this reason it is recommended that foods be cooked as short a time and in as little water as is practical. If any cooking water is left it should be used for gravies or soups unless it is so strongly flavored that this is out of the question. Steaming is one of the preferred methods for cooking since the time required is short and little water is used.

Graphite Lubricator

AN unusually handy device for use around the home, the car, in the shop, or in any one of a hundred other locations, uses dry graphite for lubricating almost anything that needs such treatment. Both the container and the graphite which it uses are essentially new. The graphite

The rubber-sided graphite "gun"

itself is processed to a point where it is of extreme fineness. Thus its lubricating qualities are enhanced.

The container has a wooden base and soft rubber sides. The cap holds a spout which is so arranged with a valve that the flow of graphite can be accurately controlled. Pressure on the sides of the rubber container forces a fine stream of the graphite out of the spout, which can be directed to the point where the graphite will do the most good. Both the container and the lubricant are a product of the Joseph Dixon Crucible Company.

Dry Ice Aids Fruit Industry

A SIMPLE carbon dioxide treatment of fruit shipped in refrigerator cars may become common practice in many fruit shipping districts of the country, according to the United States Department of Agriculture. This would decrease substantially the present annual losses of many millions of dollars caused by rots and other diseases developing in fruit during shipment.

Transit disease specialists of the Bureau of Plant Industry have found that in experimental shipments the greatest development of transit diseases occurs within the first 24 hours after the fruit is loaded in cars, that pre-cooling the fruit stops most of this early disease development, and have discovered that treating the fruit in the cars with carbon dioxide gas has practically

the same effect on disease organisms as pre-cooling.

The principal advantage of the gas method is not that it will replace present pre-cooling practices, but that it will give the advantages of pre-cooling to shippers to whom refrigerating equipment is not available.

The carbon dioxide treatment is simple and has several outstanding advantages. The fruit is treated by placing small quantities of solid carbon dioxide over the load or in the ice bunkers in addition to the ordinary icing. Instead of melting to a liquid as ice does, the solid carbon dioxide changes to a gas and not only cools the fruit but has also a definite physiological effect in preventing the development of transit diseases and in keeping the fruit fresh and firm.

New Paper Milk Bottle

AN entirely new kind of milk container, made of heavy paraffined paper and with a winged self-closing top, has been announced by the Reed Company, Inc. of New York.

In addition to its attractive appearance, which has been approved by both dairies and housewives, this new container offers milk consumers a bottle that is easy to open and close. To open this container, you simply raise the metal top, press back two of the wings, and compress them to form the spout. The container is closed by simply pressing back the spout and replacing the metal clip, which keeps the container tightly closed. This new kind of spout never leaks or drips, and it pours as easily as the spout of a cream pitcher.

Exhaustive tests have shown that the container has sufficient strength to withstand the roughest handling and that, even in extremes of heat and cold it remains perfectly leak-proof and sanitary. As it is made of paper, it eliminates the need of picking up empties, bringing them back, inspecting and washing them. Moreover it does away with bulk, weight, breakage, and waste, and effects a tremendous reduction in bottling costs.

A complete, compact machine, which measures only 4 by 22 feet and can be installed in any dairy, does the entire manufacturing and filling job. Blank sheets of heavy paper of the exact size required are fed into the machine, which makes, sterilizes, fills, and caps the containers in a single automatic operation.

This machine does the whole production job at a rate of speed equivalent to customary production, and at a tremendous saving in material, labor, storage, selling, and hauling. One machinist for supervision and one attendant to replenish supplies on the machine are all that are needed.

Ice Cave Air-Conditions Iowa Editor's House

A CASE of natural air conditioning, whereby a house is air conditioned by a flow of cool air from a cave underground, is related by J. W. Speer, manager of air conditioning products of the Westinghouse Electric and Manufacturing Company.

The house is the property of an editor of a Decorah, Iowa, newspaper. The novel

ventilation system cools his home in summer and helps to warm it in winter.

"When the foundation of his home was being excavated," said Mr. Speer, "workmen struck a small crevice in the rock. Cool air gushed from this crevice which is about two and half feet wide and extends into the rock 20 feet and then makes a turn. Beyond this turn the crevice has not been explored.

"A large size tin pipe was forced into the crevice in order to convey the cool air into the house. Part of the air is conducted to the kitchen where it maintains an even temperature throughout the summer and keeps food in excellent condition. The rest is piped to a room used as an office by the editor. An electric fan located in the pipe line helps draw the cool air into the house. Other fans circulate the air throughout the house."

Air from the crevice maintains an even temperature of 42 degrees the year 'round. As a result, the house is cooled during the hot summer months and is warmed when winter's icy blasts prevail.

