J. EDGAR HOOVER: Science at the Scene of Crime

SCIENTIFIC AMERICAN

July · 1936

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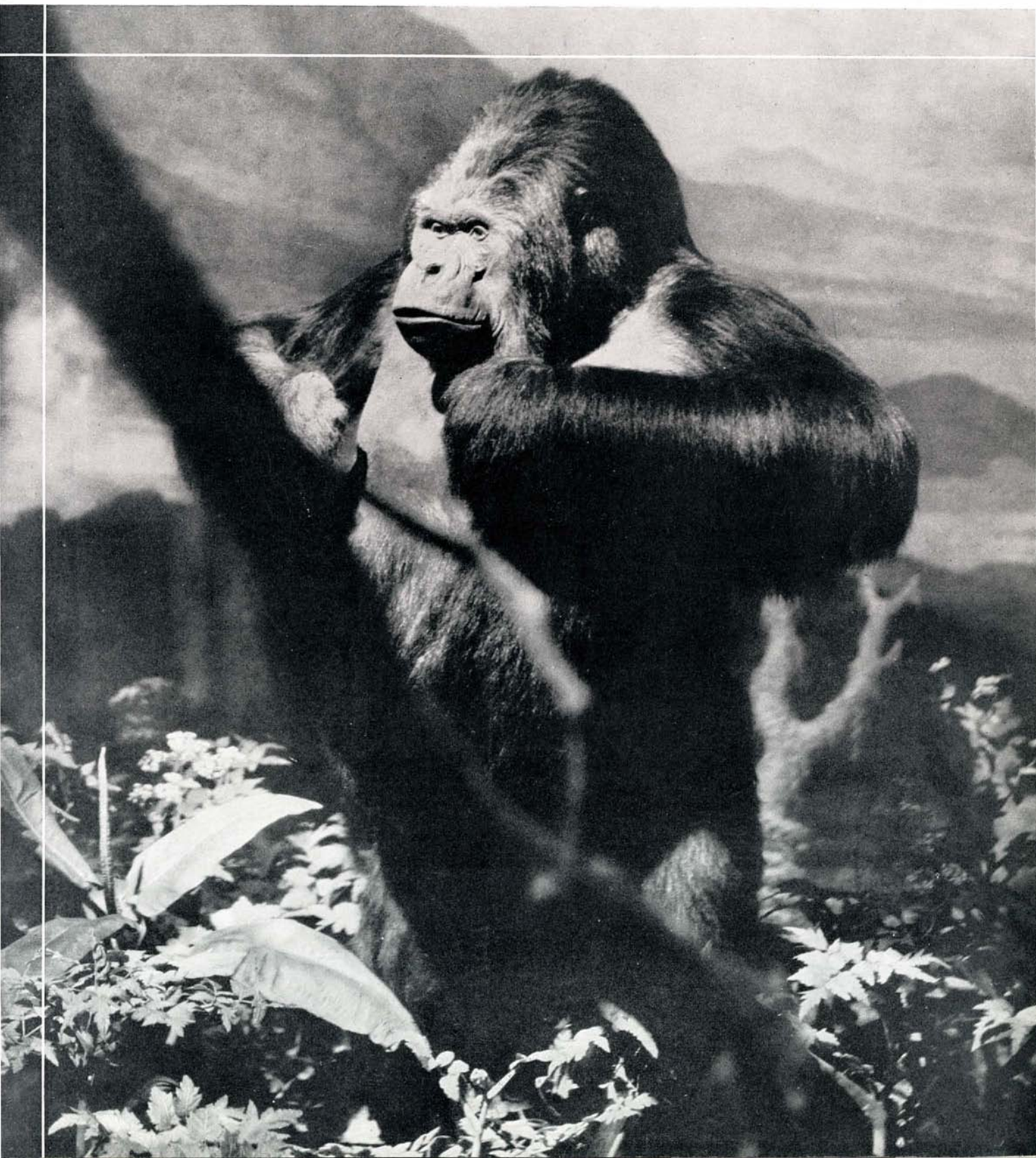

Your Hearing

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

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

Good Eyes for Life

By O. G. HENDERSON and H. G. ROWELL

THE scope of this book is what the average intelligent person would like to know about his own eyes and their care. It explains the eye machinery, and the more common eye troubles. It cites the various theories of eye changes and shows us how to avoid some of them by intelligent use of our eyes. Reading parts of this book would be a good prescription for that boy or girl of yours who insists on reading when lying down, slumped down, and so on; and incidentally some grown-ups might profit similarly. It is elementary and can be understood by anyone.—$2.15 postpaid.

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By JOHN MARTIN HISS, B. Sc., M. D.

A PRACTICAL book for the millions who suffer from their feet, by a specialist in whose files are the carefully analyzed records of 20,000 cases embracing every conceivable type of foot trouble. In an effort to relieve some of this unnecessary suffering, the author explains the mechanics of the foot, just what causes trouble, and how it can readily be overcome. The last chapter, "Aids to Home Treatment," is alone worth the price of the book. —$2.15 postpaid.

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By EDMUND JACOBSON, M. D.

IF YOU wear yourself out more through nervous tension than actual work, as many do, the graduated exercise 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.—$1.60 postpaid.

Overcoming Sleeplessness

By CHARLES WESCHEKE, Ph. G.

THIS little book is for people who can't sleep, and is full of practical advice on how to fall asleep. It is so full of good advice about going to sleep that it kept this reviewer wide awake during the hour it took to read it. It describes many practical soporific expedients.—$1.10 postpaid.

The Book of Minerals

By ALFRED C. HAWKINS

A NON-TECHNICAL, elementary handbook of mineralogy, covering minerals in general, crystal forms, the finding and identification of minerals, and the description of the different mineral species. This book would provide an excellent introduction to a science which is the basis of a growing hobby—mineral collecting.—$1.65 postpaid.

Getting Acquainted with Minerals

By GEORGE LETCHWORTH ENGLISH

THIS book is aimed specifically at the amateur collector and it tells him how to go about collecting—what to do and what not to do. With this information is combined a general elementary treatise on crystallography and mineralogy—all prepared by an author who has been an outstanding mineral collector and a scientist as well as lifelong collector. A really practical book, with 257 illustrations and 307 pages of text.—$2.65 postpaid.

What Makes People Buy

By DONALD A. LAIRD

THE professor of industrial and applied psychology at Colgate University now prepares a readable treatise for sales managers, advertising and business men. This book is a study of what the customer is like, what he wants, what are on the top layers of his mind, and what a successful salesman is like. This is a practical book for practical people and is not a thesis for closet students. It is based on the newer findings in psychology.—$2.65 postpaid.

Handbook for the Amateur Lapidary

By J. HARRY HOWARD

HERE at last is something of a real book on a subject concerning which there have been little more than pamphlets, and mighty few of these. One of these was the one dollar sketch, "The Working of Semi-Precious Stones," by the same author, who also wrote, in Scientific American, March, 1932, an article on amateur lapidary work or gem polishing. Howard's newest book now provides practical instruction in all kinds of gem cutting for the beginner and for the advanced amateur. Its accent is on the practical, for this is a real shop book that tells not merely a lot of generalities about lapidary work but actually how to do it, how to set up the rig to do it with, and even where to get the parts of that rig. Lapidary work was much of a trade secret till Howard bored in, learned the methods and, by means of his books, turned the secrets into a fascinating hobby for everybody.—$2.15 postpaid.

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NINETY-SECOND YEAR • ORSON D. MUNN, Editor

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COVER

AMONG the mammals preserved in the newly opened African Hall at the American Museum of Natural History, New York, is the mountain gorilla shown on the front cover. The late Carl Akeley deserves and has been given the major part of the credit, not alone for making possible, through his enterprise, this new monument to the passing wild life of Africa, the African Hall, but for preserving in Africa, alive and closely protected, the remaining gorillas. Disgusted with the earlier taxidermy which consisted merely of "stuffing" animals, Akeley, himself a sculptor, invented new ways of mounting them artistically. He knew his gorillas, having almost lived with them in Africa, and his observations dispelled earlier fables about them. Gorillas, if made to fight, are terrible opponents but, like nearly all animals including the more intelligent specimens of *Homo sapiens*, they avoid a fight whenever it is expedient. The big male shown on the cover weighed nearly 500 pounds.

The SCIENTIFIC AMERICAN DIGEST

Of General Interest

Chemistry in Industry

Aviation

Health Science

The Amateur Telescope Maker

Camera Angles

World-Wide Radio

Current Bulletin Briefs

Book Reviews

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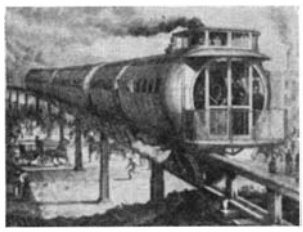
50 YEARS AGO IN . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of July, 1886)

LICK TELESCOPE—"The trustees have awarded the contract for mounting the 36-inch objective (now in the hands of the Messrs. Clark, of Cambridgeport) to the firm of Warner & Swasey. The telescope is to be 57 feet long; the diameter of the tube is 42 inches. The tube is suspended at the middle, and the point of suspension is to be 37 feet above the floor of the dome."

ELEVATED RAILWAY—"The system herewith illustrated is the invention of Mr. Joe V. Meigs, of Lowell, Mass., and has been tested under conditions far more exacting than would be found in actual practice. The trial road, beginning at the shops of the company on Bridge St., East Cambridge, has one curve of 50 feet radius, 165 feet long, on a grade of 120 feet, and on level and curves has grades of 240 feet, 300 feet, and 345 feet. So far everything has worked in the most satisfactory manner, the train rounding the exceedingly sharp curves easily, and mounting the steep grades without trouble."



IRON AND SUGAR—"M. M. Klein and A. Berg have been studying the action of sugars on the corrosion of boilers, and find that sugar in water has an acid reaction on iron, which dissolves it, with a disengagement of hydrogen. The quantity of iron dissolved increases with the proportion of sugar in the water. The salt of iron formed is the acetate. These results are worthy of note in sugar refineries and places where sugar sometimes finds its way into the boilers by means of the water supplied."

PROGRESS—"Prof. R. H. Thurston, Director of Sibley College, Cornell University, in his lecture before the graduating class of the Rose Polytechnic Institute, at Terre Haute, Ind., took for his subject the nation's great problem, the possibility of progress without revolution and without those periods of darkness and distress which have heretofore been its recording milestones. The solution of this problem he finds in education, the careful, moral cultivation of the people at large. . . . In the ideal education, the citizen is fitted for the pursuit of every desirable object in life."

WATER POWER—"Nowadays, when so many of the small cities throughout the country are supplying themselves with water works, it seems time to notice a class of small motors in which the water pressure can be utilized to develop power for driving such various kinds of machinery as are usually operated by hand."

EXPOSITION—"The people of the beautiful and enterprising city of Minneapolis, Minn., are actively engaged in arranging for their grand industrial exposition, which is to be opened on the 23rd of August next. The exposition has obtained, by donation of citizens, a site of 5½ acres of ground in the heart of the city, a central and commanding position overlooking the Mississippi River and Falls of St. Anthony."

COMPETITION—"The manufacturer who hopes to hold his own in the fierce competition which characterizes modern industry must of necessity keep a sharp lookout for valuable improvements in machinery, and must introduce them promptly when they are presented. The movement of the industries is always forward. Thousands of ingenious minds are continually studying out methods for making processes easier and more economical."

THERMO ALARM—"The thermometer figured herewith is designed for giving indications as to the temperature of silos, grain depositories, piles of coal, or certain fabrics that are apt to burst into flame spontaneously and set fire to factories or ships. The apparatus is connected with the exterior by means of conductors that traverse the surrounding substances, and that serve to indicate, at every moment, that the temperature has or has not reached a dangerous height. As soon as the needle of the thermometer strikes an index, placed at the degree of temperature that it is important to know (showing danger of fire), a bell rings."

CABLE—"At present, when telegraphic messages are sent from the United States to Brazil, they must first be cabled to Europe, and then sent from there to their destination. A new enterprise has just been organized in New York for the construction of a direct cable from this port to Venezuela and Brazil."

A T & T—"The American Telephone and Telegraph Company of New York has recently been organized for the purpose of establishing direct telephonic communication between the large cities of the country. The first line has been constructed between New York and Philadelphia . . . about 100 miles."

DYNAMITE GUN — "Lieut. Zalinski is still continuing his experiments with the pneumatic dynamite gun. The weapon is 60 feet long and has a bore of 8 inches, the projectile force being air under a pressure of 1,000 pounds to the square inch. When the gun was elevated 32 degrees, the projectile was carried about two and a half miles."

BENDING BUILDINGS — Expansion and contraction of building materials have "been noticed of late in structures of stone and iron. The Washington Monument leans to the east in the morning and to the west in the afternoon. A plummet line suspended in the interior of the dome of the Capitol at Washington was found by actual measurement to swing over a space of 4¼ inches, making a total dip from the perpendicular of 8½ inches. This movement involves the entire dome. Some years ago a learned monk in Rome suspended a plummet in this way from the top of the dome of St. Peter's and was astonished to find this mysterious movement."

Personalities in Science

JOHN G. KIRKWOOD

JOHN GAMBLE KIRKWOOD, who in his twenties has outdone the world's best minds in solving long-standing problems of molecular chemistry, has been awarded the 1000 dollar Langmuir prize of the American Chemical Society for 1936. Kirkwood, 28, an assistant professor in Cornell University, was picked as the most promising young chemist in America.

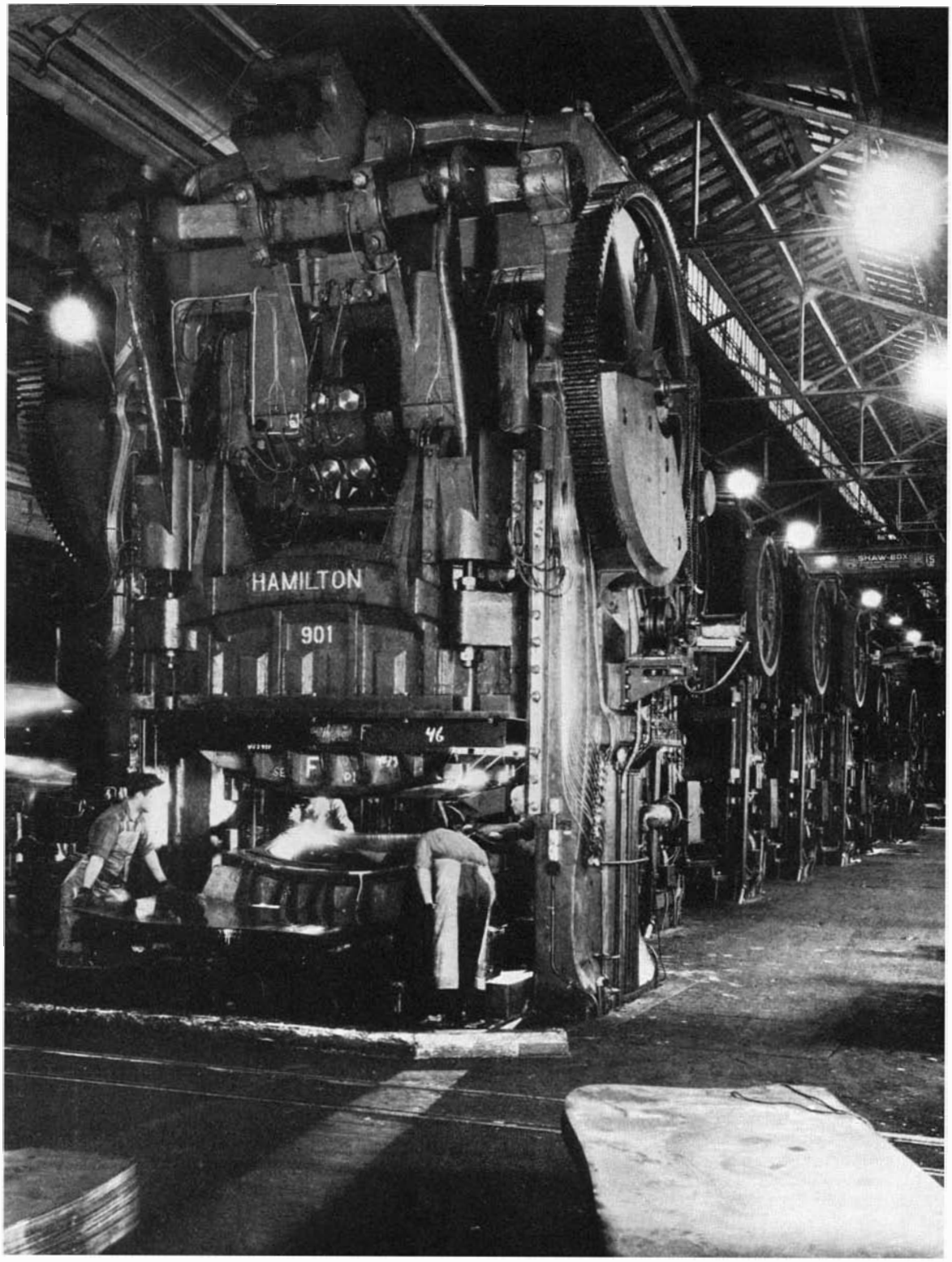
"Kirkwood's contributions are outstanding," declares the announcement of the committee of award. "He has succeeded in instances where older and more experienced men of proved ability have failed to arrive at definite results. In early papers, Kirkwood showed an intuitive grasp of applied mathematical technique and scientific insight exceptional in one of his age. Later papers are entirely independent contributions in which important advances are made in the computation of the intra-molecular field of non-polar and polar molecules."

Our representative, after calling on Prof. Kirkwood at Ithaca, writes: "In his plainly furnished quarters, surrounded by books and technical publications, with an automatic computing machine near his desk, Dr. Kirkwood looks every bit the scholar which his rare honor indicates. His sandy-colored hair, slight frame and fair complexion, give unmistakable evidence of his youth and of his Scotch-Irish ancestry. His massive forehead is accentuated by his prematurely thinning hair. Modest and unassuming, he greets callers in a friendly manner, with almost an apologetic attitude for having created so much of a stir and for being unable to point to any promise of revolutionary practical results from his work. He is purely a theoretical chemist and his office is totally devoid of any of the trappings of a chemist. In fact there is not even a chemical odor. He has no hobbies, though he plays a little tennis and smokes a pipe. He refuses to surround his work with glamor or romance, feeling that it is pretty prosaic stuff and something which can only challenge the imagination of a scientist concerned with pure theory. 'My work is highly technical and theoretical and not exciting enough to talk about' he stated.

"His program, he advised me, centers around the general problem of determining the relation between the properties of substances in bulk and the structure of their constituent molecules. The theoretical aspects of this problem fall into two classes: (*a*) The application of quantum mechanics to a study of inter-molecular forces and their potentials in relation to atomic and molecular structure. (*b*) The development of theoretical methods based upon statistical mechanics for the prediction and calculation of the thermo-dynamic properties of substances from a knowledge of the inter-molecular forces. Present work is chiefly concerned with problems of class (*b*) with reference to liquids and liquid solutions.

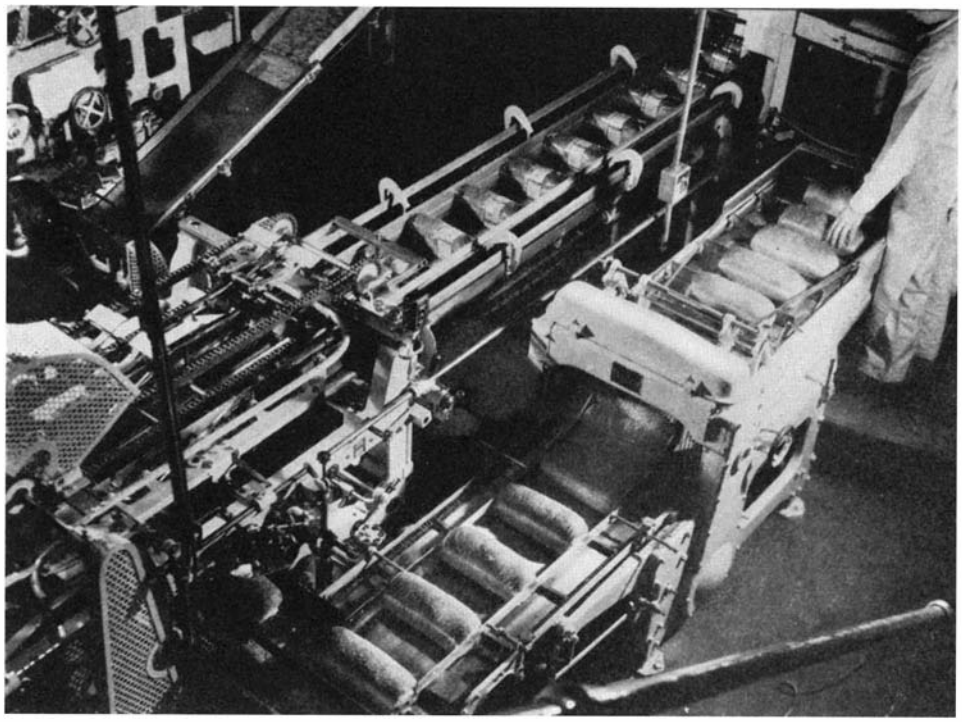
"Specific theoretical problems now under investigation or planned for the near future are the following: Extension of the Debye-Hückel theory and the calculation of ion pair distribution functions in concentrated electrolyte solutions; Further application of the theory of Zwitterion solutions to the higher members of the aliphatic amino-acid series and their peptides; Statistical critique of the Bjerrum theory of ionic association; Influence of intermolecular forces on dielectric polarization; Modification of the Lorentz theory; Influence of the dielectric constant of the solvent upon the Raman frequencies of polar solutes; Further investigation of the relation between quantum statistics and classical statistics.

"Work is already in progress on a study of the dielectric constants of solutions of the amino acids in non-aqueous and partially aqueous solvents. Other experimental investigations planned for the near future are the following: Measurement of the freezing points of binary non-electrolyte solutions and measurement of the electromotive forces of concentration cells with transference, involving mixtures of electrolytes and non-electrolytes."



IN A VALLEY OF NOISY GIANTS

THESE giants of modern times must be modernized each year—because of changes in car styles—and here the machine designer has an opportunity to draw upon his experience and exercise his genius. Basically, the design may remain the same as before, but changing automobile body styles make necessary much expensive re-tooling and altering of machines. These huge presses in a Chrysler Motors plant stamp out fenders for this year's Plymouth cars. They range from 10 to 35 feet in height, weigh as much as 400 tons, and are imbedded in massive steel and concrete foundations.