CURRENT BULLETIN BRIEFS

SIXTH REPORT OF THE UNITED STATES GEOGRAPHIC BOARD, 1890-1932. The United States Geographic Board decisions are accepted as standard authority by Presidential order. They are rendered by authorities only after extensive study of maps, gazetteers, local histories, and atlases. This is a new Federal Government publication that tells an interesting story of geography in the United States, its outlying parts, and in other countries of the world. 834 pages. *Superintendent of Documents, Washington, D. C.—80 cents (money order).*

NATIONAL PARKS OF CANADA. Report of the Commissioner for the year ending March 31, 1933. This beautifully printed pamphlet is fully illustrated. *National Parks Branch, J. B. Harkin, Commissioner, Ottawa, Canada.—Gratis.*

PIPING A WATER SUPPLY THROUGH SALT MARSH AND RIVER. (*The Power Specialist*, Vol. II, No. 2, February, 1934.) This pamphlet describes how Scituate, Massachusetts, insured adequate fire protection by laying a pipe line of Transite pressure pipe across a river. Conveyors built up the pipe walls by depositing an asbestos fiber and Portland cement mixture on a rotating mandrel. *Write to Scientific American for Bulletin 6B.—Gratis.*

VALUES OF FOREIGN MONIES, 1934. One page. *Treasury Department, Washington, D. C.—Gratis.*

HYDRAULIC POWER TRANSMISSION. THE ADAPTABILITY OF PETROLEUM OILS. (*Lubrication*, Vol. XX, No. 4, April, 1934.) The idea of applying the principles of hydraulics to power transmission dates back to the 17th Century. It was not until the latter part of the 18th Century that the actual application of the principles evolved

by Pascal was made to industrial machinery in the form of the hydraulic press. The 19th Century saw considerable activity in the extension of this idea. This pamphlet gives adequate consideration to all of the modern devices. *Write to Scientific American for Bulletin 6A.—Gratis.*

THE TENNESSEE VALLEY AUTHORITY. 1934. 8 pages illustrated. *Tennessee Valley Authority, Knoxville, Tenn.—Gratis.*

MARKET FACTS ABOUT THE SPOKANE COUNTRY AND THE PACIFIC NORTHWEST. This is a valuable publication which gives information relative to the Spokane area and includes the Grand Coulee Dam, which is of considerable importance. *Review-Chronicle General Advertising Bureau, Spokane, Washington.—Gratis.*

EUGENIC STERILIZATION

(*Continued from page* 19)

seven children and we are getting half-orphan aid from the state for them." (In California this is 10 dollars per month per child.) "We have always figured that when we had two more children we would get enough for them so my husband could stop work and we could live on the income, so it would be too soon for me to be sterilized now."

In case of any doubt, the patient should be given the benefit of the doubt and sterilization not be applied compulsorily. There are enough eager candidates for voluntary sterilization in the United States to keep all the institutions busy for many years without taking those as to whom there is a possible question.

The operations in California have been divided about equally in numbers between men and women. The operation on the male is an extremely simple one involving a slight incision on each side of the scrotum, picking up, cutting and tying the very small tube through which the sperm pass, after which the patient can, if necessary, go about his work without any further inconvenience. The operation is bloodless, may be done under local anesthetic, takes only 15 or 20 minutes, and complications are almost unknown.

The operation on the female is a major one involving a general anesthetic and an opening of the abdomen. It is, therefore, comparable in gravity to an easy operation for chronic appendicitis. The fallopian tubes, through which the egg cells must pass on their way from the ovary to the uterus, are cut and tied and no effect is produced in any way on the patient's physical life. Menstruation, for instance, is not affected. But the patient must rest in the hospital for at least 10 days while the muscles are growing together again, hence the expense of a hospital stay is added to the expense of surgery. In voluntary cases, therefore, it is often preferable to sterilize the husband instead of the wife if the same object will thereby be attained.

One of the questions which most interested us in our investigation of the California sterilizations was whether or not the sterilization of unstable or irresponsible persons would create other serious diffi-

culties by putting a premium on promiscuity and therefore tending to promote the spread of venereal diseases and the disintegration of the monogamous ideal.

This objection seems plausible and has often been used by those who have had no first-hand observation of the facts. To the student of the mentality of these people, who are irresponsible and lacking in foresight and self-control, it is plain that in any case they could not be expected to take much thought of future pregnancies. Our survey sustains this conclusion. Of the feeble-minded girls sterilized at the Sonoma State Home and afterward paroled, 75 percent had been sex delinquents before commitment. After sterilization and parole, only 8 percent of these girls, or one in every 12, became a sex delinquent; and even these few, being under careful supervision, were for the most part at once detected and returned to the state home.