A sales "device"—sliced bread—mothered this machine. Loaves, placed by hand on the conveyor, are cut by knives—one for each slice—and are carried to the wrapping machines at the rate of 2000 sliced loaves per hour

BREEDING MACHINE BRAINS

Machine Design Evolutionary . . . Basic Design Ideas . . . New Materials, Processes Demand New Machines . . . Empirical Designer Most Successful

By PHILIP H. SMITH

MACHINES have been given the sense of sight, taste, touch, hearing, balance, and direction, and the ultimate goal is to endow them with brains.

What is the photo-electric cell applied to a machine but the endowment of sight? If a boiler raises an outcry when impurities enter the water that feeds it, that shows a sense of taste. Many machines demonstrate the capacity to feel by reacting to temperature changes, while the Gyro-pilot, which aids the operation of air transports, possesses both a sense of balance and one of direction.

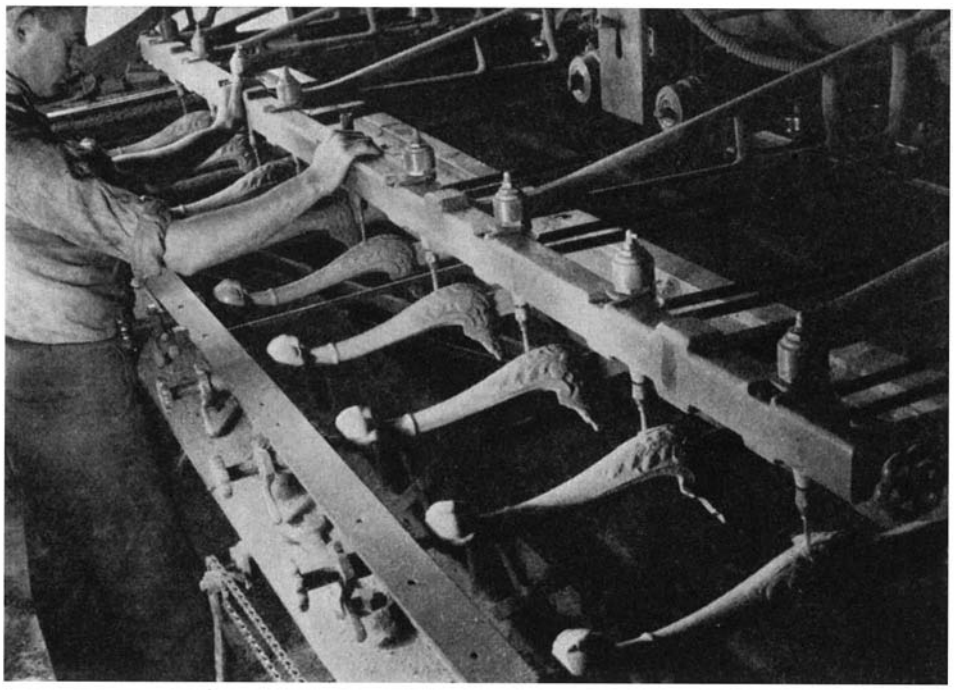
Here, in this evolutionary development which has made machines more than mere creatures of muscle, is a fact which opens the way to discover how machines come to be and what the breeding process promises for the future.

Machines are not all equally advanced, but all design follows the evolutionary process. As talents are needed, they are imparted. Today, engineers say confidently that they can "humanize" machines to solve almost any problem, and they have been so busy working at it that all industries are sudden beneficiaries. Everywhere there are new machine tools, new automatic devices with which to improve quality of products, to lower the costs of production, or to relieve workers from the fatigue of repetitive operations or undue muscular effort.

Perhaps you have sometimes wondered how these mechanical marvels came into existence. Maybe you have watched a complex mechanism swallow raw material, subject it to different treatments, and spew it forth in the form of highly finished products; and you have pondered how the human mind could have conceived such an intricate design to accomplish a predetermined end. None of this is easily disclosed, because, despite the seeming orderliness of machine development, it is a most disorderly and unplanned business; in fact, it isn't so much a business as an art.

INGENUITY is a primary requisite for machine designing success and this may be found almost anywhere. Most practical designs come from "shoemaker mechanics"—those who work without benefit of formal training but with plenty of shop experience. The college-trained man does not take kindly to machine design and isn't prominent in the field. Too often he lacks the patience to acquire the practical side which alone can lift him to the top of the heap. Competent engineers declare that training in theory, without the practical side, tends to make a designer too conversant with what can't be done, too aware of supposedly inviolable principles, whereas what he needs is an untrammeled mind which knows when to make departures.

Before the first bright idea emerges there must be a need, otherwise the idea isn't bright, and need makes every design problem unique. Probably there are as many ways of tackling the problem as there are men to do it, but a few principles of approach are being laid down to increase efficiency in reaching solutions. Practically all designers agree that a problem can be handled best by first stating it in the most accurate engineering terms possible, because the delineation may reveal clues to the solution. Beyond this point logic begins to yield to "hunches"



A master craftsman guides a carving tool over a finished leg model and a carving operation is performed on eight other legs. After this roughing out, legs are finished by hand

even with those who pride themselves on the sound progression of their reasoning.

A designer can rarely tell where he got his basic idea. To say that a machine stemmed from this or that is like trying to fix the point in the heavens from which a meteor began its flight. You see its brilliance as a fact, but its origin remains forever obscure. Coming out of nowhere as a creation, the first tangible evidence of an idea may be a few pencil marks on the back of an old envelope or a rough sketch on the tablecloth of a restaurant. But every idea has its catalyst and many of these can be enumerated.

MACHINES themselves suggest new machines. They prompt modifications, refinements, and new groupings of functions. This is evolutionary in the real sense. New materials often serve as catalyzers because they suggest new paths to explore. Advances made by one industry suggest adaptations for another. The whole mass-production idea provides an example, because the success of automatic machinery in one place prompts its trial elsewhere.

All of this imposes upon the designer the necessity for keeping abreast of developments in all fields. It demands that he use all agencies such as the technical press, actually inspect machines in alien fields, and become conversant with the properties of new materials. There is no foretelling where the catalyst may hide. A manufacturer of wood pulp products, for example, got the idea for a beater from an advertisement of a dough mixing machine. A mayonnaise mixer provided the necessary idea to a designer who was developing a new ceramic. An engineer who is about to launch a much improved gear grinder got his chief inspiration from a hobbing machine.

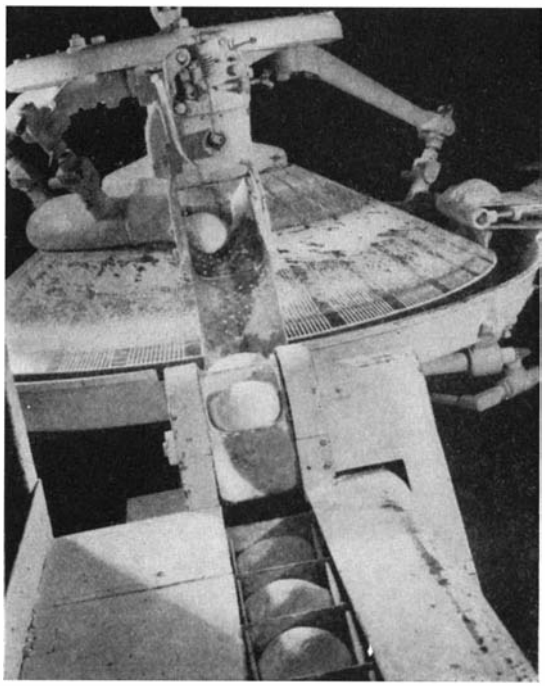
One of the most striking machines exhibited in recent months unquestionably was inspired by contact with previous machines in the same field. What makes it outstanding is its ability to perform in sequence a number of operations hitherto performed separately in the manufacture of bolts. Combining operations makes for economies in handling. The machine isn't much bigger than an office desk, yet it takes wire from a coil, cuts off a bolt length, cold heads one end, points and threads the other end and drops finished bolts into a bucket at the rate of 75 a minute.

If it is correct to say that many ideas are wholly accidental in their origin, it is only another way of saying that observation plays an important rôle in design development. A case in point is a completely automatic machine for knitting fancy hosiery. Many years ago someone noticed that a circular and full-fashioned knitting machine, when running two threads, occasionally criss-crossed by accident so that the outside thread became the inside one and vice versa. When threads of different color were used, an irregular pattern resulted. From observing this phenomenon came the "hunch" that control of the criss-crossing would permit the knitting of any desired pattern, and today this is being done.

Obstacles frequently act as a spur to the inventive mind. and, of course, a patent is the best form of obstacle. One automatic machine, still unveiled though running 24 hours a day, represents an eighth attempt at surmounting an impregnable patent wall. The first six attempts ran head-on into other patents, and, as the designer says, "Process of elimination won."

"It can't be done" is a phrase that is immensely stimulating to the really ingenious person. Overcoming the impossible produced the cigar making machine—impossible because tobacco leaves vary in size, shape, and structure. Twenty-five years labor and about 5,000,000 dollars in expense created a machine that will make 480 complete cigars per hour, in a continuous, sequential operation. First a bunch is formed, then it is wrapped in a binder, trimmed, and finally enclosed in a leaf wrapper. Present machines are basically the same as the original, but refinement of detail mechanisms make for better quality products.

Among the factors limiting the solution of a design problem, the economic factor is always decisive, and that is why the best designers are those who combine an appreciation of the economic side with their capacity to create. Quite recently a machine was developed for polishing automobile hub caps and the specifications acting as limiting factors

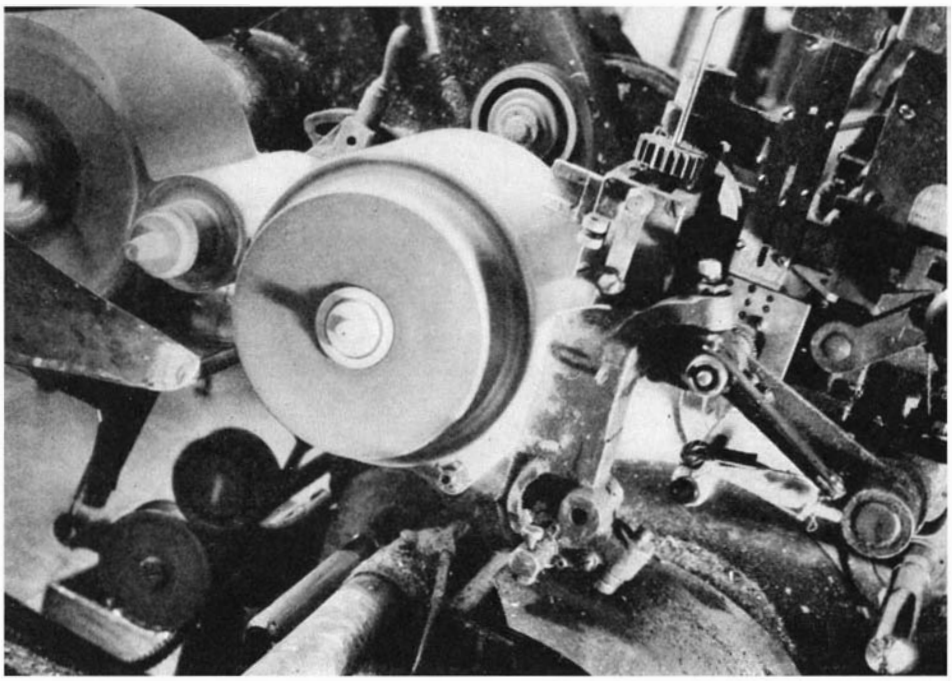


Dough is made by this rounder into balls, which are later molded by machines into loaves

were: delivery to the cap manufacturer in eight weeks; an output of 800 caps per hour; and the capacity to polish a variety of other small parts. Delineation of the problem established three aims for pursuit to meet the exigencies of time and cost. As far as possible existing units were to be used, welding was to be employed to avoid the delay involved in pattern making, and standard unit parts were to figure as prominently as possible in all sections of the machine. The machine as finally developed exceeded output and delivery specifications which goes to show how far the technique of design has been carried.

People who marvel at the proliferation of machines probably fail to realize not only the evolutionary nature of development, but the wealth of opportunities contributed by other contemporary developments. "Every time a new material is described, I can think of about 500 applications," says one engineer. Development is fan shaped, on many salients, and the give and take on many fronts fructifies the inventive mind.

Contemporaneous development creates the need for new machines and demands that existing machines be improved. Cemented carbides hadn't been long on the market before they precipitated a whole chain of events. Carbide dies for the drawing of wire have to be drilled to exact limits with diamond dust. An early ripper machine designed to perform this drilling had a spring to exert the proper pressure on the drill and a cam action to raise and shift the position of the drill while more abrasive was added by hand. Today's machine, a great grandson, in addition to being a self-contained unit, more precise in action, embraces an automatic abrasive feed by means of a controlled pump.



Tubes for tooth paste are made on this machine which trims both ends, threads the neck, and gives base coat of paint. The tube, on a spindle, spins its way to completion

A new machine in the making; and a complex, heavy lathe does the job

Cemented carbides, by virtue of their capacity to cut metal at high speed and for long stretches without losing their sharpness at red heat, forced advances in design of machines which employed them in the form of tools. Existing lathes, for example, would not permit the carbide cutting tools to be used to their maximum advantage. What then? Machine designers got busy and within a couple of years a flock of new machines appeared on the market.

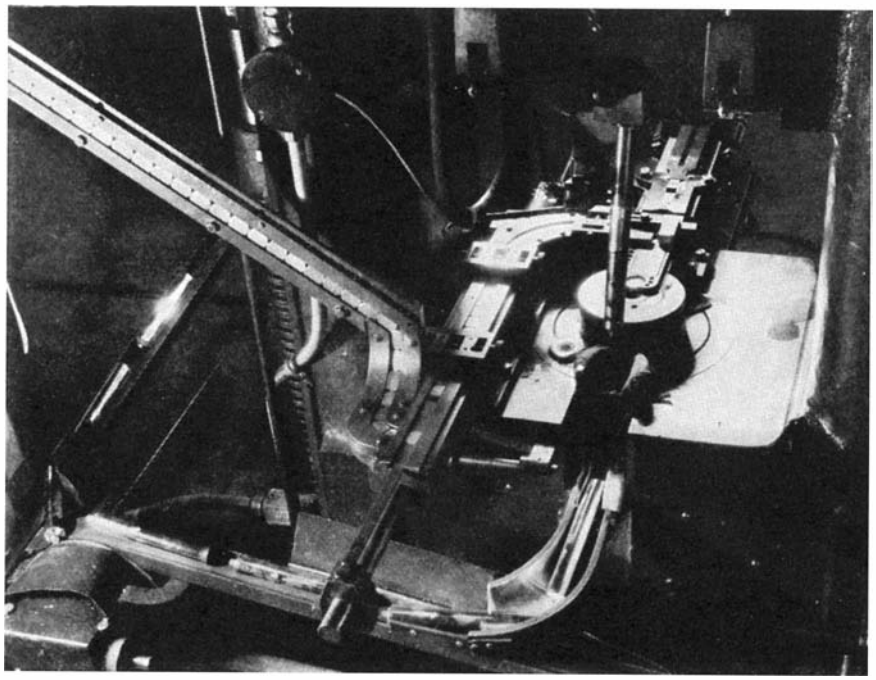
HIGH-SPEED cutting imposes greater strain upon the machine operator, so design took this into consideration. Controls were made more automatic and built right into the machines. The latest in variable drive mechanisms and gages for measuring work in progress down to thousandths of an inch humanized these mechanisms.

Notable advances have been made in matters affecting safety of the operators wherever speed and hazard are combined. The automatic shaper in the wood-working industry has forever eliminated the mutilated hand or finger as a testimonial of skill and experience in this field. The design is such that rotating knives cut in the direction of feed and cannot draw hands into the path of danger. And this pays, because production speed has been increased enormously and a more accurate cutting operation is performed.

New materials are the inspiration for many striking machines for which there was no need only a few years ago. When die casting experienced a re-birth as the result of research which made pure zinc a reality, new casting machines were needed to speed operations. When plastics began to be appreciated as a material which could advantageously supplant many others, there came a call for presses to be constructed of metals which would remain unaffected by the synthetic compounds. Adoption of a soy-bean plastic by one of the large automobile manufacturers will require 400 presses of new design. One such press molds plastic window frames and completes the operation in about five minutes. Press design is evolutionary and therefore it is not strange to find these machines being built by old line concerns.

The fickle consumer, a constant source of headache to engineers, is also a contributor to design progress. When milady calls for pastel shades in textiles, she gets them, but to the designer the demand meant a problem. His job was to make textile machinery clean in operation and he did it by incorporating oilless bearings. The American public would not purchase a new car every year if it were not for style changes and these invariably call for some alteration in machines. Body streamlining requires deep drawing of sheet metal, recently made feasible by metallurgical advances and press design.

In no industry is the need for design change and the need for design stabilization so intense as it is in the automobile industry. Mass production welcomes machines which will perform several operations simultaneously and manufacturers will pay handsomely to get them. Especially built, single-purpose machines meet this need, but with product design changing annually, there is a supplementary and insistant demand for



The machine which extrudes the metal tubes for various creams, and then ejects them by air to a conveyor belt which carries them speedily to finishing machines

flexibility without sacrifice of efficiency.

Discoveries of new physical laws and principles are a potent source of ideas for machine design and are most likely to give a big jump forward. When applied in a practical manner, they give rise to a new chain of developments. The photo-electric cell, which bestows the gift of sight to machinery, is responsible for the development of machines which wrap consumer goods with more than human precision, sort objects according to color, candle eggs, and perform other functions where the power of making a choice is desired.

THE extraordinary breeding of new machines during the past half dozen years might lead one to conclude that there are very few worlds left to conquer. But the fact is that the ultimate goal is a long way ahead. There can be a vast development, even if machines are never given brains.

Design progress is not equally advanced in all industrial fields. There are many backward industries awaiting someone to conceive the need for machines and the tremendous possibilities inherent in them. There is enough ingenuity in the country to accomplish this once the drift is felt.

The new materials being born every day afford another stimulus to machine design. Even a greatly improved material does this. Each material represents a different grouping of qualities and properties to multiply opportunity. Metallurgical progress of the past few years alone has made countless machines obsolete when judged by the new standards of performance they create. The practice of alloying which has done so much to bring forth new machine designs is still in its infancy. A prominent metallurgist has calculated that the 40 metals which can be used as alloys afford 102,050 possible combinations and if it is assumed that a variation of 10 percent in the concentration of one element constitutes a different alloy, the possible combinations rise to more than eight million.

Fabricating methods vie with materials in bringing inventive genius to the fore. The substitution of welding in the manufacture of machines formerly made of castings already has produced many design changes and improvements. Elimination of metal formerly required to impart strength, but having no other structural advantage, permits an entirely new conception of what a design may be.

Unexploited ideas should not be overlooked as a possible source of machine advancement. There are many which will remain veiled until a need arises to justify their being developed to the practical stage; there are others which cannot be utilized on economic grounds, but which may be exploited in the future. Both these potentials are exhibited by the gyroscope idea. Practical application was first made in the marine field when the Gyro-stabilizer was installed on a naval vessel. At that time there was no recognized need for a similar device to aid in aviation. The first successful application of the Gyro-pilot to aircraft came in 1915, but it wasn't until 16 years had elapsed that it flew the first transport plane. In the interim, the device was perfected, its weight was reduced more than half to make it practical; and, coincidentally, commercial aircraft were developed to a point where there was a distinct economic need for some device that would have "brains" enough to aid a pilot.

Evolution works slowly in machine design because it retards development as well as stimulates it. What has gone before provides a springboard from which to make departures, but also it determines the point of departure which may not be the best one. We get a suggestion of this in the work that is done to establish scientific bases for what has come to be accepted as fact. Machine development often seems to reach a stalemate by following traditional paths, then upsetting tradition gives it a new lease of life. Frequently needs arise faster than existing machines can meet them without drastic design changes.

IN recent years cables have been called upon to take higher voltages and heavier loads with a resultant increase in their failure. Cognizant of the new service requirements, one progressive organization has inaugurated exhaustive studies of lead sheath. Among the many discoveries already made, the fact came to light that sheath extruded at 20 feet per minute has a greater physical strength than when a rate of 60 feet per minute is employed. Such studies as these are of the tradition-smashing type which affect machine design.

Needs for machine progress and the materials for accomplishing it are assured, but the future development hinges upon the available supply of men with imagination, ingenuity, resourcefulness, and initiative. All these qualities are essential if man is to weave new strands into our industrial fabric through the agency of the machine. No one questions that such material is available, but on many sides there is grave doubt that present training will make it consistently fruitful.

"Unless the apprentice system comes back," says one engineer, "we must expect a slowing down of machine development." "Training in overalls is so vital," says another, "we have had to establish our own shop training," while another director of a machine designing organization declares: "Skill in machine designing doesn't come from books. We need college trained men who are willing to take off their collars long enough to get the practical feel."

Machines are the wonders of the age because they have traveled an evolutionary course. And the men who made them do it, themselves traveled an evolutionary path of training. Is the machine frontier to remain unexplored because the oncoming generation lacks the equipment to tackle it? If that time ever does come, then and then only will the machine become man's master.

Photographs by Ritasse, Courtesy The Sherwin-Williams Co., Sun Tube Corp., The Williams Bakery, and W. & J. Sloane.

OUR POINT OF VIEW

Two Years to Go

OUT of the mists that have so long surrounded the television situation, there recently came a faint glimmer of light. Laboratory developments have reached a stage, according to RCA engineers, where the next logical step is the inauguration of field tests, but—and this is a big "but" for the general public—television for home entertainment on a scale comparable with motion pictures and radio broadcasting is still definitely in the future. How far in the future it is difficult to say. Engineers put it at least 18 months away. Our own venture is two years or more—probably more.

At a demonstration of the best television reception which we have ever seen, indoor and outdoor scenes were televised with the iconoscope, sent by short-wave radio, and reproduced by the kinescope. The equipment used was developed by Dr. V. K. Zworykin and has been described in our issues of February 1930 and September 1933. Laboratory developments have improved this equipment to an extent where the reproduced picture in the present experimental models is approximately nine inches wide and of good detail. Viewed from a distance of five feet or so, the image is comparatively free from "graininess," and detail is as good as might be found in a newspaper halftone reproduction of similar size viewed from a similar distance.

Following this demonstration, the radio and scientific press was treated to a heart-to-heart talk with RCA engineers on the immediate future of television. With commendable caution, these engineers refused to commit themselves to any definite statement regarding the exact time when television will "enter the home," what the equipment will cost, or even what form it will take. This leaves lay observers in the perhaps unenviable position of drawing their own conclusions, based upon their analysis of objectives achieved and the possibilities of laboratory developments in the immediate future. One thing is certain: the field tests which already have started may possibly result in turning the whole problem back to the laboratory to iron out the "bugs."

Assuming, however, as we may well do under the circumstances, that the "bugs" are minor and that extensive and careful field tests show television to be ready for the public, the technicians will face a problem complicated by advances made in other fields of entertainment. The public demands and gets high quality motion pictures, either in the theater or with home movie outfits. Radio broadcast entertainment has reached a high peak of technical efficiency. Thus television, when it is ready, if it is to be received as something more than a mere novelty, must be able to compete rather closely in quality and flexibility with these two established forms of entertainment. From a commercial point of view, television will probably supplement them: the competition we refer to is for public acceptance and continuation of interest, and is not intended to indicate a commercial competition.

From the point of view of those interested in the promotion of television, the questions now arise: Will the public, blasé because of a take-it-for-granted attitude toward radio broadcasting and motion pictures, be satisfied for long with television reception of pictures small in size and comparatively lacking in detail? Will they accept the limitations of image size and program scope in television reception?

Television has come a long way since its beginnings, although on the other hand it has been a long time in reaching its present stage of development. Remarkable progress has been made in a field that presents difficulties perhaps unmatched in any other line of scientific research. But there is a long, hard road ahead before television becomes a commonplace in our everyday lives. That the many obstacles will be overcome there is no doubt; the tantalizing fact that the problems seem insoluble may be the very spur needed to urge the television engineers toward their still distant goal.

In the light of the present developments in the laboratory and of the possibilities to be expected from comprehensive field tests, we venture a prediction: Television entertainment on regular programs will not be available to the public for at least two years, at which time there will be on the market television receivers with the limitations mentioned above. Public acceptance of this radio service will be small at first, but the very fact that television may be had at a turn of the dial will be an incentive that will eventually produce television receivers in which the image will compare favorably with home movies in both size and detail. When that point has been reached, the engineers may well feel that they have accomplished a feat of great magnitude.

Conservation Progress

TROUT streams and game coverts, bass lakes and big-game ranges are the natural heritage of this continent, but a heritage that has been squandered, laid waste by greedy commercial interests with an eye to profit and with no respect for the needs or wants of the general public. It is, therefore, with no little pleasure that we read the progress report of the American Wildlife Institute, organized last year and mentioned on this page in our issues for September and November 1935.

With a program that stresses education as an effective means to the desired end, the Institute has actively taken up the cudgels of American sportsmen and has achieved in a short time a remarkable degree of success. It cannot be gainsaid that organization of interested groups, so that their combined voice will be far stronger than their individual voices, is an admirable method of swaying public opinion—and thereby, legislative opinion—in the proper direction. This is now being accomplished through the formation of the General Wildlife Federation by the Institute. The Federation looks toward the eventual bringing together of thousands of scattered sportsmen's clubs into state federations, these to form parts of the national group, all working toward a common end. With such an organization functioning properly it will be possible to exert influence both locally and nationally for the best interests of all.

The aims of the Institute are sufficiently broad in scope to embrace the problem of wildlife conservation in all its aspects. Already there has been held a conference of representatives from the United States, Canada, and Mexico. Educational propaganda in the form of posters, motion pictures, and lectures has been released with admirable results.

The conservationists face a hard battle, but, in contrast to the spasmodic efforts that have been exerted in the past, the present efforts are being directed on a scientific and business-like basis. In no small measure is Jay N. ("Ding") Darling responsible for the success to date. He has been one of the guiding spirits of the Institute and the Federation. Surely he deserves the support of every sportsman and nature lover who can see far enough into the future to realize that, unless vigorous action is taken, wildlife on the North American continent is doomed to follow in the steps of the dodo.

THE ROAD TO EMPIRE—II

Excavating the Sacred Well of Minturnae, and the Peculiar Surprise that was Found in it . . . What to do After Lightning has Struck a Public Building

By JOTHAM JOHNSON
University Museum, Philadelphia

(In our June number, Dr. Johnson described the early results of the excavations at Minturnae, Italy, which he directed for the University Museum of Philadelphia. He here tells more minutely of one of the monuments discovered by his expedition.)

DURING our first week at Minturnae we discovered the early forum of the city and the Appian Way (though it was to be weeks before we recognized them) and began isolating a building which we called Temple *A*. On its west flank we were held up by a truncated cone of concrete (Figure 1) six feet in diameter.

It looked like the base of some monstrous column. Starting from a simple moulding at ground level, a smooth stuccoed shaft rose four feet, breaking off abruptly. It stood so close to Temple *A* that a few inches of its base had been cut away to make room for the latter's ground course. Therefore—and this was important—it was older than the temple.

Figure 1: **A truncated cone of concrete which was at first a puzzle**

I was unimpressed and impatient to go on. Fortunately my inspector, Ernesto Tarabbo, enjoyed parallel powers of initiative as well as unlimited powers of veto. He found a comfortable perch up top of Temple *A* and off and on for two days I saw him sitting there in puzzled dejection. I was mystified, too, but ashamed to display it so openly. So it was Tarabbo and not I who eventually climbed down, scratched a circle in the rough top of the ruin, and called Alessandro to dig within. It had occurred to him that it might be a well.

The first objects to come out were neither significant nor exhilarating: field stones, potsherds, a broken marble decoration, loose dirt, then a dreary marble statuette without head, arms or feet.

As the hole deepened Alessandro lay on his stomach scooping out sand with a pointing trowel until we grew weary of his leisurely progress and thrust him down the shaft. It was just wide enough for his shoulders.

Photo by W. H. Witte

Figure 2: **We found an acroterion representing a winged victory**

So far, the finds had all belonged to the late Empire. But, beginning about four feet down, the shaft of the well had been tightly packed with broken terracotta roof tiles and tile covers—and other things.

It contained little dirt, and with Alessandro handing the tiles up, progress became rapid. Without warning, the Victory (Figure 2) appeared. She was perfectly clean except for a little damp sand which easily brushed off. We set her up, admired her, and photographed her. Some of the original paint—gay red and blue, white and black—stuck to her. She was an acroterion from some small temple. We judged her to belong to the 3rd Century B.C. At one jump we had spanned four or five centuries and were back in the middle period of the Roman Republic, where we had wanted to be all the time. The well's stock began to climb.

Tarabbo nudged my elbow. Alessandro had just passed up a battered stone, once part of an altar. On two surfaces, still preserved, were traces of letters; I made out GVR and around the corner FVLG. Months later I realized that these were part of the words AVGVR FVLGVRALIS, 'priest of lightning'; I have no idea what the rest of the text said.

I took Alessandro's place for a moment. Inside it was fairly roomy, but dark; the blue disk of sky gave less light than you'd think. I presently found myself standing on the upper edges of more roof tiles packed vertically. The inside surface of the well was not stuccoed.

I climbed out again. It was five o'clock. Tarabbo went down for a brief look and then we carried the marbles, the Victory, and the inscription to the storeroom and knocked off, leaving Pasquale, the night watchman, to guard the well with his life.

Next day we went on. Alessandro spent the morning passing up roof tiles, varied now and then by a pailful of wet sand and once by the crumbling bones of some sheep. Soon after lunch he reported that the shaft was blocked by a round stone. We hauled him out and I went down. True enough, a column

Figure 3: **"Dug down outside and cut a hole in the foundations"**

drum filled the shaft, except for a hand's breadth on each side. It was inches wider than the mouth; it could not have been lowered into the completed well. Therefore it must have been placed before the well was finished. I pinched myself.

I reached my arm down between the drum and the masonry. Below the drum I felt a bulging, curved surface like the echinus, or cushion, of a Doric capital, upside down. This completely filled the shaft. The well had clearly been built up after these objects had been laid in place. It could never have been intended to hold water.

We called it the Sacred Well. Other things claimed our attention, but we looked forward to finishing the job. Only heaven knew what primitive treasure might lie beneath those heavy stones.

In the spring Maestro Esposito was lent to us from the Naples Museum. He dug down outside the sacred well, cut a hole in its foundations (Figure 3), found two capitals (Tuscan instead

Figure 4: **Found two capitals, but the odd finds were still a puzzle**

of Doric) instead of one, hoisted them all out and lined them up nearby.

He also found two coins; one of Domitian, Emperor toward the end of the 1st Century A.D., the other of Maxentius who was ruling in 300 A.D. The latter was found *under* the lower capital. Inasmuch as the capitals had been buried about 40 B.C. and never again disturbed, the coins called for explanations. Probably they were loose in the top fill and slipped down ahead of us as we worked, one even reaching the mud at the very bottom.

This was one of the least of our worries. Esposito had found that the lowest 30 inches of the foundations were not conical but square, like a lidless box. He and one Giuseppe set to work on this with mallets and stone chisels, to enlarge the hole they had started higher up. We expected nothing exciting from the masonry, but the sacred well was not yet exhausted. The 'stones' imbedded in the sandy grey mortar proved to be fragments of terracotta temple decoration, of the same date as the Victory.

The operations were not completely uneventful, for the well threatened to collapse and we had to build a heavy cradle to hold it (Figure 5). Then we broke down the three sides we could reach, recovering more than a hundred terracotta fragments, still brightly colored. The mystery deepened further when we found that, instead of sporadic unrelated pieces, we could assemble them into almost complete plaques (Figure 6). There were enough types for two buildings. Assuming that the missing fragments are in the inaccessible fourth side, it is clear that the builders of the sacred well, in devotion to some precept of unrecorded ancient ritual, had gathered new, unbroken units and deliberately smashed them to include in the masonry.

I promised myself a week in a Rome library to read about wells. But before I could get away, the Gordian knot was cut by the Senator from Minturno, who appeared at the dig with a reprint from an Italian review in which dozens of obscure ancient references had been pieced together to describe a 'bidental.' Boiled down: When lightning struck a public building the citizenry, through their religious agents the haruspices, were at once concerned to purify the places struck and to offer an expiatory sacrifice to the author of the untoward omen, hoping to repair the past effects of the lightning and conjure away future effects.

THE priests gathered up the material traces of the celestial fire, the remains of the objects struck; they sought also to find the thunderbolts into which old superstitions held that spent lightning was transformed. They then dug a pit in a clean patch of turf and, singing funeral hymns, buried the lot. In this way the lightning was thought to have been buried and made harmless. Then they sacrificed a pair of two-year-old sheep (*bidentes;* thus the well was called a 'bidental'). When this tomb

Figure 5: **The weakened mystery well had to be shored up below**

Figure 6: **Plaques which began to provide hints of coming solution**

had been enclosed within a high wall, to hide it from human eyes and protect it from outrage, the ritual was complete.

Except for the thunderbolts (!) this was a fair description of the Minturnae monument: a well-like structure containing architectural units of two destroyed buildings (conspicuous 'remains of the objects struck') and the bones from a sacrifice. Then it was easy to identify the foundations of a wall built to hide the well from view. Finally we recognized the two buildings involved: the capitolium (capitals and one set of terracottas) and the stoa (column drum and other terracottas) which together had constituted the forum of Republican Minturnae. The Victory, too small for capitolium or stoa, came from some third building outside the forum, and implies widespread destruction.

We can now go back to the beginning and reconstruct a short, separate chapter of Minturnae's history.

Lightning struck the forum about the end of the Republic, and capitolium and stoa were burned to the ground. The Minturnese set earnestly about constructing the expiatory bidental we found. Beside the shell of the Capitolium they dug a square pit and lined it with low masonry walls, incorporating sample terracottas. Into this coffin they lowered the capitals and the drum. Then they built up the conical lining of the well, balanced precariously, as we found, on the middle points of the four walls. When it was finished they sacrificed two sheep, and filled the well with roof-tiles, the Victory, and a fragment of an altar set up by an augur fulguralis 150 years before. Around it they built a wall and called the job done. Later, Temple *A* took the protective place of the wall on the east. In the course of centuries two coins made their way in, but otherwise the well was not molested until the death of the city.

SCIENCE AT THE

How Special Agents of the Federal Bureau of Investigation Operate . . . Photography . . . Blood Tests . . . Preservation of Evidence . . . Moulage

OSCAR is dead. He was found murdered in his own room. Clues that might lead to the solution of the crime were not lacking but they could be found only after careful examination by trained observers. The secret of this "mystery drama" is that Oscar is a dummy used in the training school for Special Agents of the Federal Bureau of Investigation, Washington, D. C. After the scene has been set, students of the school are required to conduct examinations of the room and report their results which are graded in accordance with their skill in discovering, recording, evaluating, and preserving the evidence found. The importance of this work at the scene of a crime cannot be over-emphasized because it is here, many times, that evidence is found directing clues to the solution of a case. For this reason, the Special Agents are given thorough training in this phase of their work.

Upon arriving at the scene of the crime, it is incumbent upon the investigator to see that nothing in the vicinity is touched, if possible, until a complete examination has been made. Special Agents of the FBI are provided with equipment to be used in this examination, enabling them to obtain the evidence and to record accurately the facts to which they may be called upon later to testify in court.

It is often of the greatest value to have a photographic reproduction of the scene. Each field office of the FBI is provided with cameras of the latest type, which do not require an expert photographer to operate and which can be used with equally satisfactory results for indoor and outdoor pictures. One of the cameras used in the field offices is provided with a double extension bellows in order that it may be placed close enough to the object to take a full size picture. It can be used to photograph a handwritten signature or a fingerprint and in these types of pictures a one inch scale is included. In all work where the double extension bellows is used, focusing is done by use of the camera's ground glass back. This method of focusing is particularly helpful in taking portraits. The camera is equipped with an automatic shutter, giving accurately timed exposures of one-half and one second, which is of great value in copying and making close-up photographs. On the other hand, in outdoor scenes, where motion occurs, exposures as short as 1/250 of a second can be made.

Notes are taken, in connection with the photographs, recording the exact position and condition of objects at the time of the examination and, whenever possible, data are obtained concerning their normal appearance and condition. Exact measurements, taken by use of a tape measure or other measuring device, are used to make diagrams on cross-section paper. A compass is frequently used in connection with the preparation of drawings and diagrams to insure absolute accuracy.

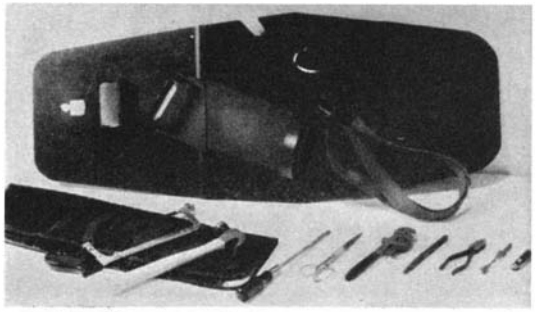


Photo courtesy Franklin Institute

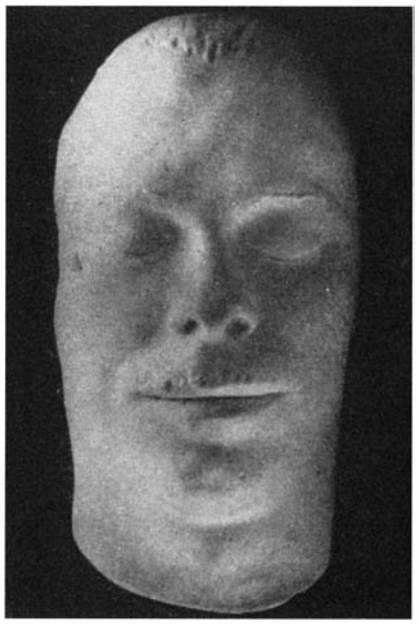
Shield (top) and kit of tools used by Special Agents in certain phases of their crime work

Oscar is dead! Students of the Training School, Federal Bureau of Investigation, collect and record all the evidence found at the scene of a hypothetical crime

After the general survey has been made, the examination of the crime scene proceeds in an orderly fashion. Extreme care must be exercised that nothing is overlooked. The magnifying glass, which is part of the Special Agents' equipment, can be used to examine articles for latent evidence. The Agents always keep in mind the fact that any article at the scene of a crime may be capable of giving evidence leading to the solution of the case. It is of the utmost importance that any article found which, in the opinion of the investigator should be forwarded to the Technical Laboratory of the FBI at Washington for analysis, should be carefully handled and packed for transmission. Documents, such as letters, telegrams, papers, and so on, are placed in Cellophane envelopes to protect the latent evidence which may be developed in the laboratory. Any dust particles or like substances requiring laboratory analysis are packed in small boxes. Chemically clean vials protect liquid

SCENE OF CRIME

By J. EDGAR HOOVER
Director, Federal Bureau of Investigation



Moulage death mask, made by the process described in the accompanying article. Note preservation of minute details in skin and hair

evidence. Labels reading "Do Not Open, Evidence For The Laboratory" seal this evidence. The Special Agent who procured the evidence then places the date and his initials on the seal. When original evidence is received in Washington, it is opened in the laboratory and the envelope or box in which it was sent is filed, after being initialed by the person who received it. Thus a chain of custody is established in the event the evidence becomes of value in the case.

It may be necessary to determine the nature of stains that appear on some substances at the scene of a crime. The benzidine test for the presence of blood is used by Special Agents in the field as an investigative procedure to select stains for further laboratory examination. In the presence of blood a blue or greenish color is produced by application of this solution, which is sensitive to one part in 300,000 and will detect very old stains as well as fresh blood.

The first step in making the benzidine test in the field is the removal of a small portion of the stain from the substance to which it adheres. This can be done by chipping off a small part of the stain with a knife. This substance is then placed on a chemically clean piece of white blotting paper. A physiological salt solution is then dropped from an eye dropper on the stain, causing it to dissolve. The benzidine reagent is then applied to the blotter and the color, if the stain is blood, changes to blue. In order to be sure that the test is being correctly performed, a control test is carried out by placing the salt solution on another piece of blotting paper and applying the benzidine reagent. The control test, of course, shows no color.

THE benzidine solution is prepared by placing a few crystals of recrystallized benzidine in the bottom of a test tube and adding grain alcohol until the benzidine just dissolves. By this means a saturated solution is prepared. Two or three drops of glacial acetic acid are then added and the solution is well shaken. After two or three drops of hydrogen peroxide are added, the entire solution is again shaken. The solution should be used immediately and must be prepared fresh for the examination. The physiological salt solution is prepared by dissolving common salt in distilled water. The strength is .85 percent, which is approximately one fourth of a teaspoonful of salt in one cup of distilled water.

The positions of stains which prove to be blood are evidence of the action which caused them. The spattering of drops indicates the direction from which they fell and the force with which they were projected onto the surface upon which they were found. Drops of blood

Moulage reproductions of guns

from a wounded person who is walking will usually be pear-shaped, the smaller end pointing toward the direction in which the person was going. Round drops are found when there is no movement of the wound. If the wound is on a person's hand, when he swings his arm backwards some of the blood will be thrown away from the direction in which he is walking, and the smaller end of the drop will be pointed away from the direction in which he was going.

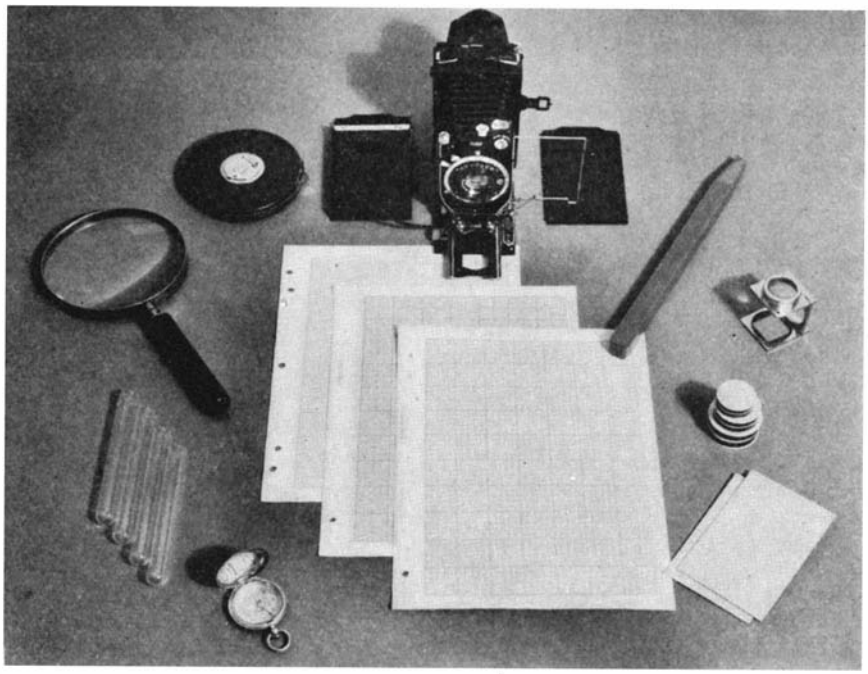
In addition to the position, the condition of the substance believed to be blood is important. The amount of coagulation or clotting helps in determining the length of time which has elapsed. Normally, human blood begins to clot in two or three minutes and completes the process in seven to nine minutes. Variations in conditions surrounding the blood cause the time of coagulation to vary in each case, but the absence of coagulation indicates the lapse of a very short interval.

The drying of blood is another factor, independent of coagulation, which is utilized to estimate the age of a stain. From one to two hours is required for a single drop of blood to become dry, while larger amounts dry much more slowly.

The color of stains is important. In a fresh stain, blood has a bright scarlet color. Upon exposure this gradually changes first to brown, then dark brown, and finally almost black. The variation of conditions affects the rapidity with which the change of color occurs; however, from the color of a blood stain, a fair conclusion may sometimes be drawn as to its age. Under certain conditions, blood may be violet, green, yellow, or other shades, and the investigator should not overlook the possibility that a stain showing such shades may be a blood stain.

VERY often, at the scene of a crime, evidence of a perishable nature may be found. By the use of moulage, the invention of Dr. Alphonse Poller, Viennese scientist, reproductions of such evidence generally can be made with absolute accuracy of detail. While photography is of the greatest value in recording and preserving perishable evidence, it fails to reproduce the third dimension of objects, and often that detail is necessary to make identification. Moulage is particularly useful in showing the shape of wounds existing on the body after death, in reproducing facial features permanently for identification, and in preserving impressions made upon perishable objects, such as tooth marks in an apple and impressions in sand, dust, or mud.