This great improvement in their conduct was, of course, not due to any change in their sexual lives brought about by sterilization, because it produces no effect of that kind. It was due to training in the institution, better mental and physical health, and parole under careful supervision in surroundings where it was as difficult as possible for them to get into trouble. On the other hand, from the California point of view, this parole was possible only because of the previous sterilization. Without sterilization these girls would simply have married, as a large part of them did anyway, and would have produced another group of defectives and dependents for the taxpayers of the state to encounter in the next generation.

MARRIAGE after sterilization, on the other hand, promotes in many instances the best stabilization of girls of this type, who can get along with a little help and supervision if they do not have the responsibility of children. Both husband and wife can work and therefore can support themselves even though both are inefficient economically. If, however, the wife had borne a steady succession of children, the earnings of the husband would have been inadequate to support the family. They would have gone on the county charities and finally, to judge by experience in other cases, the husband would have become discouraged and with the advent of a new pregnancy would have simply deserted, leaving the taxpayers to assume the entire responsibility for the wife and children.

A careful canvass of the Medical Superintendents, parole and probation officers, social workers and others who have had first-hand contact with sterilization in California, showed them to be unanimous in approval of the law and brought to light no instance of its abuse.

Sterilization is not a panacea, but in the light of California's experience, it appears to be one of the many measures that are indispensable in any far-sighted and humanitarian program for dealing with society's tremendous burden of mental disease, deficiency, and dependency.

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The above article is the second of a series of three on sterilization. The third, presenting the point of view of the opposition, will appear within two or three months.

Books SELECTED BY THE EDITORS

THE ARCHITECTURE OF THE UNIVERSE

By W. F. G. Swann, D.Sc., Dir. Bartol Research Foundation, Franklin Inst.

UNDOUBTEDLY this is an outstanding popular book, the author being an outstanding physicist known the world over. In its 424 pages it covers the newer physics: the nature of matter, atomic theories, relativity, space and time, and the cognate corners of modern science. The 50 pages of it which this reviewer read were bright, witty and fascinating, but he bogged down and gave up the ghost after fighting through that much. The reason was that the paragraphs are interminable—one page, two pages, even six and seven whole pages in length, unrelieved and solid. The effect, not noticed at first, is cumulative—like plowing hour after hour through heavy sand and every now and then coming up standing, breathless and gasping for air. What a pity to load so clever a text with so heavy and needless a disability. We heartily recommend this book to those who think the purpose of frequent paragraphing is purely ornamental.—$3.95 postpaid.—*A. G. I.*

THE WORLD COURT—1921-1934

By Professor Manley O. Hudson

A CLEAR impartial story of the court's work including a presentation of the history of the proposal for American adhesion to the court. A reference handbook for the study of documents and other basic data.—Cloth $2.65 postpaid; paper, un-indexed—85c.

ROMANTIC COPPER

By Ira B. Joralemon

A CHRONICLE of greed, ambition, and miraculous discoveries, of comic rivalries and tragic failures. A rapidly moving, robust story of copper from ancient Cyprus to the sensational development of Butte.—$3.20 postpaid.

INDUSTRIAL RADIOGRAPHY

By Ancel St. John, Ph.D. and Herbert R. Isenburger

THIS is a compact, practical working treatise on the use of X rays for the study of flaws in castings, welded vessels, forgings, small parts and other articles, and is mainly for the engineer. It is not just a collection of interesting generalities but it actually tells how to do things—how to make the installation, the exact procedure in use and, in short, the kind of every day things the actual worker must know. There are accessory chapters on the development of X rays, their nature and properties, also on cost data, radiography with gamma rays—the whole picture. It has 70 illustrations, 181 text pages, tables, and an exhaustive bibliography, and is nicely produced, with a rugged binding that will stand kicking around the shop or laboratory.—$3.70 postpaid.—*A. G. I.*

ALCOHOL, ITS EFFECTS ON MAN

By Haven Emerson, M.D.

IN this compact 114-page book a professor of public health at Columbia University tells us a few favorable things about alcohol, together with so many unfavorable ones that a man who is really honest with himself will no longer have a leg to stand on after reading it—unless he simply declares that he drinks, not for the good it will do him, but because he likes it and that's that. If you like to argue about firewater and want some really scientific, approved ammunition with which to knock down your opponent, or if you merely want to know what scientists (most of them, anyway) think about alcohol, here it is, all regimented and systematized in this pocketful. It is a sane, calm presentation, with more light than heat—no ranting.—$1.15 postpaid. —*A. G. I.*

THE STORY OF ENERGY

By Morton Mott-Smith

AN authoritative, concise, and easily understood book rounding out the popular treatment of mechanics and energetics begun in two earlier works ("This Mechanical World" and "Heat and Its Workings").—$2.15 postpaid.