The application of the moulage process does not require any great amount of training or any particular technique. Commendable work can be turned out



Equipment used by Special Agents for recording and preserving evidence gleaned at the scene of a crime. Accurate scale drawings are frequently made

by anyone with a little practice. The actual process consists of the making of a negative mould and a positive cast. The material for the negative is a colloidal preparation while the material used in the positive cast is a resinous wax. They both require heating before being applied. After being heated, the negative material is applied to the object with a brush or spatula. The negative hardens upon drying and is easily separated from the object. The heated positive material is then poured into the negative mould and allowed to cool. When that hardening process is finished, the negative mould is peeled, cut away, or slipped off the positive form and the particular piece of work is completed, giving a reproduction of the object in its finest detail of form and texture.

MOULAGE material may be transported from the place where it was prepared to the scene of a crime in vacuum bottles or jugs, as the occasion requires. The reproduction can be made while the object remains in its original position, if desired, and without any difficulty or elaborate preparation.

Where minute detail is unnecessary in the reproduction of evidence which may perish or be destroyed, plaster of Paris casts may be made. This method is excellent for the reproduction of footprints and tire tread impressions in the earth or snow. The material is quickly and easily made by mixing finely powdered plaster of Paris in water. This mixture should be free of lumps and air bubbles; care should be taken in pouring the mixture upon the object to be copied so as not to disturb its shape. The mixture is then permitted to harden, requiring about 20 minutes, being strengthened by imbedding sticks, wire or other stiff materials, and is then removed. By spraying a thin coating of oil on the earthen mould, the sticking of earth to the plaster is prevented. Snow should be thinly coated with talcum powder before the mixture is poured.

The Federal Bureau of Investigation maintains a file of approximately 1800 specimens of tire patterns, covering tire models manufactured by both Canadian and American tire manufacturers, rebuilders, and remoulders. When a plaster of Paris or moulage cast of a tire tread found at the scene of the crime is forwarded to the Technical Laboratory, it is compared with the designs on file. By use of this file, the type of tire used by an automobile at the scene of the crime can be definitely known. Later, when an automobile is recovered which may have been used in connection with the crime, specimens of tire tracks from all parts of the tire's surface can be obtained and matched with the tracks found at the scene of the crime.

DAILY, at the Technical Laboratory of the FBI, experiments are being carried on by technicians in an effort to provide the investigator in the field with new scientific equipment and to augment the use of existing equipment. Special Agents in the field are kept advised concerning the progress of this work and each month the entire investigative personnel of each field office is required to attend a conference at which new developments and new methods of scientific approach to the problems of a case are discussed. Without a scientific approach in the field, science in the Crime Laboratory would be materially hampered. The interdependence of these two phases of criminal investigation is kept uppermost in the mind of the investigator as he conducts his examination at the scene of the crime.

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EDITOR'S NOTE: *The admirable record of the Department of Justice in cleaning up kidnapping cases under the Lindbergh Law is disclosed by a recent Associated Press dispatch. All "public enemy" kidnapping cases under the jurisdiction of the Department have been solved, resulting in the conviction of 146 persons in 63 kidnappings. Twenty-nine of these went to jail for life; sentences of all totaled 2028 years.*

A collection of equipment for field offices of the Federal Bureau of Investigation includes such items as tools, lights, binoculars, and, of course, handcuffs

High Efficiency From New Lamps

Rainbow Colors . . . Sun-Like Brilliancy . . . Still in Laboratory Stage . . . May Open Vast New Fields

A POSSIBLE revolution in lighting practice may be approaching as a result of developmental work now in progress on two new forms of mercury lamps known as fluorescent and capillary types. The first appears to have great potentialities in providing a wide range of remarkable colored lighting effects; the second—of relatively small dimensions—produces, in some cases, a brilliance exceeding that of the sun and emits a wealth of photo-chemical rays useful in commercial, industrial, and therapeutic applications. Since the lamps are still in the laboratory stage of development, it has not yet been determined whether they will eventually be used in combination with conventional incandescent lamps or as separate units.

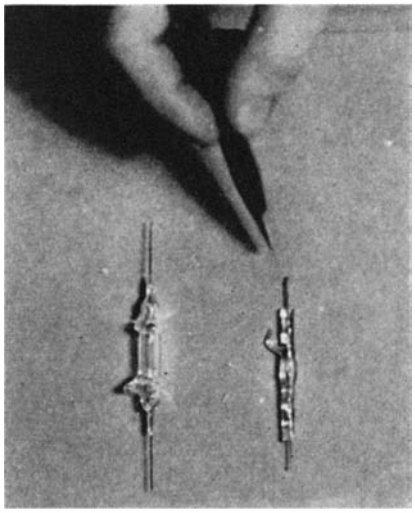
Initial development of the capillary lamp was done by the Philips Glow Lamp Works of Eindhoven, Holland, and subsequent American research at the Lamp Development Laboratory of the General Electric Company, Nela Park.

For the electric energy used, the fluorescent lamps will give from 50 to 200 times as much colored light as do ordinary colored incandescent lamps, and in addition produce a quality of color far superior. Within the bulb is a trace of mercury, a small amount of argon gas at low pressure, and a special fluorescent powder which clings to the inner surface of the glass.

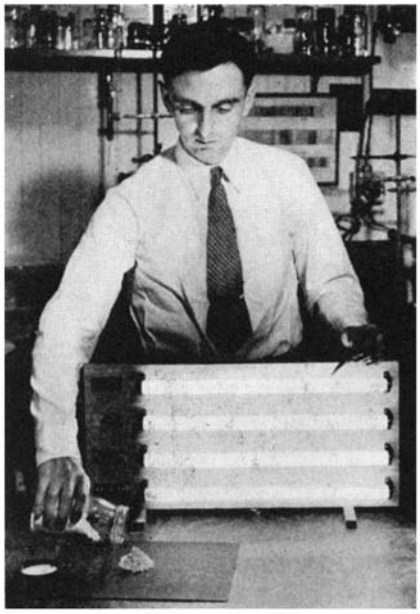
WHEN the lamp is turned on, the argon serves as a "starter," and in a few moments a feeble, blue light and a large amount of invisible ultra-violet radiation is generated. The invisible ultra-violet radiation strikes the fluorescent coating and is transformed into visible radiation of colored light, the various colors being produced by powders of different chemical composition. In this transformation of invisible ultra-violet radiation into visible radiation lies the great gain in efficiency over the present use of colored incandescent lamps.

It is expected that the new fluorescent lamps will be widely used in homes, theater lobbies, supper clubs, hotels, stores—in fact, wherever colored light can serve as decorator and scene painter.

The new capillary lamps, which are of both air- and water-cooled types, can be made to emit about three and one half times as much light, for the electric energy consumed, as the average incandescent lamp. They derive their name from the tiny tube or bore in each lamp. In the tiniest capillary lamp, the bore is so small that it will hardly accommodate a common pin. It is in this tiny "tunnel" that extremely high pressure can be developed. Like other mercury lamps, the capillary lamps require special equipment for starting and operation and need several minutes to arrive at full brilliancy.



Two of the fused quartz capillary lamps. At right is the water-cooled type; at the left, air-cooled



Four laboratory specimens of the new fluorescent mercury lamps. In the foreground is a sample of the fluorescent powder used in them

Water-cooled capillary lamps—only an inch long and one eighth of an inch in diameter—will supply as much light as the conventional 1000-watt filament lamp. It has been found that by raising the pressure within the lamps, the production of red rays is increased to such an extent that it is possible to obtain about as much red from these tiny lamps as exists in sunlight. At the highest pressures yet attained in the laboratory—equivalent to several tons per square inch—the brightness of the light produced exceeds that of the sun. Under very high pressures, however, the lamps are likely to break from excessive heat, hence the need of a jacket containing cooling water.

The light from the air-cooled capillary lamps, being rather deficient in red rays, is unsuited for uses where color discrimination is important. It is possible, however, to place the air-cooled lamps within bulbs inner-coated with fluorescent powder, and early experiments in this connection indicate a considerable improvement thereby in color quality. This may eventually result in light of a quality akin to daylight. The air-cooled lamps, in their present form, are about two inches long and three eighths of an inch in diameter—yet they produce light equivalent to that of a 200-watt incandescent lamp which is about 8 inches long and 3½ inches in diameter.

IT is expected that capillary lamps will find ready application in a host of fields. For example, the air-cooled lamps, inside of bulbs inner-coated with fluorescent powder, should be "naturals" wherever a higher quality and quantity of work-light is wanted. Within clear bulbs of special glass, these lamps deliver beneficial ultra-violet in such abundant amounts as to hold great promise in the therapeutic and photographic fields.

Water-cooled capillary lamps, because they produce photo-chemical rays, sun-like brilliance, and are relatively small in size, hold great promise for application in highly specialized fields. The future will probably see these lamps used in blueprinting; in motion picture production and projection equipments; in air beacons and searchlighting units; and possibly in street, highway, store, and factory fields.

Are We Inside a Dark Nebula?

Recent Investigations Suggest that Our Part of Space is Slightly Hazy, and Provide a Hypothesis of the Origin of the Sun's Family of Comets

By HENRY NORRIS RUSSELL, Ph. D.

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

EVERYONE familiar with astronomical photographs is acquainted with the dark nebulae—those enormous foggy or dusty regions of space which appear here and there against the starry background of the Milky Way. Some of them are readily visible to the unaided eye—notably one in Cygnus, which crosses the Galaxy transversely, and other great irregular regions in Ophiuchus and Scorpio, above Antares. The most prominent of all, close to the Southern Cross, has been known for centuries to mariners by the name of Coal-Sack.

A first glance at the photograph suggests that the denser of these clouds are entirely opaque. But careful counts of the numbers of stars in equal regions of the sky within the obscured regions and outside show that this is not the case. The stars behind show through, but with brightness diminished to a quarter or even a tenth of the original intensity.

Compared with these cosmic clouds, an ordinary terrestrial fog seems like a solid wall; it cuts off more light in a hundred yards' thickness than a dark nebula does in a light-year. Indeed, the clearest and most pellucid air is opaque compared with them. The hundred or two of miles which the rays of the setting sun traverse suffice to reduce its light to less than one percent of what we get at high noon.

The Coal-Sack, which obscures a smaller proportion of the light, and is many parsecs in thickness, must be many thousand millions of times more transparent than the purest air—or else correspondingly thinner than the air we breathe. The whole solar system might be immersed in such a cloud, without diminishing the light of the remotest planet by an amount which our most delicate photometric apparatus could measure.

A region, about eight degrees square, around Rho Ophiuchi (at center). "It is clear," Barnard says, "from an inspection of the picture, that the actual background of the sky here consists of a uniform distribution of stars." On this background are seen one large and several small lanes of dark nebulosity extending to the left. These dark irregular cloud regions are mentioned by Professor Russell in his opening paragraph and their distance is approximately 400 light-years

THE light of the stars, which shows through the cloud from outside, would be perceptibly weakened; but if we were near the middle of a uniform ball of thin haze, the stars all over the sky would be affected to about the same degree, and it would be hard to find this out. If, however, we were near the edge of the cloud, so that it looked much thicker on our side of the heavens than the other, we should see more stars on the clear side than in the opposite direction. But then we would have to make sure that there were not really more stars there—which would not be easy.

Go still further: Suppose that the fog, though very thin, extended so far that all the nearer stars were included within it: Could we detect it then, even if it was lop-sided? An interesting paper by De Corlin of Lund in Sweden attempts an answer.

The parallaxes and distances of thousands of stars have been observed, by the direct trigonometric method, using essentially the surveyor's geometrical principles, and also spectroscopically—finding from the intensities of certain lines in the spectrum how bright a star really is, observing how bright it looks, and then calculating the distance. Thin fog in interstellar space will not affect the first method at all—so long as we can see the star. But it will vitiate the results of the second, for the calculations are made on the assumption that space is clear, and the faintness of a star due only to its distance. Obscuration of light will make the stars look fainter, and our calculations will put them too

far off. If the fog is thicker on one side of the heavens than the other, the distances of the stars on that side, determined from their spectra, will therefore be too great. On the clear side they will be too small—since the spectroscopic calculations are adjusted so as to make the average for the whole sky come out the same as by the more direct method.

In the great catalogue of parallaxes, recently published by the Yale Observatory under Dr. Schlesinger's direction, there are some 1100 stars whose distances have been determined by both methods. De Corlin, studying these results, and grouping the stars in different regions of the heavens, finds that, on the average, the spectroscopic method puts the stars in the southern heavens (Scorpio, Centaurus, the Southern Cross) rather farther away than do the direct measures of the same objects, while in the opposite region (from Cygnus to Andromeda) the reverse is the case.

This suggests that our part of space is indeed slightly hazy, thickening toward the first-mentioned direction, and thinning toward the other. The haze appears to thicken on the side toward the center of the Galaxy.

THIS result, if confirmed by other methods of study, as its author recommends that it should be, will be of great general interest. It may be noted, however, that the degree of fogginess which De Corlin derives is very small indeed—far less than in such dense obscuring clouds as the Coal-Sack—and that it changes very gradually. The maximum difference in absorption of light which he finds, between stars 50 parsecs (160 light-years) away, in opposite directions, amounts only to a fraction of a stellar magnitude, while on the edges of the best-known dark nebulae, a similar change happens in something like a thousandth part of the distance. Small as this change is, it cannot keep on much farther than is indicated by his investigations (which were deliberately limited to the near stars, and for sound reasons), for in the region where he finds the haziness to be increasing, we observe the magnificent star-clouds of the southern heavens, while the opposite side of the Milky Way is much less brilliant. But there is nothing impossible, or even improbable, about this.

If we are really in a nebulous region of space, some astronomical problems apparently quite unconnected with the original problem may be solved—in particular, the old and difficult one: Where did the comets originate?

Both comets and planets belong to our system—they share the sun's motion among the stars: But in all other respects they are so different as to justify fully the late Professor Chamberlin's description of them as "the two solar families." Comets are swarms of particles of very low average density: They do not move in almost circular orbits, like the planets, nor approximately in one plane; instead, they move in highly elongated orbits, which extend to great distances from the sun, in all directions indiscriminately. Moreover, planets are obviously long-lived and permanent members of our system, and comets as clearly are not—they are subject to many changes. A comet which passes near a planet may be speeded up by its attraction and sent off into space in a hyperbolic orbit, never to return.

If it avoids this fate, but moves in a long ellipse with a period of tens or hundreds of thousands of years, the attraction of the nearer stars, though far too small to prevent its return, may shift its orbit so that, when it does come back, it will be too far from the sun to shine brightly enough for us to see. If, on the contrary, it comes near enough to the sun to be stirred up to grow a fine long tail and appear as a brilliant object, it will lose, in this very process, a part of its own substance, which flies down the tail, driven by radiation pressure, and is lost in the depths of space.

Between the chances of being driven out of our system, and the slower, but sure, probability of ultimately wearing out, it is hard to see how any comet can have kept circulating about the sun, and shining for anything like the past duration of our system. The suggestion has often been made that the comets are late-comers compared with the planets and, in particular, that at some time in the not very remote past (cosmogonically or geologically speaking) the sun passed through a nebula, and carried off bits of it, which were left moving about it in elongated orbits.

There are difficulties here too, but if we assume that the nebula in question was very rich in isolated swarms of particles, such as comets appear to be, the hypothesis may be tenable. The vast majority of these swarms would pass round the sun in hyperbolic orbits and be lost; but some might be diverted by the action of the planets into ellipses and return again and again. Those which came back most rarely would last longest, which may help to explain the existing preference for long periods. It is still hard to explain why the distant ends of the orbits show no notable preference for any direction in space; and we do not know whether or not the dark nebulae contain such swarms as has here been supposed. But there is at least room for speculation of a legitimate sort.—*Princeton, May 5, 1936.*

Another plate by Barnard, showing a dark nebulosity, two degrees by three, in the region of Theta Ophiuchi. "Whatever the material in the dark space may be," says Barnard, "it is evident that we are not looking out into space through an opening in the Milky Way." Both cuts are from the Barnard photographic atlas

HIGH-SPEED CALIFORNIA

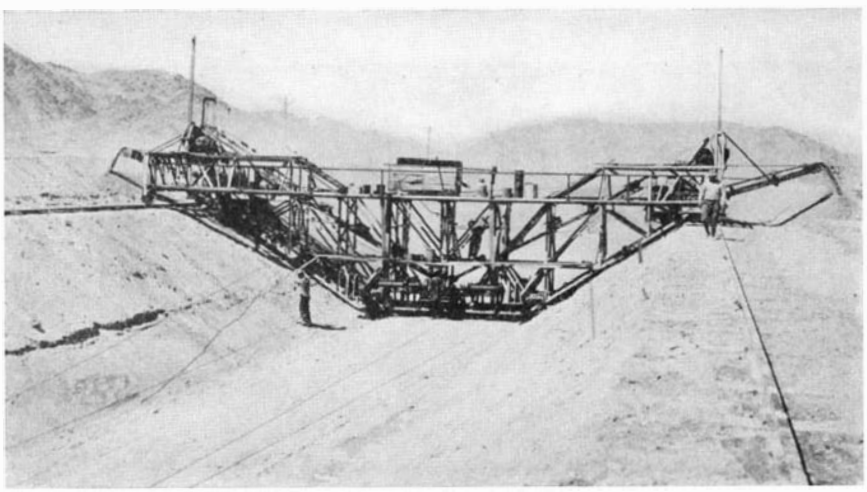
Open canals of the Colorado River Aqueduct are first "roughed out" with giant drag-line shovels after which the sides and bottom are smoothed for paving

By ANDREW R. BOONE

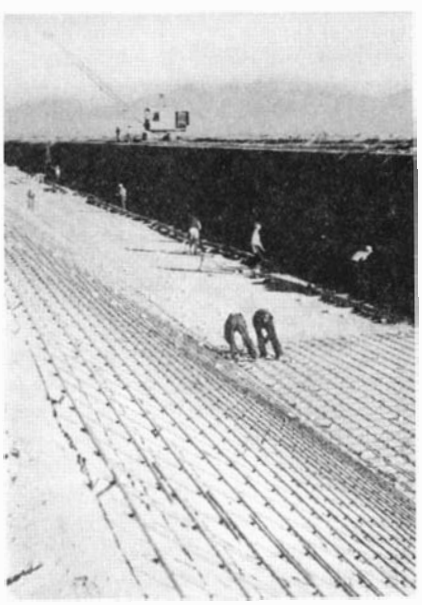
FINISHED smooth as glass by means of giant trimming and paving machines, 62 miles of canals in southern California are being "streamlined" in order that a billion gallons of Colorado River water may be supplied daily to Los Angeles through the 242-mile Metropolitan Water District aqueduct. [See also September and November, 1934, Scientific American.—*Editor*.]

The canals form only part of the huge 220,000,000-dollar undertaking. There are also 92 miles of tunnels, 55 miles of conduit, and 29 miles of siphons. By smoothing the water-contact surfaces of all these units, eliminating sharp curves, and abolishing all rough spots, the required volume of water can be carried in underground bores 16 feet in diameter, whereas it is estimated that 18-foot tunnels would be required were they left rough.

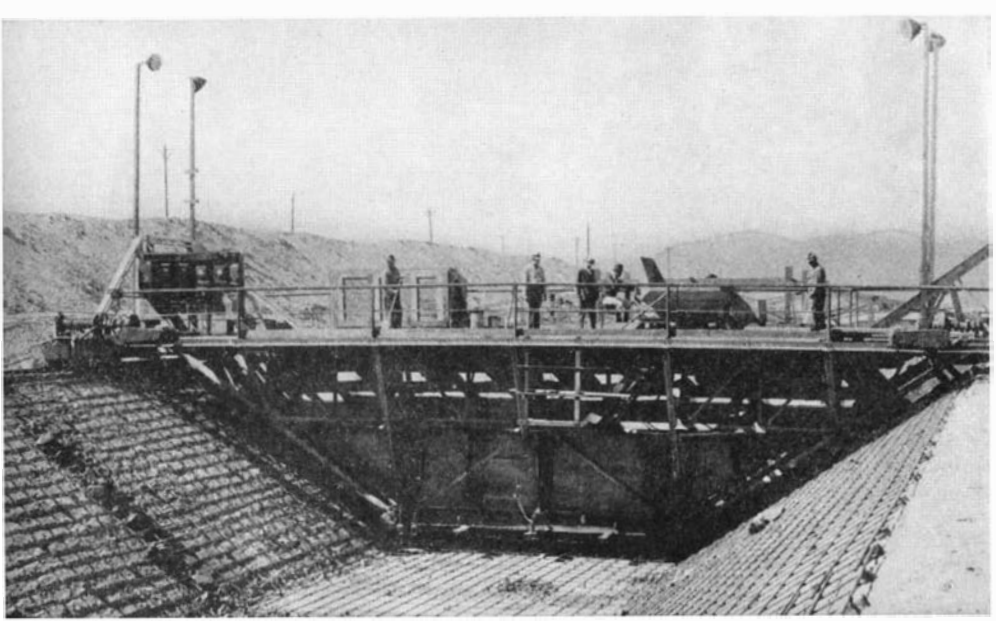
One of the most interesting mechanical developments used on this project is the canal trimming machine which, moving on rails, straddles the 60-foot ditch. After a section of the canal is "roughed out" by a drag-line shovel, the trimming machine smooths the sides and bottom. As it runs back and forth, a series of knives slice away thin sections of earth and an endless chain dumps the "shavings" out along the banks. Paving is accomplished in a single operation by means of giant machines which lay the concrete, spread it, and tamp it in place. The pavers are really rolling bridges supported at the ends on trucks which run on rails upon and paralleling the canal banks. Concrete, supplied by double-ended mixers rolling on Caterpillar treads, which can be loaded from trucks at both ends simultaneously, is dumped from the mixers on the canal bank into a motorized, bottom-dump hopper car which then runs across the



The canal smoothing machine travels on rails on the canal banks, shaving the sides and bottom. The removed material is discharged on both sides of the canal

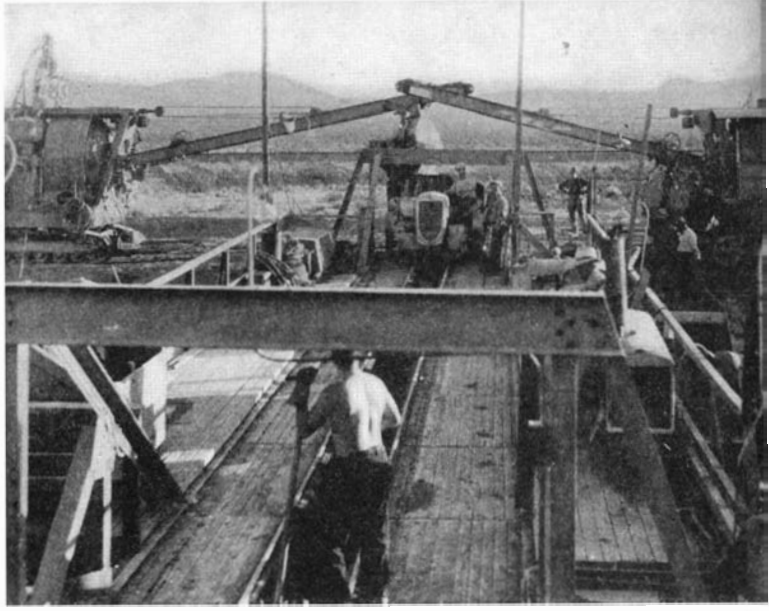


Placing the re-inforcing steel on the canal bed, making ready for the high-speed concrete laying machine



The paving machine placing concrete on the re-inforcing steel. Operation of this giant paving machine is described in text

Paving For Aqueduct

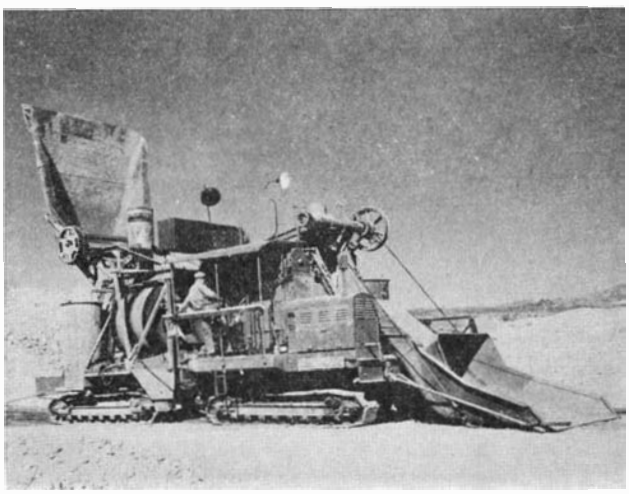


Mixed concrete is loaded on the motorized dump hopper car (center background) and distributed to the working edge of the paving machine through the slot that leads to a series of small compartments

top of the paver, dumping the concrete down between the rails into a chute, and thence into small compartments provided to keep the plastic concrete from moving laterally down the slopes and piling up at the bottom. The hopper car makes one and one half trips a minute, distributing the concrete evenly. Ready to operate, the complete paver weighs in the neighborhood of 48 tons. These machines are moved by motor driven winches pulling against anchors on the rails or in the ditch ahead.

Formed to the shape of the finished canal and welded in place on the paver is a steel slip form for the finished surface of the concrete. In the leading edge is a tube in which an eccentric rod revolves rapidly, thereby vibrating the concrete as it is laid, packing it down, and at the same time producing a smooth finish. As the machine progresses, the finishers follow behind, and from framed wooden "jumbos," also mounted on the side rails, work over the surface of the concrete with hand trowels to produce the desired hard finish. At a speed of about one foot per minute, one of the machines will pave approximately 500 feet, placing over 700 yards of concrete in one eight-hour shift, whereas the abandoned hand-placing method could only account for a 200-foot advance, placing only 282 yards.

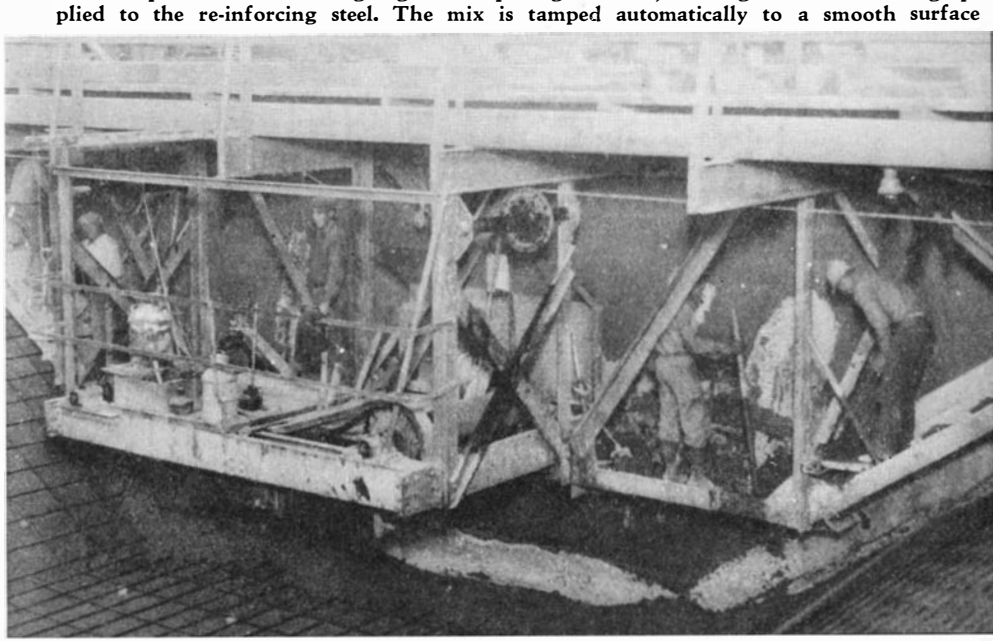
Within tunnels, conduits, and siphons, workmen grind down inequalities, particularly at joints, with high-speed emery wheels. Finally, the concrete is rubbed to a high lustre. Nowhere throughout the length of the winding aqueduct is there a sharp corner. Thus friction is reduced and water will flow with little restraint the entire width of the state of California—from Parker Dam to Los Angeles—through a series of tubes and canals containing 5,760,000 barrels of cement, or enough to build a highway 14 feet wide from San Francisco to New York. This is the world's biggest cement job, surpassing Boulder Dam by 170,000 barrels.



One of the double-end concrete mixers which may be loaded with materials at both ends simultaneously. The mixer advances on endless treads to keep pace with the concrete laying machine as it proceeds

Smoothing the inner surface of one of the conduits with an emery wheel to reduce resistance to water flow

A close-up view of the working edge of the paving machine, showing the concrete being applied to the re-inforcing steel. The mix is tamped automatically to a smooth surface



YOUR BRAIN

By G. H. ESTABROOKS
Professor of Psychology at Colgate University

I HAVE a friend who lost a great part of his brains during the World War. He was wounded in the head by a fragment of shell, which also destroyed large areas of grey matter. When he was sent to hospital the shattered bone was replaced with a silver plate and he eventually returned to the front, ending his career as a colonel of infantry. Obviously no great harm had been done. Another chap has a bullet in the front of his head and seems quite normal. One psychologist reports taking a tumor, the size of an orange, from the right side of a man's brain. He suffered no ill effects and had had very few symptoms up to the time of operation. A medical acquaintance tells of a case wherein syphilis had so destroyed the brain tissue that he was able to thrust a medical lance up through the nose into the brain and to within half an inch of the back of the head. The individual later died of the syphilis, but up to that time his main symptom had been dizziness.

In other words, it is astounding what damage one can do to the brain with little or no result. One authority says that the most remarkable thing about the human body is how much it can stand—and how little it can stand. For the reverse is also true of the brain, as of all parts of the body. The slightest pressure on the vagus nerve, which controls the heart, may cause instant death. A tumor the size of a pea, on the pituitary gland in the head, may result in blindness, while those of us who went through the last war recall numerous cases of men dead without a scratch on the body—just the result of air pressure from an exploding shell.

A knowledge of the way in which the nervous system works is essential if we would understand mental disorders. This can be made quite clear if we attack our problem from the practical end. Just what happens when something goes wrong in a specific place? For example, we divide the nervous system into three broad levels, the brain proper, the basal ganglia or structures at the base of the brain, and the spinal cord with its incoming and out-going nerves. Now suppose the syphilis germ invades the nervous system. Various things may happen because this particular bug is by no means choosey in his diet. He will attack bones, arteries, skin, or nervous tissue and, what is more, he may start work on any level of this nervous system. Let us suppose that he attacks only the spinal cord, or the lowest level. The result is a peculiar interference with walking or handling the arms. Locomotor ataxia, we call it and, if no complications result, the individual may be normal in all respects except that he walks with the peculiar shuffling gait characteristic of this disease.

But the syphilis may go up to the base of the brain. The symptoms will then be much more severe, seen largely in a lack of emotional control. The individual becomes subject to the most violent fits of temper, or outbursts of crying and laughing. Yet otherwise he is quite sane and can reason as clearly as ever. Only when the brain proper becomes involved do we get that terrible insanity known as general paresis.

Let us review this picture a little more carefully. Suppose your right leg is paralyzed. What is the cause? Like the devils in the herd of swine, the possible number of causes is legion. For example, it would be quite simple for any surgeon to paralyze that leg of yours by cutting the nerve anywhere between the spine and the muscle; but the nerve lies pretty deep and generally escapes ordinary accidents. Moreover, there aren't many germs that attack the nerve outside the spine.

WITHIN the spine, however, many things can happen. One of the most tragic is infantile paralysis. The germ of this disease is very select as to diet. It feeds only on the cell bodies of those nerves which go to the muscles. As a result the muscles, robbed of the nerves which control them, can do nothing and simply waste away. We have hopes that a serum, made from the spinal column of the monkey, can be prepared to check this pest but, so far, little can be said. Then spinal meningitis might be the cause of this paralysis. Here the germ attacks the coverings of the spine and these become inflamed, sometimes to such a degree that these coverings actually grow into the nerve cells and destroy them, causing all sorts of paralysis. Syphilis of the spine generally comes out as locomotor ataxia, already mentioned and more a disturbance of walking than an actual paralysis. Tumors of the spine are not infrequent and may cause paralysis of a limb, while the cord may also degenerate in pernicious anemia, giving a similar result. Of course a "broken back" or any serious injury to the spine might paralyze a leg, while the surgeon, when he uses a "spinal anaesthetic," produces the same result for the time being. These are a few of the commoner causes of paralysis.

All this is dependent on the fact that your leg movements are controlled from the brain, that the "lines of communication" go down your spine, and that any interference with these pathways will always cause trouble. But note that this has nothing to do with mental disease, despite the fact that nervous tissue is involved. In other words, you may have diseased nerve cells even, as we shall see, in the brain without having insanity and you may also have insanity without any brain injury at all. Destruction of nerve tissue at this lowest or spinal level can only cause interference with muscular movements. But note that "spinal" meningitis may spread to the brain, which is very serious; also that spinal syphilis may do the same, and that infantile paralysis may get to the base of the brain and cause death. This is a different story, to which we will now pass.

When the disease germ spreads its activities into the base of the brain it is quite another matter—and much more serious. Here, just under the brain proper, which consists of a large, wavy mass, are several structures which are very important. First are those nerves which control heart and lungs. That is the reason why "high" infantile paralysis always worries the doctor. When the face becomes paralyzed, it is a sign that the infection is getting very close to the lung and heart nerves, so he telegraphs for an "artificial lung," and prays for the best. A broken neck may be fatal for the same cause—which is the reason why the hangman is so very careful to arrange his knot so that the pressure will be just where it ought to be. He aims to please.

Then the lines of communication from brain to leg or arm muscles pass here on their way to the spine. So an infection in the brain base may give you "St. Vitus dance," paralysis or twitching in any part of the body, or that curious apathy that goes with "sleeping sickness" but which has nothing to do with sleep.

Finally the brain base has some curious association with emotions, and here we first cross the path of insanity. For example, suppose we have a syphilitic

How Much and How Little the Brain Can Stand . . . The Hangman Is Careful . . . Insanity . . . Delirium Tremens . . . Stroke . . . Opium Visions . . . Epilepsy . . . Dementia Praecox . . . Other Things that Happen to People's Brains, and What They Signify

infection in one of these structures, the optic thalamus. The individual shows a weird lack of emotional control. He will laugh for an hour with no cause whatsoever—and he doesn't feel funny. He feels like a fool but can do nothing about it. All his other emotions may be similarly "unstuck." This condition becomes much more serious in sleeping sickness, which is a disease of the brain base. In addition to his sleep the individual may develop an intense irritation which makes him a very dangerous person to have around. When in one of these fits he is likely to commit crimes which make ghastly reading.

From the base of the brain we move to our highest level, the brain proper. Here again disease may yield several results, only a few of which can be classed under the head of insanity. For example, just above your ear is the motor area of the brain, which controls all body movements. It is a fairly large section, so we can interfere with one part, yet not affect another. When your friend has a "stroke" it simply means that a blood vessel has burst in this area and has knocked out the brain cells controlling the arm, the leg, or other part. But note that while his brain is injured, he is by no means "insane."

ONE of our most fascinating chapters in psychology centers around this problem of brain localization. For example, just about under the bulge of your forehead is the learning center for delicate muscular movements. Here you learn to write, to play the piano, or to handle your knife and fork. Should you receive an injury in this area, such as that caused by syphilis, a bullet, or a bursting blood vessel, the result may show itself in the curious disease "apraxia." Here you lose all capacity for skilled movements. Asked to sign your signature, you find you have completely lost the ability to write. The best you can do is to seize the pencil in your fist and sign in letters a foot high. Given a knife and fork, your manners would shock a chimpanzee. One of the funniest exhibitions I ever saw was a soldier, wounded in this area, trying to pick up a cup by its handle. He finally ended by seizing it in both hands, pressing so hard that he broke the china completely—and he was as much amused at his clumsiness as were any of the observers.

Just about under your brow ridges is the "speech" center of the brain. It is here that you learn to talk, to handle your tongue and lips. Any interference with this section of the brain may give the condition called "motor aphasia." You literally forget how to use your speech apparatus. You know what you want to say but when you try to say it you talk gibberish, just as you may know what you want to play on the piano but be unable to do so, as in "apraxia." Both are actions involving high grade muscular coördination, and any trouble in the coördinator ruins the activity.

Then we have "auditory" aphasia, which is the same picture but upside down. This is also a disease of the language function but at the other end, as it were. The nerves from your ear go into the brain almost straight, and just back of the temple you have the association center for hearing, which means that you learn to understand language in this brain area; whereas you learn to speak it under your brow ridges. If any injury occurs in this section of the brain near the temple, the results are about what you might expect. You can no longer understand spoken language and even music may be meaningless. Should an individual talk to you in your native tongue, say English, it would literally be Chinese, so far as you are concerned. Yet you can read, for that is a matter of the eyes. The first case I mentioned in this article, when hit by the shell fragment, suffered an injury here. As a result he had to relearn English, and French, really his native tongue, was forgotten completely.

Another curious condition results from injuries to the back of the head. Here is where the nerves of vision finally end. Here also is the learning area for everything that comes in by the eyes. For example, suppose you have a tumor in this area, or a blood vessel bursts. You can no longer *read* English, because this is a matter of vision, and the learning areas have been wiped out. You can still understand everything that is spoken and can yourself speak with no difficulty, but even a flaming advertisement for your favorite cigarette on Times Square is beyond your reading capacity.

Some of our most interesting cases are those suffering from congenital cataract. Here the eyes are quite all right, but there is the white veil in front of the pupil at the time of birth. Remove this—modern surgery can do so—and the patient has normal vision. Several such cases have been cured at about 40, and then they see for the first time. But they have to learn what they see. Confronted with a fountain pen the individual may call it anything from a dime to a dreadnought until he slowly learns to use this new sense.

ALL these conditions are very interesting and may result from any type of injury to these local areas. Syphilis is a great offender. Spinal meningitis may leave some such condition, depending on its location in the brain coverings. Even influenza seems capable of affecting the brain, and scarlet fever or diphtheria are of course notorious for the blindness or deafness which may follow. Brain tumors do their share of mischief, while the "stroke" of old age or the "concussion" of youth may result in just about anything. Certain poisons and drugs have a startling but temporary effect—witness delirium tremens or the visions coming from opium. Any interference with the blood supply to one of the local areas results in immediate trouble. This causes the failing senses of old age. The brain arteries become clogged with calcium salts—hardening of the arteries—no blood gets through, and you have those curious lapses of memory for which old people are famous.

But note that, despite all this injury to the very highest levels of the nervous system, we could not describe any of these people as being insane. As a matter of fact, we are just a little puzzled as to why they are not insane. It seems, however, that insanity results only when the brain *as a whole* is involved. For example, any of these particular areas may be attacked by syphilis. The results will be those already described, and the patient is said to be suffering from cerebral syphilis. But note that this disease may also cause the very dangerous insanity known as general paresis. Here, however, the *entire* brain, and no particular area, is injured by the germ. Similarly with brain tumor: a small tumor in one of these areas will give the results already specified, but a very big tumor in some areas will give no results. But if the tumor is so located that it causes pressure on the *entire brain*, then the individual is much safer in an asylum.

Alcohol seems to act in the same way; its effects are generally on the brain as a whole rather than on a particular area. Its first move is to paralyze the very highest centers which, through their controlling action, seem responsible for our ethical behavior. Then it descends in its activity until it produces complete unconsciousness. The various types of insanity connected with alcohol, such as delirium tremens or alcoholic hallucinasis are the result of poisoning to the entire nervous system. This, needless to say, occurs only in cases of great excess. Various other drugs, such as morphine, can give a picture of temporary insanity. We even have such cases from bromine poisoning.

FINALLY, poisons from within the body itself can produce the same results, although these are generally temporary in nature. The delirium which accompanies pneumonia or typhoid fever is the effect of poisons from these germs acting on the brain. One of the best cases of manic insanity I ever saw, a case so violent that I made his acquaintance while he was strapped in a hot bath, was the result of an infected appendix. To be sure, the condition was only temporary and cleared up with the infection, but it was most convincing while it lasted—just as is the individual who is "fighting drunk."

Insanity, when it is a matter of brain injury, is a diseased condition of the entire brain. In some cases we have to do shrewd guessing. Epilepsy, for example, we class as a type of insanity. We have every reason to believe that certain poisons arising from the digestive tract produce the "fits" and the emotional excitement that accompanies the condition. Indeed we can even control the fits by means of the ketogenic diet and dehydration, a method at present so severe as to be impractical. But we still cannot put our finger on the poison, though we are certain it exists. Dementia praecox, most common of all insanities, quite incurable and generally classed as one of those diseases which involve no brain injury, is said to be yielding to treatment by insulin, in Vienna. If so, many a chapter of abnormal psychology must be re-written and this type of insanity must be added to those involving a diseased brain.

We should throw in a word of caution here. Do not confuse the insane with the feeble-minded; it is a very easy error to make. Feeble-mindedness is also dependent on defective brain activity—indeed we may say it is *always* linked with an injured or undeveloped brain, and that this condition can generally be demonstrated to exist where it occurs. We classify the feeble-minded into two broad groups, the "poor stock" cases and the "clear sky" cases. In the former, the condition is essentially due to heredity and the brain is generally very poorly developed. The "clear sky" cases illustrate our thesis even better. These are of five types. First, birth injuries, where the brain has been definitely damaged during labor. Then "hydrocephalus" or water on the brain, which prevents the brain from developing. In these cases the head often becomes very large because of this internal pressure. Microcephalus is the opposite condition, the so-called "pinhead" whose head is not large enough for normal grey matter. The "cretin" idiot has not only an undeveloped brain but undeveloped body as well, because of poorly functioning thyroid gland, while finally the "mongolian" idiot still has us puzzled. He is certainly feeble-minded, has a very inferior brain, but no one has yet discovered the reason.

Note that, in the feeble-minded, the individual never *did* have a good brain, whereas the insane has, or at least did have, a high-grade nervous system. The engine is good but the gears are grinding. The feeble-minded never had a good engine at any stage of the game.

Finally, we should answer a question which has probably been troubling you. If the psychologist insists that mental life is always tied up with activity in the brain, how does he explain the so-called "functional" psychoses, such as dementia praecox, where there is no brain injury? There can be no doubt that those who have dementia praecox are just as "crazy" as the best example of brain syphilis, yet the brain, as we examine it after death, is just as good as yours, or mine. Does not this involve a contradiction?

No, it does not, and I think you can easily grasp the point that is involved. We sometimes refer to these functional psychoses as "habit" psychoses. They are also called diseases of the attention, and they can be explained in terms of learning. For instance, little Johnny finds that the boys on the street are too rough. They like to make fun of him, and when he does try to assert his rights, the results are both painful and humiliating. So Johnny retires to the house, reads his fairy books and *imagines* himself a hero, a king, or what have you. He finds it very pleasant—far more so than attempting to prove his rights in the harsh world of reality. So, in accordance with the famous pleasure principle, he retreats more and more into a world of dreams, becomes less and less interested in the world around him, until finally his dreams become real—to him. He loses all contact with the world and is perfectly satisfied to live with his own thoughts. But you can see that no brain injury is involved. It is a "habit" of thought, his attention is fixed on his own dreams, just as yours is fixed on the stock market and, in your spare time your thought "habits" keep you tied to the financial section of the newspaper.

Similarly in hysteria. The child discovers that the very best guarantee to having its own way is to stage a temper tantrum, so it lies on the floor, kicks and screams. Results are (sometimes) excellent. These childish tantrums become "habits" and develop into the hysterical "fit" of the adult. The pervert gives another excellent example. As a child he learns homosexual activities, continues these into adult life and becomes the pervert.

We call these disturbances functional because the brain is all right as to structure, but it functions wrong; yet such mental disorders are just as dependent on brain action as if caused by syphilis, alcohol, or a brain tumor.

Perhaps the most annoying type of individuals who cross the psychologist's path in a professional way are those hide-bound "structuralists" who insist that insanity *must* be linked with brain injury. They form a whole school and spend their research lives with both eyes glued to a high-power microscope, duty bound to demonstrate the injury which *must* exist in the brain of the dementia praecox. If no such condition can be demonstrated it simply means that the microscope is not good enough. Should you venture to assert that perhaps the brain tissue is in no way diseased, you are at once dubbed a "supernaturalist," and that of course closes the argument —for them. As one such believer in the occult, I repeat my position. That type of human behavior which goes with insanity is always linked with brain activity—faulty brain activity if you will—but this does *not* necessarily imply injured brain tissue.

THE point of this article is that mental life—and by that we mean consciousness—is probably always associated with activity of nerve tissue, but the picture is not always a simple one. Injury to your nerve cells at the lowest level has little effect on consciousness, and results in the higher levels—brain base and brain itself—are various, dependent on where the injury takes place. Certainly all brain injury does not yield insanity, and probably a great deal of mental disease exists without anything of disease in the nervous system. But, for all that, you must bear in mind how great is our mass of evidence that consciousness depends on a brain. Any good surgeon, if he wished, could rob you of the ability to read, to write, or to speak. He could paralyze anything from your toe to your entire right side, or leave you in a condition where your next and permanent address would be the state asylum. The functional insanities do not in any way disprove this contention.

Tracking Down Your Trade Mark Title

You Own Your Trade Mark, but Can You Prove It?

By SYLVESTER J. LIDDY
New York Bar

WHEN an individual, firm, or corporation adopts a trade mark it is usually with the thought that some day the right to that trade mark may be a vital factor in the future of the business in which it is used. Despite this fact, adequate steps to protect that right are but rarely taken.