HEREDITY AND ENVIRONMENT

By Gladys C. Schwesinger

THIS is a book for the student rather than the average reader and it is very scholarly. It contains a study of the genesis of psychological characteristics and bears largely upon the measurement of intelligence and personality. It takes up the problem of heredity and environment from a new point of view, examining and analyzing the data on intellectual similarities and differences of identical twins reared apart, children adopted into foster homes compared with their biological and foster relatives. The author is on the staff of the Eugenics Research Association and is a clinical psychologist.—$4.20 postpaid.—*A. G. I.*

WRITE IT RIGHT

By Ambrose Bierce

ON the proper use of words and correct diction, this volume is primarily intended for authors, editors, proof-readers, lawyers, clergymen, and educated students. Written by a master of style and with irresistible wit.—$1.10 postpaid.

YOU MUST RELAX

By Edmund Jacobson, M. D.

IF you wear yourself out more through nervous tension than actual work, as many do, the graduated exercises and self-disciplinary methods described in careful detail in this book should help you to reduce this kind of strain due to modern living. It describes relaxing, which turns out to be much—very much —more of a science than it appears to be on first thought. This little volume has been highly recommended by Walter B. Pitkin, author of the best seller "Life Begins at Forty."—$1.60 postpaid.—*A. G. I.*

SKY DETERMINES

By Ross Calvin, Ph. D.

SKIES as the source of moisture and heat have determined the mode of life of long forgotten people of New Mexico as well as that of the present ranchmen. A beautifully strange story of desert country affording a unique approach to the arid Southwest, full of delightful observations and experiences of the author.—$2.65 postpaid.

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Attempted Dress Copyrights Fail

PIRACY in any form is to be deplored. Where existing legislation is inadequate to meet the needs of modern merchandising, new laws should be enacted.

Attempts have been made recently to have the Federal Courts broaden, in effect, the scope of our existing copyright laws. This, our courts properly have refused to do. Nevertheless, certain organizations operating under titles such as "Copyright Bureaus," and similar designations, have been circularizing the dress trade and associated industries claiming to be able to secure valid and substantial protection for dress and other garment designs by means of copyright. These concerns have secured for their clients a number of copyrights for *drawings* showing the dress or other garment supposedly protected, and have represented to the trade that the garment itself was protected by such copyright. Such representations are absolutely unfounded. They are based upon a misconception of the functions and theory of copyright protection. Design patent protection is one thing. Copyright protection is quite another. It is true, of course, that the drawings submitted to the Registrar of Copyrights present copyrightable subject matter as a *drawing or work of art*, and it is likewise true that anyone who copied that drawing would be infringing the copyright secured. It does not follow, however, that the dress or other garment shown in the drawing is protected. Objects of a utilitarian nature, such as garments, dresses, textile curtains, and similar items may be protected only by design letters patent.

The rules and regulations for registration of claims to copyright, notably Rule 12, are very definite and clear. Rule 12 states:

"The protection on productions of the industrial arts utilitarian in purpose and character even if artistically made or ornamented, depends upon action under the patent law * * *. Toys, dolls, advertising novelties, instruments or tools of any kind, glassware, embroideries, garments, laces, woven fabrics or similar articles are exempted. The exclusive right to make and sell such articles should not be sought by copyright protection."

Recently a great many concerns have been threatened with suit for alleged infringement of copyrighted drawings on the theory that the reproduction of the garment shown in such drawings was an infringement. Several suits were brought in the United States District Court for the Southern District of New York. In each case a preliminary injunction was requested by the plaintiff and in each case the defendant moved to dismiss the suit. In one of these cases, Judge Goddard in dismissing the suit stated:

"To give an author or designer an exclusive right to manufacture the article described in the certificate of copyright registration when no official examination of its novelty has ever been made would unjustly create a monopoly and moreover would usurp the function of Letters Patent."

In another case, Judge Knox had this to say:

"Whatever may be the defects of the design patent statute I do not believe that the complainant, by adopting the procedure here followed, can secure all the protection that a valid design patent would secure."

Under the present copyright law no protection may be secured for objects having a utilitarian purpose or character, and manufacturers or merchants should not be misled by the representations of these self-styled "bureaus" and copyright "companies" soliciting their business.

Chemical Patents

CHEMICAL patents issued in the principal countries of the world during 1933 aggregated 28,051, a record figure, according to a summary made public by Prof. E. J. Crane of Ohio State University, editor of *Chemical Abstracts*.