Ordinarily what happens is this: Someone in the organization thinks of a good word mark or design mark, or a combination of word and design; perhaps a search of the Patent Office records is made to ascertain whether or not the proposed mark has ever been registered—frequently, this is not done. A commercial artist is called in to design an attractive label and perhaps outline an extensive advertising campaign to publicize the new mark. Often, steps are taken to have the mark registered in the United States Patent Office and, where the trade is international, throughout the world.

Too frequently, registration is neglected but even where a registration is effected the trade mark owner usually stops there with a feeling that he has done everything necessary adequately to protect his rights. Such is not the case. For example, years pass and in the interim no one has questioned his right of ownership. Suddenly and out of the proverbial clear sky comes a threat of a claim by someone else of priority of use. Then begins the hunt for evidence. No systematic files of trade-mark data and memoranda having been kept, the hunt and the search become a hit or miss proposition. The owner of the trade mark plaintively states that he was not thinking of law suits when he adopted his trade mark. Had he thought of law suits *then* he might well have avoided one *now* by being in a position to place his evidence before his opponent on short notice and thus end the controversy before it has really started.

How then can such a situation be avoided? It can be avoided by systematically preserving every bit of data which might conceivably throw light on the history of the adoption and use of the trade mark. This sounds like a big order but it is not nearly so complicated or difficult as it seems. It is not sufficient to preserve merely a few old labels. Old labels make fine exhibits but an exhibit is nothing in and of itself when regarded as evidence, unless it can be vouched for by some one who has first-hand personal knowledge that the label, or other exhibit in question, is genuine and that it truly represents the fact or other circumstance claimed for it.

What then should be done? To begin at the beginning: The person or persons who devised the mark should dictate and sign a memorandum for the files that on such and such a day they worked out this particular trade mark, mentioning any circumstance from which they conceived the idea of the particular mark. This should be signed, dated, and witnessed by some other member of the organization so that there can be corroboration in this regard. A notation should be made by the artist or artists who designed the label. Bills for printing, designing, and so on, should be preserved, initialed, and carefully filed in a separate compartment devoted exclusively to that trade mark. Duplicate bills, invoices of first sales (and occasional subsequent sales), as well as specimens of early advertising and advertising copy, should be retained and placed in such file.

WITH reference to the first sales of goods under the new trade mark, proper notation should be made by shipping clerks and others who had anything to do with the early sales and shipments. If the owner of the mark is a corporation, a copy of the corporate resolution of the adoption of the mark should be placed in the trade-mark file together with printer's proofs, sketches and designs, and all preliminary data as well as the finished label. There should be a memorandum in the file pointing to related book entries.

Through the years all changes in the design of the label should be noted carefully. If any radical changes are made in the mark, trade-mark counsel should be consulted. The mark should be registered in the United States Patent Office in its new and varied form. When additional lines of merchandise are added a new registration should be secured covering such additional items and careful notation made in the trade-mark file that item "so and so" was first sold under the trade mark in question under "such and such" a date and the early procedure as to shipping invoices, orders, and book entries, repeated.

It should be borne in mind that oral testimony is frequently uncertain, vague and unreliable. But with actual documented exhibits to refresh recollections and to back up the oral statements of witnesses, particularly where many years have elapsed, the strongest and most convincing proof is furnished.

It must be remembered that at its inception the trade mark in and of itself is valueless and is a mere naked symbol. It becomes a valuable and a tangible right only when it has actually been used and associated in the business of the owner and becomes thereby a symbol of the good-will of the business. Good trade marks have in themselves built up considerable good-will and the mark, which may be of negligible value at its outset, may soon grow in value by leaps and bounds, so that after a period of years the whole business of the owner comes to center around it. That is when the trade-mark pirate becomes interested because it is then that his piracy becomes worth the risk. If the trade mark is backed up by documented facts and documented evidence, the pirate will not get far.

Once the potential value of a good trade mark is really recognized, the time, trouble, and perhaps nominal expense necessary to start and preserve an adequate trade-mark file become well worth while.

POLAR MOLECULES

The New Science of Molecular Structure . . . Old Puzzles Unpuzzled . . . The "Why" of Some Things

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

WHY does alcohol mix freely with water while gasoline merely floats on top? Why does kerosene mix freely with gasoline but not with water? Can kerosene and water be made to mix? Why do salt and sugar disappear in water with the stir of a spoon while powdered sulfur, iodine, or mothballs merely settle to the bottom? Why will soap mixed with water remove dirt and grease?

The answers to these questions and many more like them have puzzled scientists for many years. During the past few years, however, new answers have been found. These answers have come from a study of the sizes, shapes, and charges of the molecules themselves. As a man in the dark may paint a mental picture of an object by feeling its contours, so scientists have pictured the tiny invisible molecules by feeling their "contours" with all sorts

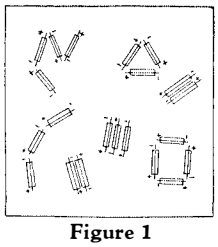


Figure 1

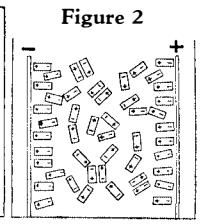


Figure 2

of electrical feeling devices. The result is a new science of molecular structure.

Molecules of water, for example, are now thought to be constructed like tiny magnets having a positive electrical charge at one end and an opposite or negative charge at the other end. For convenience, they may be pictured thus, [+ −], and are known as polar molecules. If a number of needles were magnetized and each placed on a tiny cork float on water, they would tend to form in groups with the positive end of one toward the negative end of another somewhat as illustrated in Figure 1. If the water were stirred, the groups would be constantly broken up and changed about.

This, then, is the scientist's picture of the behavior of water molecules. Molecules pair off, forming groups and figures; they change partners in the perpetual marathon dance; they constantly move about, loath to be alone. Water is aptly termed an "associated liquid" because of the tendency of the molecules to associate with one another. If water is placed between two oppositely charged plates, the molecules line up against the plates as is shown in Figure 2, like dancers lining up for the "Virginia Reel," men on one side, women on the other.

By increasing the temperature of the water, the dance tempo is increased till some molecules are whirled off into space much against their will. Thus, water slowly evaporates as molecules leave the surface. At the boiling point the tempo has become so furious and fast that hosts of partners are torn apart at once to be whirled off into space and travel solitary paths. As the temperature is lowered, the dance tempo decreases till the couples and groups finally take up definite positions and instead of moving about merely vibrate or "shimmy" in position. The water is frozen. Because of the great attraction existing between molecules, they are not easily separated and the boiling point of water is high. For a similar reason, it is easy to "freeze" the molecules in position and water has a high freezing point.

THE molecules of which gasoline is composed are quite unlike those of water. While they are relatively long they have no positive nor negative poles. Hence, they are called non-polar molecules. For convenience they may be pictured thus: ( ). There is no attraction between molecules. Each leads a solitary life, though their greater weight forces them to remain close together as a liquid. Each molecule dances alone, frequently rubbing shoulders with his neighbors but bouncing off again to continue the everlasting solo dance. As heat is added and the dance tempo increases, the solitary dancers with no partners to hold them back are easily whirled off into space. Consequently, gasoline vaporizes rapidly and has a low boiling point. Likewise, because of lack of desire to group up, it is not easy to "freeze" the molecules in position. The dance tempo must be greatly slowed down before the molecules quit moving about to take up fixed positions. Hence, the freezing point of gasoline is lower than that of water. Figure 3 illustrates the conditions existing in gasoline—no grouping up.

Gasoline molecules are strictly barred from the water dance hall, first because they are lone "stags" without partners, and second, because they are unattractive. Water molecules greatly prefer their own company. The "caste line" is strictly drawn. Gasoline molecules cannot even wedge their way in between the attractive forces existing between the water molecules. An invisible electrical set of bouncers surrounds the water dance hall. If a gasoline molecule by chance gets in too far, he is promptly bounced back again among his fellows. In their attempt to "crash in," the gasoline molecules spread out on the surface of water looking for an opening till they form a layer only one molecule deep on top of the water. Thus, a tiny drop of gasoline placed on a tub of water may form an iridescent film over the entire surface of the water. Figure 4 illustrates the relation existing between water and gasoline.

On the other hand, alcohol molecules are welcomed into the water society with extended arms, for they too are of the polar caste. They come in groups and pairs to exchange partners freely with water molecules and may thus be whirled off to the most intimate circle of water society. Though they belong to the same caste, alcohol molecules are, nevertheless, less

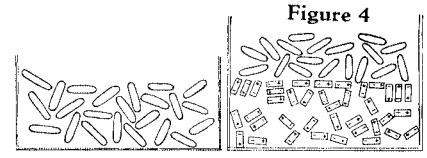


Figure 3

Figure 4

polar than water molecules. Hence. pairs can be more easily separated and the boiling point of alcohol is lower than that of water. For similar reasons, the freezing point is also lower. Thus, the addition of alcohol to water lowers the boiling and freezing points of the water in proportion to the alcohol present. Figure 5 illustrates the dissolving of alcohol in water.

Kerosene molecules, like those of gasoline, are of non-polar caste. They too are solo dancers. As such, they may mingle freely with gasoline molecules, for there is nothing to prevent free mixing. Like gasoline molecules, however, they too are strictly barred from water society. Because the molecules are longer and heavier than those of their gasoline compatriots they are less easily whirled off into space. The boiling and freezing points of kerosene are therefore higher than those of gasoline.

Thus far, only cases of liquids mixing with one another have been considered. However, the situation is quite similar when solids are mixed with liquids. Sugar, because it dissolves in water and not in gasoline, must be made up of polar molecules. The molecules are not simple polar molecules like those of water, however. They are large and heavy and each has several polar "hooks." The molecules might be pictured as in Figure 6.

SUGAR, like frozen water, is a solid. Evidently the attraction between polar groups of neighboring sugar molecules is sufficient to hold them in fixed positions. The music does not start till the temperature is raised and there is no free dancing of either pairs or groups. But sugar is welcomed, nay, urged to enter a water society. But the analogy must be changed. The smaller water molecules, like tug boats, pull and tug at the giant liner to free her from her moorings to neighboring liners. Having freed one liner, other waiting tug boats attach themselves to the next, and so on till each liner, escorted by numerous tug boats, is traveling about through the tug boat infested sea. Thus, sugar molecules in a lump of sugar are torn apart by the energetic water molecules to become members of the joint water-sugar society. Figure 6 illustrates the dissolving of sugar in water.

Salt is a peculiar substance in many ways. Instead of having polar molecules like sugar or water, the molecules have

Figure 5

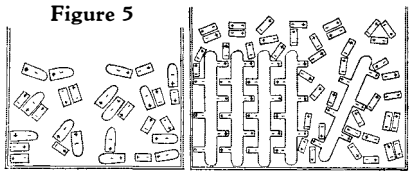


Figure 6

been broken apart so that the positive charge is isolated in one of the parts and the negative charge in the other. The situation can be represented thus: [+]—[−] . The parts are known as ions (meaning wanderer) since each part may travel its own path somewhat independently of the other. In a salt crystal, the positive ions cling to the negative ions, much as oppositely charged pith balls cling together quite strongly.

When a lump of salt is placed in water, the water molecules are strongly attracted to the outside ions and begin tugging away at them. In the tug of war between the pulling of the water molecules and the tendency of the ions to cling together, water wins. One by one the lump is stripped of its outer ions till nothing remains. Each ion is then escorted through the solution by its water molecule escort. Occasionally, escorted ions of opposite charge come so close together that they temporarily escape from their water guardians to re-unite, but the ever-moving watchful water molecules see to it that divorce is prompt. Figure 7 illustrates the dissolving of salt in water.

Solids such as iodine and moth balls belong to the non-polar caste. Hence, the molecules have no polar hooks to which water molecules can attach. In fact, they cannot "crash" the water dance floor because of the ever-vigilant electrical bouncers. However, they are welcomed in the non-polar society of gasoline or kerosene as solo dancers. The moving gasoline molecules by mere collision with the solid substance tear off the outer molecules and permit them

Figure 7

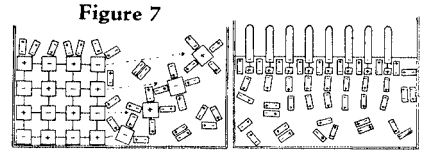


Figure 8

to solo dance. These heavy molecules are "kept moving" only by constant collisions with the lighter gasoline molecules.

The simple rules of solubility may be summed up in two statements.

1. Polar liquids, such as water, dissolve other polar liquids and solids as well as ions, but will not dissolve non-polar substances.

2. Non-polar liquids, such as gasoline, dissolve other non-polar liquids and solids, but will not dissolve polar substances.

Soap also has an unusual type of molecule—while one end is of the non-polar type, the other is polar. It can be represented thus: (−)—[+] . This odd situation makes the soap molecule literally an amphibian. In water it swims with the non-polar end waving in the air, in oil with the polar end waving in air, as is illustrated in Figures 8 and 9. If the polar end of a soap molecule appears at the water dance hall, it is welcomed warmly, but the non-polar end finds entrance difficult though it may enter through the influence of its polar end. It usually finds itself in the anomalous position of being half in and half out. This unhappy molecule finds itself a "half caste" sometimes welcomed in both oil and water, sometimes rebuffed by both. However, the very half caste position makes the soap molecule one of the most useful of all molecules in the social melting pot of molecules.

If kerosene and water are shaken together they quickly separate into two layers on standing. If a little soap is first added, however, small droplets of kerosene remain scattered through the water. There is no separation into layers. The half caste soap molecules have

Figure 9

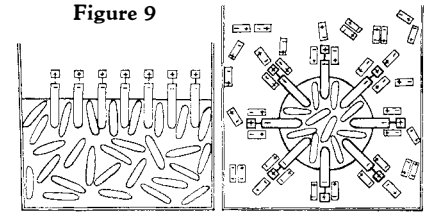


Figure 10

served to make kerosene and water compatible. Even so, the kerosene molecules can be escorted into water society only in groups, never singly. To change the analogy once more, a small unarmed group of kerosene molecules penetrates hostile water territory only when surrounded by an armed soap cordon of police molecules to open the way and prevent attack by the armed and angry water caste. The soap molecules, friends of both groups, are merely the police enforcing the natural law. Figure 10 illustrates the suspending of a drop of kerosene in water.

SINCE dirt, grease, oil, and fat consist chiefly of non-polar molecules it is evident that they cannot be removed from materials by merely adding water. Without its police force, molecular society is undemocratic and dirt cannot enter exclusive water society. Again the police force is called on. Materials are rubbed with soap. The rubbing serves to break the dirt up into groups small enough to be properly escorted. The police molecules form their protective cordons and the escorted groups move off unafraid into the very heart of a hostile society. Thus, because of its dual nature, soap is enabled to bring polar and non-polar substances together and serve as an excellent cleansing agent.

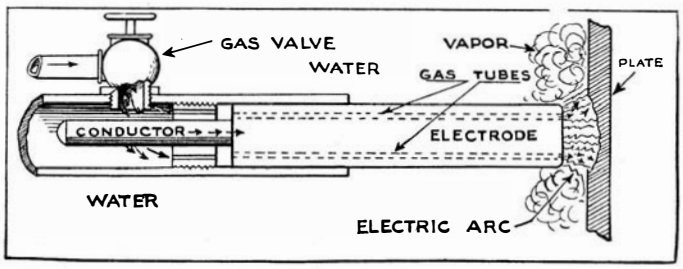
Molecular society, governed by immutable natural laws, is certainly not democratic. The position a molecule must occupy in molecular society was fixed long before that molecule was born in the cooling stars. Nor is there any rebellion against fate. Polar or non-polar, charged or uncharged, associated or single, complex or simple, molecules behave as law decrees they must. Each species of molecule remains in its own caste which is pre-determined by its "electrical contours." Only when properly escorted and protected for the journey may it attempt to cross caste lines.

Arcs Cut Under Water

Electric Torch Rips Submerged Metals . . . Gases Create Working "Hollow" . . . Oxygen Burns Metal Being Cut . . . Possible Welder . . . Many Uses

By R. G. SKERRETT

CUTTING metal bodies under water by burning them with an electric arc is being done far more extensively than most of us are aware. This means of dealing with difficult situations is saving time and money and achieving results that would be exceedingly hard to effect in any other way. As with everything else that the engineer develops, the American electric subaqueous cutting torch has been considerably improved since it was conceived a decade or so ago.



Principal features of the electric underwater cutting torch. The "plate" being cut is grounded and is the return circuit

This extremely adaptable tool makes use of the intense heat of the electric arc and is a great advance over the oxy-acetylene underwater torch that made its appearance first in Europe. That

Diver, with cutting torch, before donning helmet to work submerged

torch had to be ignited in the air and then carried very carefully down into the water to prevent being extinguished. It had also to be held within a limiting angle while working submerged; if doused by the flooding of the cup around the flame the diver had to make his way back to the surface to have the gas re-ignited.

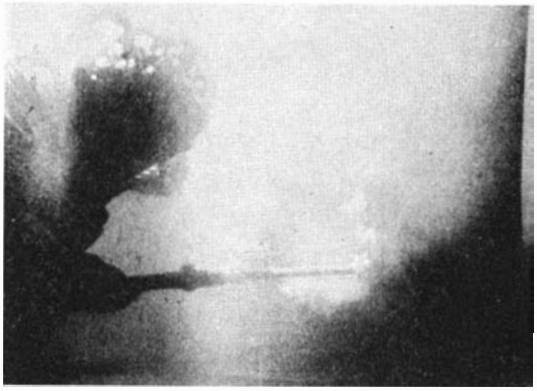
The electric torch, on the other hand, has none of these hampering restrictions. With the current switched on, the diver has only to touch with the tip of the tool the metal to be burned and then to retract the electrode a fraction of an inch. Since the metal body acts as the "ground," or return circuit, an incandescent arc is produced, and that arc, with jets of high-pressure oxygen issuing from the tip of the electrode, melts the opposing metal and blows the fused particles away. The great heat of the arc and the gases of combustion vaporize the enveloping water and create a cavity in which the arc can do its work. The arc ceases the moment the tip of the tool is withdrawn less than an inch from the immersed metal. The electric torch works equally well in any position, at any depth, and is unaffected by the temperature of the water.

IN its earlier form, the electrode was a round rod of carbon with longitudinal passages for the emission of the compressed gas at the tip. Today, the carbon is rectangular in cross-section. This gives the diver a choice of a corner or of a wide or short edge to meet the conditions best suited to the desired cutting. Even resistant cast iron and manganese bronze can be cut under water with one of these torches, and up to date the tool has successfully burned its way through any metal encountered.

With a current at sufficient pressure to produce the required arc, it should be plain that a diver must be heedful that the tip of the tool does not touch any metal part of his suit when the current is switched on. Therefore, the risk is reduced by using direct current which, unlike alternating current, exerts a repulsive force when near a metallic mass; but even the latter current might shock a diver if the bared tip touched him. The torch is truly a two-edged instrument that can be entrusted only to a qualified expert, and even then the unexpected might happen. It has been known to burn a long furrow in the metal breastplate of one diver on striking accidentally a glancing blow.

When functioning properly, the arc has the sound of a vigorously boiling kettle with intermittent cracklings—the latter being due to the rapid expansion and contraction of small globules of molten metal blown away from the cut. An expert, even if he cannot see the tip of his torch because of muddy water, is guided by sound in holding the tip continuously about a quarter of an inch away from the metal he is fusing. It takes much practice to reach this stage of expertness.

While developed originally to aid in submarine salvage operations, the electric underwater metal-cutting torch is now used in many other fields of engineering service and probably in the largest number of instances in the repair, inspection, or cleaning of subaqueous water mains and similar conduits. Lately, the torch has been much employed in removing sections of heavy steel sheet piling that had to be cut off level with the bottom of some waterway to prevent interference with shipping, and in a number of cases in recent



An unusual photograph of a diver cutting metal in water with an electric cutting torch

years the torch has been of the greatest service in removing the tangled steel structures of collapsed bridges or in getting rid of the submerged parts of old bridges that have been supplanted by new structures. Indeed, on one recent occasion, the damaged span of a bridge, with one end underwater and the other end still connected to an associate span, was released so that the whole span could drop to the bottom of the river. In that position the torch cut the steel fabric into sections that could be easily lifted, one by one, by a floating derrick and landed on a convenient wharf. That procedure was the simplest and least costly one to follow.

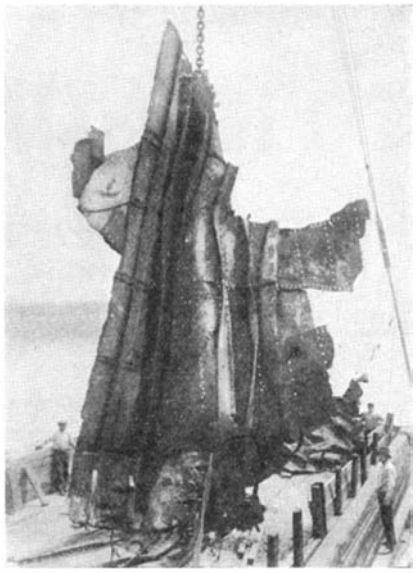
DURING last summer, the water in the Great Lakes reached an exceptionally low level. Many of the large cities bordering the Great Lakes obtain the major part of their essential supply of water from those bodies; and, to avoid contamination by sewage, the intakes are located far out from the shore. These intakes are usually circular shafts or tubes, rising vertically, equipped with gates in their sides. At one intake crib, the gate openings were nearly half their height above water, because of the lowness of the lake, and the inflow of water was seriously diminished. The only solution lay in cutting away to a greater depth the gate openings in the cylindrical iron intake well. In the course of an afternoon and evening a diver equipped with an electric underwater cutting torch did his work so well that the openings were extended far enough to permit the admission of an ample supply of water.

At a new bridge across a river in Pennsylvania, the piers were built in the dry within enveloping cofferdams formed of steel sheet piling driven firmly into the bed of the stream. The contract required that all the piles should be pulled out after the piers were completed; but a heavy rainfall abruptly transformed the river into a raging torrent before all of the piles could be removed, and eight of them remained and were bent away from the neighboring pier by the sweep of the turbulent flood. When the river became calm again, the deformed piles could not be pulled, and the only way to get rid of them was to cut them off level with the water bed with an electric torch.

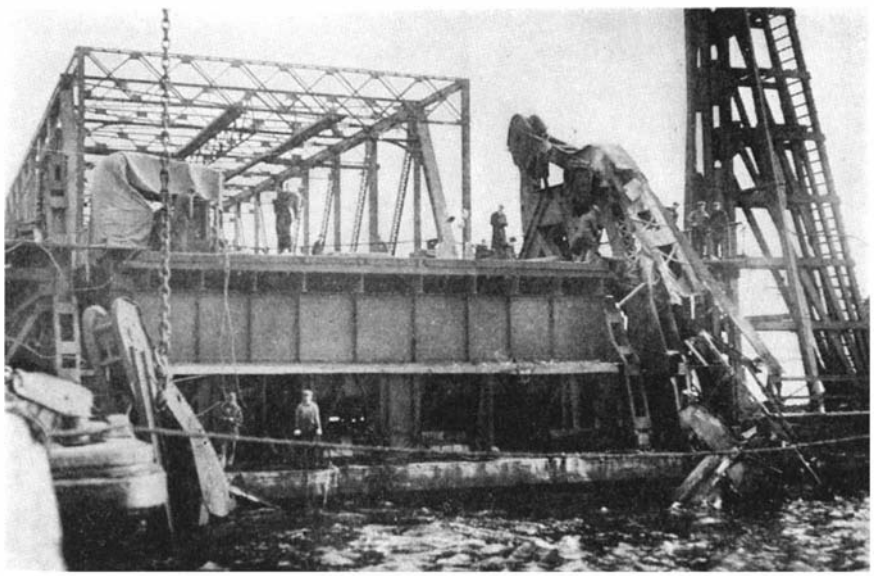
On the upper Mississippi River, where the Government is building a series of locks and dams to promote waterborne trade at all open seasons, much of the construction work has been and is being done within unwatered cofferdams built of steel interlocking sheet piling. At Lock No. 9, the piling at the corner of a cofferdam, situated where the river ran strongest at high stages, was so bent and twisted that the steel sections could not be pulled in the usual way by the ordinary equipment. They had to be removed, notwithstanding, to clear the river channel. Again, a diver and an underwater cutting torch were brought into play.

A seaboard dredge had the steel casing on one of her spuds, or anchoring spars, very badly bent and curled up at one corner where it had struck a rocky bottom; when that spud was raised, the deformed metal jammed in the well or passage in the vessel through which it had to move up and down. The craft was crippled, and to make her fit for service the jammed spud had to be released. Instead of taking the vessel into a drydock the hampering bent steel was cut free with an electric subaqueous torch.

In marine work, in addition to cutting openings in the steel structures of sunken craft to facilitate their salvage, torches such as have been described are employed to remove wire cables that have been caught in propellers and wound about them so that they could not be turned; every now and then a propeller, put out of balance by the damaging of a blade, is made smooth-running again by removing a corresponding area of an opposite blade. This work does not entail the expense and loss of time of drydocking, and it gets rid of the annoying, and often serious, vibrations in a ship which an unbalanced screw will cause. There is no telling where the underwater metal-cutting torch may be put to service next. This tool, which seems to violate all of our long established ideas about the normal antagonism of fire and water, is one more evidence of what the inventive mind and the engineer can bring about in harmonizing naturally opposing forces and thus achieving the supposedly impossible.



Twenty tons of crumpled steel plating cut from a sunken ship's hull



When the steelwork of this bridge collapsed, the cutting torch cut it under water into small pieces to facilitate removal, speedily clearing the river bed

RESEARCH work has blazed the way for another valuable application of the under-water metal cutting electric torch. Laboratory experiments made a year or two ago indicated that such a torch could be used to weld metals under water—the arc then serving to fuse metal rods so that the molten metal could be deposited subaqueously to bind together contiguous metallic bodies. The resultant welds when tested revealed excellent physical qualities. The first practical employment of this process was recently made by an oil company on the Pacific Coast. Some of that concern's submerged pipe lines were found to be impaired by corrosion pits that would eventually lead to leaks. It is reported that the pitting in the pipe walls was remedied, after the areas were cleaned, by filling the depressions with metal melted with the electric-arc torch, primarily designed for cutting work—another example of the way the engineering world moves onward.

STRANGE SENSATIONS

Tests for Color Blindness . . . Most Prevalent in Males . . . Color Blind Interior Decorators . . . Taste is also Deficient in Some Individuals

By LAURENCE H. SNYDER
Professor of Zoology, Ohio State University

A RESERVE officer at his first summer encampment was undergoing the usual physical examination upon arrival. In the course of the examination a test for color blindness was given. The officer was found to be quite color blind. Turning to an acquaintance in the line, he said: "That is very strange. I am chief chemist at

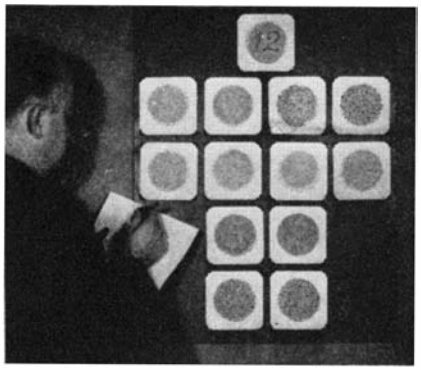


Figure 1: **A test for color blindness. Numerals built up of dots camouflaged (to the color blind) by dots**

a large pottery works, and one of my most important jobs is to pass on the final blending of the colors in the pottery!"

A prominent zoölogist who has spent the greater part of his life studying fishes, and has described many new species, including, of course, color descriptions, discovered after he was past 60 that he was color blind for all the pastel shades.

A physician, in discussing color blindness, said that he was 21 years of age before he knew that there was any way to tell that cherries were ripe without pinching them.

An ornithologist, who taught college classes in bird study for several years, prided himself on the fact that he taught his students the songs of birds. He himself was able to tell practically any bird by its slightest sound. It was not until some years later that he discovered that the reason why he learned bird songs was that he was so color blind that he had never really seen a bird in nature. Bird skins and stuffed specimens in the laboratory were his source of knowledge concerning shape and structure, but in the field song was his necessary guide.

The strange thing about color blindness is that the person with this trait as a rule never realizes it until he has been given some standard test. Even then he frequently refuses to believe it. What he has always seen seems perfectly natural to him, and not until he thinks back to many little incidents of his past life will he be able completely to accept the fact that he is deficient in the sense of color.

COLOR blindness is of various sorts. Rarest of all are the people who are completely color blind. To them the world is composed entirely of various tones of gray, much as a photograph would appear. Less than 100 cases of total color blindness have been recorded in all the world, and other physical defects of the eye usually accompany the condition. This type of color blindness occurs equally in both sexes, and is inherited as a recessive character; that is, it may skip generations and then crop out again.

The next most rare type is "pastel shade" color blindness, a condition in which the affected person can see bright colors with ease, but cannot distinguish the various lighter shades. This type of defect is largely confined to males, and is hereditary, although as yet nothing very definite is known as to its exact mode of inheritance.

Red-green color blindness is the commonest of all forms. It exists in varying degrees, but always involves difficulty with the distinctions of reds and greens. It has been recognized for a long time, family pedigrees from the 18th Century being known. This type of color blindness again occurs far more commonly in men than in women. Its mode of inheritance is well understood, being what the geneticists call "sex linked." Red-green color blindness may appear in a boy when neither parent shows the defect, but it does not ordinarily appear in a girl unless her father was color blind. A color blind father will not transmit his defect to his sons, but will transmit it through his daughters to half of their sons. If a color blind man marries a woman who has color blind relatives, some of their daughters are very likely to be color blind. A color blind mother, on the other hand, will have sons all of whom are color blind, and will likewise transmit it through her daughters to half of their sons.

If both parents should be color blind, all the children will show the defect. Color blindness is occasionally the result of disease or injury, such as injury to the optic nerve by tobacco or alcohol. Such cases, being *acquired* color blindness, would, of course, not show hereditary transmission.

Numerous tests for color blindness have been devised. These include the matching of yarns, the recognition of symbols or figures in color mosaics (Figure 1), and the projection of colors on a screen for recognition and comparison. A most interesting test is the Japanese chart devised by Ishihara, in which certain numbers are visible to the normal observer, while quite different numbers appear to the red-green color blind person, and the pastel shade color blind individual sees no number at all.

About one boy in 12 or 15 is color blind, and about one girl in a hundred. A surprisingly large number of interior decorators suffer from the defect.

The camera is color blind. On the color mosaic test, the camera records the number visible to the red-green

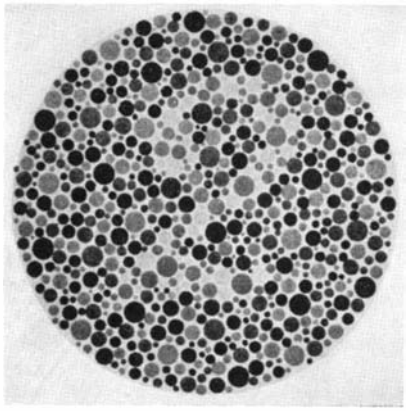


Figure 2: **What the camera, also a red-green color blind person, sees but not what a normal eye sees**

color blind person, and not the number apparent to the normal observer (Figures 2 and 3). This fact should provide a good basis for a detective mystery.

Color is not the only sense which may be deficient in various people. Taste is also deficient in many persons. This fact has been known only for the last few years. It was discovered quite by accident in the laboratory of a large chemical products company. In the manufacture of rubber materials, certain substances are used as "accelerators" of the rubber. While a chemist was preparing one of these substances (para-ethoxy-phenyl-thio-carbamide) the dust from the process flew about the room. An assistant in the room complained of the bitterness of the dust as it got in his mouth. The man preparing the substance was quite unable to detect any bitterness, although he was working right over it. Upon placing small crystals of the substance in their mouths, it was found to be extremely bitter to the assistant, quite tasteless to the chemist preparing it.

THE accidental discovery of this taste deficiency provided an item of much interest to biologists, particularly to students of heredity. Careful studies were immediately inaugurated, and many interesting facts were unfolded as the studies progressed. For this first substance studied, about 70 percent of the population were found to be tasters, while 30 percent were non-tasters. Moreover, this taste deficiency was found to be inherited. The ability to taste the crystals never appears in a child unless it was present in at least one of the parents. When both parents are non-tasters, all the children are non-tasters. In other words, the taste deficiency is inherited as a recessive character.

Following this discovery, a large series of compounds has been tested for taste in a large number of persons, and many of the substances have been found to produce different reactions in different people.

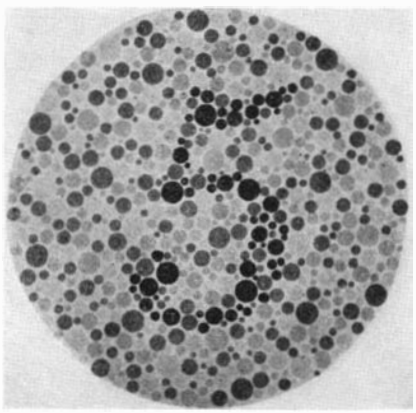


Figure 3: **What the normal person sees. To make the camera "see" it a color filter had to be employed**

People vary in their reactions to the different compounds. An individual may taste certain of the substances and not others. The person who is certain that his sense of taste is exceptionally well developed may be the very one to find one of these substances quite tasteless, while the person who admits that his taste is not acute may find it exceedingly bitter.

Chemical handbooks commonly give the taste of the various compounds mentioned. It now appears that these descriptions must be entirely rewritten, since the recorded taste is merely the reaction of the person who wrote the description, and this may not apply at all to the person who reads it.

Some of the substances tested occur in common foods. Thus creatine, a common constituent of lean meats, is tasteless to a goodly proportion of the population, while having a characteristic taste to the remainder. A pound of lean meat may contain as much as two grams of creatine: an appreciable amount when it is realized that a single crystal of one of these substances is enough to provoke a strong taste reaction. Soups made from lean meat contain a good deal of extracted creatine, which must mean that soups have decidedly different tastes to different people.

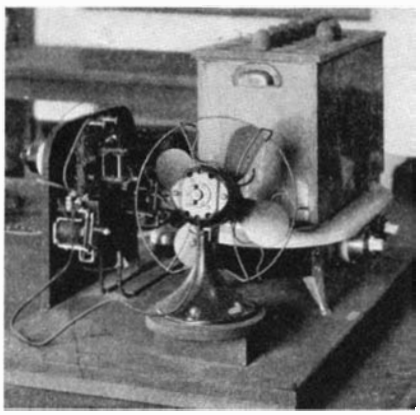


Figure 4: **Keeping taste compounds at fixed temperature for the tests**

Other substances occurring in foods are at present being investigated for their differential taste-producing qualities. It may very well be that, when you say to your child at the dinner table, "Now you eat up all that spinach or I'll spank you and put you to bed," the spinach tastes very different to the child than it does to you.

The hostess of a large and famous restaurant recently heard of the newly-discovered taste deficiency, and immediately sensed a possible practical application. She has found that it is sometimes necessary to discharge chefs, because, while skilled in cooking and preparing meals, they are quite unable to produce the flavor and seasoning which patrons desire. Tests for taste deficiency to various substances of this nature are now being developed.

Figure 5: **Taking a standard taste test in a scientific testing laboratory**

A short time ago rubber ice trays for electric refrigerators made their appearance. In producing such rubber articles, compounds of the nature of para-ethoxy-phenyl-thio-carbamide are used. The first rubber ice trays were soon found to be objectionable to certain persons because they gave the ice and the ice water a bitter taste. A compound which would not excite a bitter taste in anyone had to be found for use in accelerating rubber. At present great care is taken to use compounds which are tasteless not only to the inventor in the manufacturing plant, but to everyone else. This is also true in the manufacture of rubber nipples for babies' use.

Not only do people vary in their reactions to crystals or strong solutions of many compounds, but they vary in the strength of their responses. A very weak solution of one of the carbamides is tasted by only a small percentage of the population. Stronger and stronger solutions are tasted by an increasing proportion of the population, until nearly everyone tastes a saturated solution. Temperature also plays a part in the strength of the reaction. Experiments to unravel the complexities of taste and its inheritance are being carried out in several scientific laboratories at present (Figures 4 and 5).

VARIATIONS in sensations could be multiplied, but enough has been said to indicate that our reactions are not at all alike even to the most commonplace things. Tone deafness, odor deficiency, and others are being investigated. We are born with different capabilities. No matter what trait we care to measure, we find that people differ. Much of this variation has a definite hereditary basis. Truly we live in different worlds.

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Pawnbroker's Microscope

HOW much will you lend me on this fine blue diamond? This is the question one Bausch & Lomb technician is asking the other in the accompanying illustration. Because borrowers are asking this question of pawnbrokers every day, the Provident Loan Society of New York, world's largest pawnbroker, will give its

Wide-field binocular microscope fitted for examination of gems

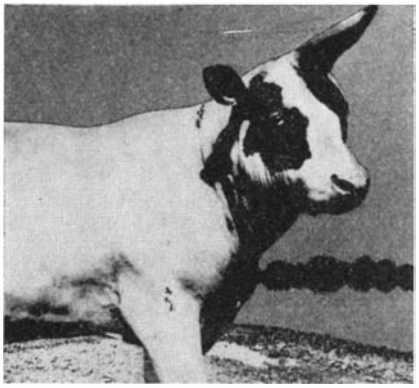
answer through a new microscope to the people who borrow more than 25,000,000 dollars annually from the company on pledged jewels.

Handling this enormous amount of personal jewelry requires the closest scrutiny by gem experts. Good quality synthetic corundum, such as sapphire or ruby, may be so free from flaws as to conceal its nature completely from the hand lens. White zircon, white sapphire, and even white quartz are sometimes substituted for diamonds, or green spinel and green sapphire for emeralds. A thin layer of genuine material is often backed by material of practically no value.

The new wide-field binocular microscope is fitted with a ball and socket chuck upon which rings, studs, and small jewelry may be mounted and turned in any position to secure the advantage of transmitted light through the stone. Replacing the familiar watchmaker's loupe, the pawnbroker's microscope holds the jewel rigid while the gem expert examines the stone to determine its axis; searches for impurities in inclusions; notes the perfection of its facets; and determines whether it is a substitute, an imitation, a synthetic stone, or the real thing.

Biologist Produces A Live Unicorn

UNICORNS no longer belong wholly in the doubtful twilight of mythology, where dwell griffins, dragons, and such-like fabulous beasts. There is a live unicorn right here in the U. S. A. of this modern



Above and right: **Two views of the live unicorn created by a biologist**

year 1936. Nor is he under the suspicion and ban of science; quite the contrary, science is responsible for his existence.

The 1936 model unicorn was produced by Dr. W. Franklin Dove, biologist at the University of Maine, through a rather simple surgical operation on the head of a day-old bull calf. By transplanting both horn buds, or little knots of tissue that normally produce a pair of horns, to a close side-by-side position at the center of the calf's brow-ridge, Dr. Dove induced the growth of a single very massive horn that has proved to be a most efficient weapon. Indeed, so much more successful has it been than the usual two horns that its proud possessor has undisputed domination over his companion cattle, and has developed much of the proud yet unaggressive bearing and disposition ascribed to the unicorn of fable.

The operation by which Dr. Dove's bull calf was enabled to become a unicorn was similar to some of the tissue transplantations used in plastic surgery on human beings, to remedy the disfiguring loss of a nose or other facial feature. When the horn buds were cut loose from the young animal's skull, a strip of skin and underlying flesh was left attached to each one, to carry the normal blood supply until the transplanted beginnings of horns could take hold on the spot where they were planted. Also, since the horn buds are circular, Dr. Dove cut their adjacent edges flat, so that he could set them close together, and so encourage the growth of a single horn mass.

The Maine unicorn is now about two and one-half years old, a splendid young animal of the Ayrshire breed. He is strong, fearless, well able to fight though seldom doing so. His biological "inventor" holds that his marked docility is due largely to the fact that the unicorn knows his own strength and the superiority in combat that his single weapon gives him; full self-confidence has done away with truculence.

Dr. Dove has searched the literature of

FRUIT—LEAVES

THIRTY to 40 leaves are necessary to produce the food to develop each peach on a tree. Forty to 50 leaves are required to develop a good-sized apple, and about 50 for an orange.

unicorn lore, which is both ancient and voluminous. He is strongly inclined to believe that earlier peoples anticipated him in his unicorn-making surgery, and that they produced leader animals for their herds in this way. One passage in Pliny, noted naturalist of Roman times, indicates that ancient herdsmen operated on the horn buds to produce multiple-horned beasts. Other more modern references indicate that shepherds in the Himalayan state of Nepal made unicorns of rams, and that two African peoples knew the secret of unicorn cattle.

Everywhere in ancient literature, both Biblical and classic, the unicorn is credited with great strength, great nobility, and great independence. He is always the leader of the beasts. His single horn, tipped with red or black, is the symbol and source of his power. He rules the others with it; he dips it into pools of undrinkable water and takes away the poison. Yet he is gentle, so that he will obey even a young girl. Later legend stresses this point, until it was claimed that only a virgin could tame a unicorn.

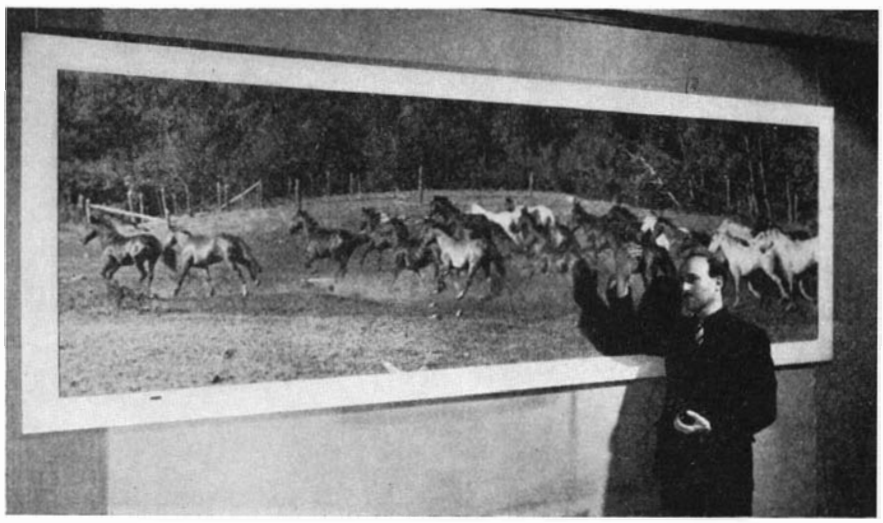
The unicorn is mentioned three times in the Old Testament, always in terms of high esteem. Indeed, the first reference, in the Book of Numbers, likens the unicorn even to God. Balaam, the heathen prophet who ran full tilt into the power of Jehovah, and of course got the worst of it, reported back to his king: "He hath as it were the strength of an unicorn!"—Copyright *Science Service.*

Remarkable Photographic Enlargement

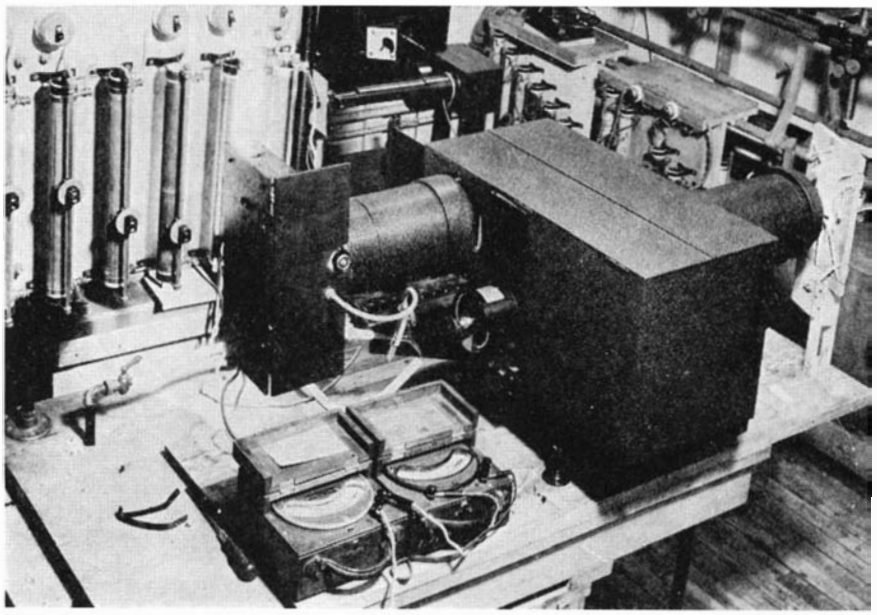
A NEW record in photographic enlargement has been achieved by the well-known New York photographer, Ivan Dmitri, using duPont Superior Panchromatic Film. This photograph, showing Wyoming wild horses in action, was made from a one-inch by one and three-eighths-inch negative which was enlarged in a single step, without retouching, to a size measuring eleven feet two inches by forty inches—the greatest single-step enlargement known. The feat is all the more remarkable because only a three-eighths-inch by one and three-eighths-inch section of the original film was used. This is a 97-diameter enlargement, increasing the area of the picture 9400 times. Its accomplishment suggests greater possibilities in enlargement through the use of improved film, as an eight-inch by ten-inch negative, enlarged proportionately, would produce a picture half a block long and six stories high.