"The 1933 volume of *Chemical Abstracts*", Prof. Crane said, "contains 64,190 abstracts, representing new information of chemical interest appearing in scientific journals throughout the world as well as reviews of the chemical patents granted in the various nations. This is a gain of 6109 over 1932, the biggest year heretofore.

"There is, of course, a considerable lag between the time of application and the date of issue of patents so that the patents issued in a given year reflect, in part, activity of the preceding year or two. Even allowing for this there is reason for encouragement in the trend disclosed. The obtaining of patents is a form of industrial preparedness. They are an investment in the future. They suggest a live industry, potential growth, hopefulness, faith. Chemical industry has been keeping fit and it is not by marking time that it has been doing so."

"Simoniz"—"Lusterize"

IN a recent decision First Assistant Commissioner Spencer held that The R. M. Hollingshead Company, of Camden, New Jersey, is not entitled to register, as a trade mark for polish and polishing preparations for automobiles, the term "Lusterize" since that term is merely descriptive of the goods. He further held that the opposition could not be sustained because the term "Lusterize" is not confusingly similar to the mark of The Simoniz Company, of Chicago, Illinois, "Simoniz," upon which the opposition was predicated.

With reference to the similarity of the two marks, after stating that that question would be considered in view of the possibility of further appeal, and noting the holding of the Court of Customs and Patent Appeal that "Simoniz" and "Permanize" are confusingly similar, he said:

"Judging the two marks in their entireties, as must be done, it becomes at once obvious that they are a great deal more alike than are those involved in the case at bar. Thus, the marks 'Simoniz' and 'Permanize' are, with the exception of the suffix, substantially identical; whereas, the marks 'Lusterize' and 'Simoniz' are, with the exception of the suffix, entirely different. Thus, considering the marks in their entireties, it appears that there is no confusing similarity between them. To hold otherwise would virtually concede to opposer the exclusive right to the suffix 'ize' as a trade mark on an automobile cleaner and polish."

Bibliography of Inventions

AN excellent bibliography of publications in the German language relating to inventions and inventors, much too long to reprint in the limited space available here, appears in the May 1934 issue of the *Journal of the Patent Office Society* (Washington, D. C.). Prepared by Stefan Jellinek, examiner in the Austrian Patent Office, the list includes also works of a general nature dealing with the history of industries, and further, works dealing with outstanding engineers and manufacturers. Each publication or paper listed is described briefly in English.

"Air Washed" Bird Seed

IN *ex parte* The R. T. French Company, First Assistant Commissioner Spencer held that company, of Rochester, New York, is not entitled to register, under the Act of 1905, the term "air-washed," as a trade mark for bird seed.

The ground of the decision is that the term is merely descriptive of the goods and that it does not function to indicate source of origin.

With reference to the question of descriptiveness, the First Assistant Commissioner said:

"It is apparent from the record that in the preparation of the applicant's product the seeds 'are merely put through an air blower apparatus for the purpose of removing chaff and other intermingled foreign matter.' The term 'wash' means to cleanse by any effective agency and, accordingly, to characterize a product as being 'air-washed' is to indicate that it has been cleansed by air. Obviously and admittedly applicant's product has been so cleansed.

"In its brief, the applicant contends that 'the seeds themselves are not cleansed at all, in the sense that any adherent grime or dirt is removed from them.' It is not deemed pertinent or desirable to indulge in metaphysical arguments of this nature. The purchaser never does and it is his interests that are being protected in these proceedings."

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A Research in Marriage

By G. V. Hamilton, M.D.

The present volume of 556 text pages summarizes the data from the intimate and extensive self-revelations of 200 married persons who are serious-minded and well above the average as to intelligence and cultural attainment. It presents, in the words of the author, who is a psychiatrist of standing, "some of the more important things that happened to the 200 spouses of my study during their childhood, and their present beliefs, attitudes, predicaments, and characteristic modes of performance with regard to sex and marriage." Thus we get a fair average slice of humanity with the bars down—ordinary inhibitions off—and the findings are in harmony with those of the newer science of sex.—$5.20 postpaid.

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By Edgar Mayer, M.D.

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Finger Print Instructor

By Frederick Kuhne

This is the standard work on the subject of finger-print identification. It is used in the schools of instruction of the U. S. Department of Justice, the Connecticut, New York, New Jersey and Pennsylvania State Troopers and by the Police Departments of most of the larger cities of the country. It is written so that anyone can learn by self-study and many individuals are taking up this fascinating hobby. There is a great opportunity in this line if one will but study attentively—$3.15 postpaid.

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