According to Mr. Dmitri, no special technique of operation is required for such an enlargement, the results being made possible mainly through improvements in fine-grain film, fine-grain technique, and color synthesization. Mottled effects of "grains"—due to films and developers—formerly prohibited a single-step enlargement of this extent. With the improved film, this is no longer a serious factor.

Mr. Dmitri emphasizes the fact that research on lenses, films, and developers, conducted by expert technicians, at a cost of millions of dollars, has given the photographer more adaptable materials and allowed him to spend more time on artistic composition. Until lately, it was necessary for the amateur to devote many hours to acquiring deep technical knowledge. Now, better equipment has relieved him from this requirement and widened the scope of the camera in art.



A 97-diameter photographic enlargement made in one step



The monochromator, which emits light of a single wavelength

And What's a Monochromator?

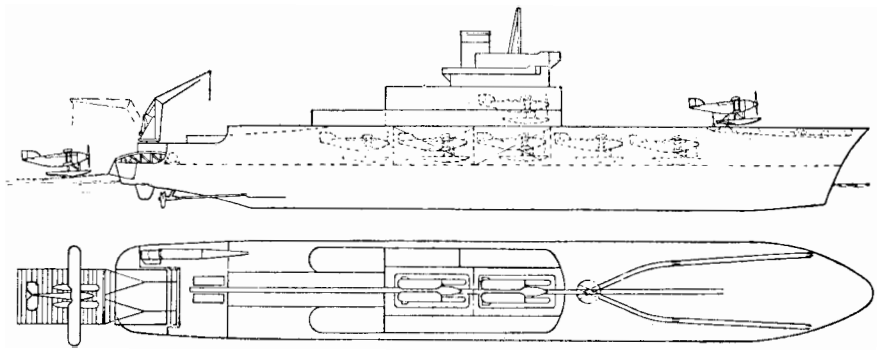
IN operation today in the Research Laboratory of the General Electric Company is one of the world's most powerful sources of single-colored light and monochromatic ultra-violet radiation—known technically as a monochromator. The function of the equipment is to take the light given off by a mercury vapor arc and, through the use of an optical system, filter out all except a few of the vibration frequencies present in the light. Through this operation the instrument produces single-colored, single-frequency, or monochromatic light.

The optical system of the instrument, its most important feature, was made possible by the development in the General Electric Company some years ago of clear fused quartz. Through this development it was possible to produce the large seven- and ten-pound quartz prisms which constitute the heart of this powerful monochromatic apparatus.

The apparatus consists essentially of an ultra-violet source, entrance slit, entrance collimating lens, the two large fused quartz prisms, exit collimating lens, and the exit slit. Purity of the radiation is obtained by changing the corner angles of the two prisms in such a way that the greater portion of the unwanted wavelengths of light are refracted out of the optical system to be absorbed by black shields.

Prevents Mildew On Paint

WHITE paint on interior surfaces subject to moisture frequently turns black as a result of mildew. Paint chemists have found that small amounts of mercury worked into the paint as a paste will eliminate this nuisance. A mildew preventive consisting of 73.8 percent by weight of zinc oxide, 1.2 percent by weight of bichloride of mer-



A "vest-pocket" naval aircraft carrier designed in England

cury, and 25 percent by weight of linseed oil, forms a smooth, easily workable paste for use by painters. *Paint, Oil & Chemical Review* points out that such pastes must be marked with appropriate warning labels, as mercuric chloride is a deadly poison.—*A. E. B.*

High-Speed Naval Aircraft Carrier

THERE is no doubt but that the aircraft carrier is an indispensable element of any navy, if that navy's airplanes are to be effectively used. The disadvantages of aircraft carriers lie in their immense expense, large size, and the fact that they are vulnerable to attack. It would seem, therefore, that a small aircraft carrier of high speed, extreme mobility, and cheapness of construction and operation would be of interest.

By courtesy of *Flight*, a sketch of a "vest pocket" aircraft carrier designed by John I. Thornycroft and Company in England is shown herewith, in which these objectives are sought. An interesting feature of the carrier lies in the employment of the Hein landing apron or "canvas" similar to that employed in the German-South Atlantic service.

At the bow of the vessel a catapult is provided which will handle aircraft up to 8000 pounds in weight and catapult them at 57 miles an hour. The catapults are designed to be exceptionally long so as to permit gentle acceleration, thus making their operation safe for aircraft loaded with bombs. There is an advantage in placing a catapult at the bow since the speed of the ship helps in increasing the relative wind. If, for example, the minimum speed of an airplane is 57 miles an hour and the carrier is traveling at 27 miles an hour, only 30 miles speed is necessary at the catapult.

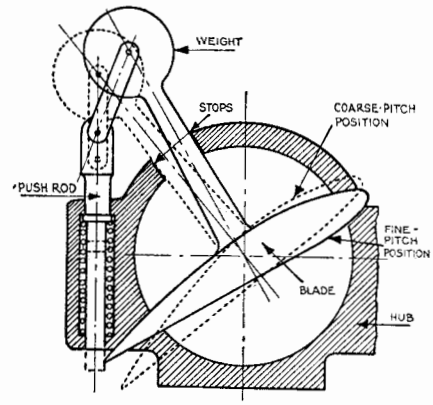
The Hein canvas allows an airplane to be picked up while the carrier is itself maintaining full speed, so that it is less vulnerable to torpedo attack by submarine.

With the conventional aircraft carrier, the deck has to be long enough for the airplane to alight. With the new design the over-all length of the carrier is 360 feet and the displacement only 3000 tons. With a shaft horsepower of 40,000, a speed of 28 knots is expected of the new design.—*A. K.*

Automatic Variable Pitch Propeller

CONTROLLABLE pitch propellers are usually considered as somewhat complicated pieces of mechanism. The Schwarz automatic variable pitch airscrew, however, which has been successfully tried out in Germany, is exceedingly simple in principle and execution, as can be seen from the drawing.

The propeller blade is so mounted in the hub that it is free to rotate in its end bearings, with the rotation limited by two stops. At the same time the propeller blade on each side is controlled by two opposing moments: one due to the push of the spring shown at the left of the diagram; the other



The actuating mechanism of a new automatic variable pitch propeller

due to centrifugal force acting on the weight shown at the top of the diagram.

At take-off and climb, when the engine is turning up relatively slowly, the moment of the spring is greater than the moment due to the centrifugal force of the rotating weight. Accordingly the blade is pushed over to the right stop, and assumes a "fine" or low-pitch position. It is this position that is desirable for take-off and climb.

When the airplane changes over from the climb to high or cruising speed and the engine speeds up, it is the rotating weight which takes charge, and the blade accordingly moves over to the other stop. The airscrew assumes the "coarse" or high-pitch position, and at high speed it is the high-pitch position which is desirable on the score of aerodynamic efficiency.

Therefore the blade acts efficiently under all the main conditions of flight.

Of course, with a manually controlled variable pitch propeller, or with the constant-speed variable-pitch propeller of American practice, a better coordination between plane speed and propeller pitch can be attained, since more propeller settings are available. But the simplicity and light weight of the new device give it claims to serious consideration.—*A. K.*

RIO AIRPORT

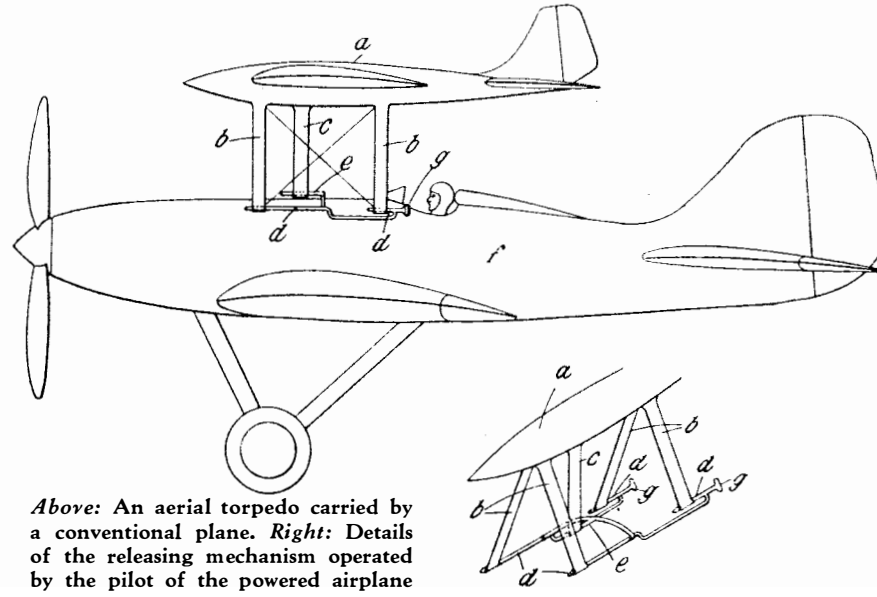
CONTRACTS have just been let for Brazil's new Federal Airport at Rio de Janeiro. Designed to accommodate the giant Pan American, Clipper type, flying boats, the airport will be only two minutes' ride from the heart of the South American city.

An Aerial Torpedo

THE *London Aeroplane* of recent date contains the following significant sentence: "No nation will officially admit the existence of wireless-controlled pilotless aeroplanes which carry high explosive instead of crew and are thus in effect dirigible flying bombs."

Captain Norman Macmillan, a noted British aviator, has disclosed his ideas for a dirigible aerial torpedo, although not wireless-controlled, which is illustrated in the diagram.

Above a conventional airplane *f* is mounted a smaller "pilotless" airplane *a*. The pilotless airplane carries the bomb. The smaller machine is supported on the struts *b* and *c*. When the pilot pulls the handle *g*, the locking pins *d* and *e* are withdrawn and the bomb-carrying craft is launched into space following the same path as did the piloted airplane at the instant of release.



Above: **An aerial torpedo carried by a conventional plane.** ***Right:*** **Details of the releasing mechanism operated by the pilot of the powered airplane**

The pilot can then dive or turn back while the dirigible bomb glides down to its target.

There are certain to be practical difficulties in the realization of this conception, but it certainly has interesting features. Bombing could be carried out with far less hazard to the pilot, and the protective aprons of captive balloons could be readily pierced without hazard to the attacker.

Other possible refinements are gyroscopic control of the flight path, and control by an aneroid to flatten the trajectory when attacking targets of low elevation, such as warships.—*A. K.*

Faster Training Planes

PART of the 61 Model NS-1 primary trainers which the Stearman Aircraft Company has delivered to the Naval Air Training Station at Pensacola are shown in one of our photographs.

There was a time when a primary training ship used a horsepower of under one hundred and attained a speed of 80 or 90 miles an hour. By contrast, the new NS-1's are equipped with 235-horsepower Wright Whirlwind engines and have speeds which are unofficially estimated as about 140 miles an hour. Naturally, as the speed of our single-seater pursuit ships grows to high figures the training planes have to keep pace.—*A. K.*

Statistics of Aircraft Safety and Use

SOME of the questions frequently asked regarding aviation are: Is private flying progressing? What sort of airplanes are being built? How safe is private flying? How safe is flying on the airlines?

The statistical side of aviation has not developed to anything like the extent of the statistical side of railroad transportation, and these questions are difficult to answer accurately. In the recent Aeronautical Session of the National Safety Council, an excellent and authoritative picture of the situation was offered by John H. Geisse, of the Bureau of Air Commerce, in a fine paper and some interesting charts.

Figure 1 shows the air miles flown during each six month period from the latter half of 1928 to the first half of 1935, the last period for which statistics are available. Miscellaneous flying (that is, private flying, school flying, aerial photography, et cetera) accounted for approximately 80 percent of the total mileage until it started its retrogression. In the first six months of 1935 it still exceeded scheduled flying by about 40 percent, and it is to be expected that this is its all-time low in relation to scheduled flying.

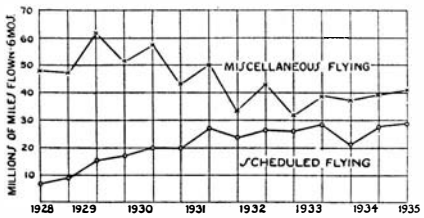


Figure 1

Figure 2 tells a similar story. On this chart are plotted the values of airplane production against years, in non-scheduled, military and transport aircraft. In the gay year of 1929 non-scheduled construction was way ahead, then dropped sharply and is only now beginning to curve upward. The construction of transport airplanes was much more steady and is now sharply increasing.

A group of new high-speed naval training planes

Perhaps Fig. 3 will go as far as anything else to explain the reason why transport flying has forged ahead so much more rapidly than miscellaneous flying. This chart gives fatal accidents due to all causes per 10,000,000 miles down. It appears that miscellaneous flying is many times more hazardous than scheduled flying.

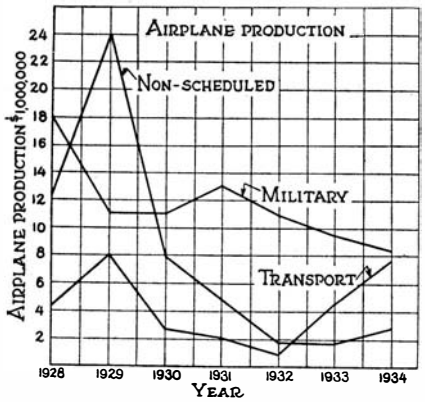


Figure 2

Mr. Geisse attributes the difference almost entirely to airplane characteristics. He maintains that more money and more effort should be spent in developing a safe private airplane. In this he is entirely right. But the difference in safety is not entirely attributable to the airplane. Scheduled flying is undertaken by the very best pilots, with every imaginable aid. Private or miscellaneous flying is undertaken by pilots of the most varied qualifications—some are very good, some indifferent, and some very bad. Miscellaneous flying may be over territory *not* provided with beacons and radio beams.

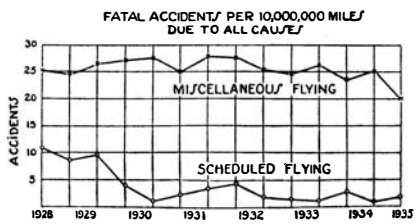


Figure 3

Something also has to be said of cost, which Mr. Geisse's charts do not touch upon. Private flying is an expensive hobby. We are far from the "flivver" airplane. Only real prosperity will spread the means to buy and operate private airplanes. Meanwhile our private airplane manufacturers are not idle, are building as cheaply as the extent of the market will allow, and are never ceasing to improve their product in safety and reliability.—*A. K.*

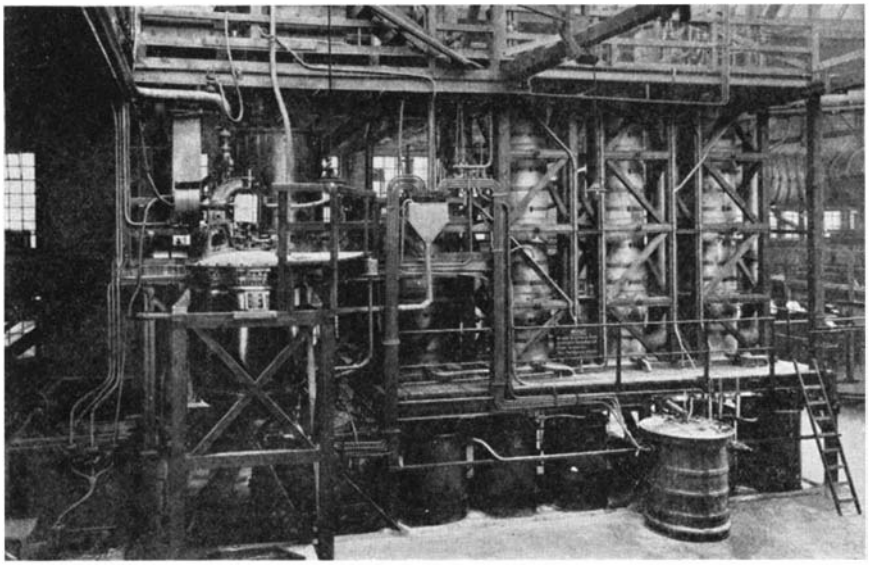
Progress in Two-Row Engines

SINGLE-ROW air-cooled engines in large transport operation appear to be almost as obsolete as four-cylinder automobile motors. Since the 1920's the radial air-cooled engine has been steadily made more powerful by internal supercharging, higher speeds, increased compression ratios, and the use of gasoline with high octane rating. But there was a definite limit to this type of power squeezing. The next step was quite evidently in the direction of twin-row engines.

The single-row nine-cylinder engine seems to reach its limit at a normal rating of 750 horsepower with an allowable overloading to 850 horsepower at take-off. With the latest Twin-Row Wasp, 900 horsepower is normal rating, with 1000 horsepower for take-off. However, if the engine is opened full throttle at sea-level it will give 1150 horsepower for a weight of 1250 pounds, giving a truly marvelous weight-per-horsepower ratio.

Besides offering greater power, the two-row engines have the inestimable advantage of smoother operation because of the more frequent impulses per revolution of the propeller. Thus, in the single row there are 130 heavy impulses per second from a 6¼ inch cylinder; in the two-row there are 250 lighter impulses per second from a 5½ inch cylinder.

Cooling was at first considered a great difficulty in two-row work. But progress in cylinder head finning and in pressure baffling has eliminated the trouble. The cylinder head design consists of cast-on rocker



Plant for recovering pure sulfur dioxide from smelting plant waste gases

boxes and deep, closely spaced cooling fins. The pressure baffles are deflectors between the cylinders which entirely shut off the free flow of air between the cylinders and direct the air completely between the fins. Thus *all* the air which is passed over the engine contributes to its cooling.

Service tests of the twin Wasp have been entirely satisfactory. One outstanding performance has been the flight of 3600 miles non-stop by the Navy Consolidated flying boat from the Canal Zone to San Francisco; others are the repeated transpacific flights of the Pan American Clippers. The engineers have not ceased their efforts, and even greater powers are predicted for this type of prime mover.—*A. K.*

Sulfur Dioxide Recovery

A NEW process, applied in Germany and the Netherlands, recovers sulfur dioxide, the objectionable gas produced as a by-product of many industrial operations, in pure form directly from the dilute waste gases. Sulfur dioxide kills vegetation when allowed to go to waste in the air and hence legal restrictions require that plants producing the gas prevent its escape. Many methods have been used for capturing sulfur dioxide and converting it into useful, salable forms—generally sulfuric acid. However, there is an important market for the gas itself in pure form as the working medium in certain refrigerating systems and for other processes. Hitherto it has been uneconomical to recover the gas itself from the dilute mixtures produced by many industrial operations, particularly the smelting of ores. The new process, called the "sulphidine" process, solves the difficulties formerly met by dissolving the gas in a mixture of xylidine (similar to aniline) and water. This mixture removes sulfur dioxide from even dilute mixtures completely and quickly. When saturated, it readily parts with the gas on heating. The recovered gas is extremely pure and the cost of the process has been found to be low enough for economy.—*D. H. K.*

Bridge Floor Grating

A FEW years ago bridge engineers were startled by a suggestion made by Walter E. Irving, C. E., that open gratings be used as decking on bridges. The traditional idea was that the floor of a bridge should be of solid construction, and the conservatism of engineers kept them from foreseeing the many advantages of an open grating such as that developed by Mr. Irving. Since then, however, this new construction has been used with such complete satisfaction in a number of large bridges that it has taken its place as an important contribution to bridge building.

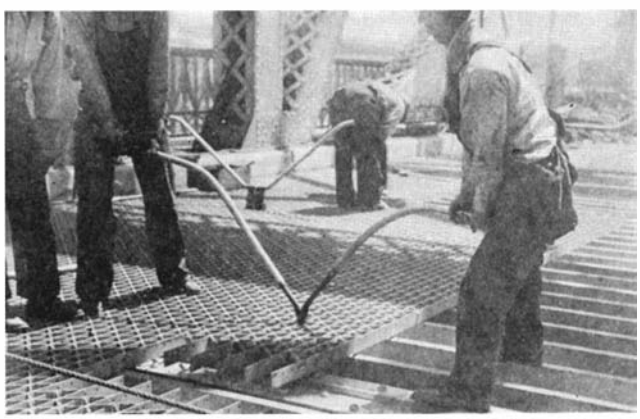
As shown in the accompanying illustrations, Irving decking is very similar to the sidewalk gratings so familiar to all. The interstices are, however, much larger and the vertical thickness considerably more than is usually found in gratings of this sort. Its principal construction feature lies in the fact that it is joined by a patented interlocking process which makes an entire bridge floor, in effect, a single sheet rather than a series of joined panels.

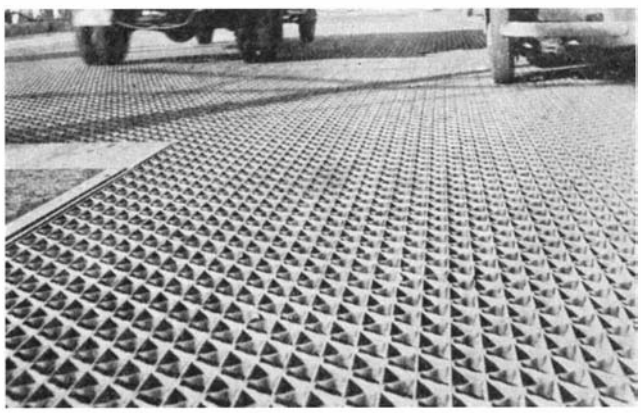
Contrary to first impression, installations of this decking have not worn the tires of automobiles unduly. Its main advantage is, perhaps, its light weight in comparison with heavy, paved floors so generally used. Another extremely important advantage is that at no time does ice or snow accumulate and impede traffic. This last is important when it is considered that on some bridges very great difficulty has been experienced in working out a road surface which will prevent accidents. A notable example of this problem may be seen in one of the New York City bridges over the East River where, despite much study of the problem, many disastrous accidents have occurred in wet or snowy weather. According to reports of those who have studied installations of Irving decking, such accidents will never be caused by the flooring.

Book on Aircraft Diesels

THERE has been so much controversy regarding the aircraft Diesel engine, so much development work carried on in Europe and the United States, that a book on this topic is both timely and valuable. Such a book is "Diesel Aircraft Engines" edited and published by Paul H. Wilkinson. Mr. Wilkinson has been connected with the aircraft and engineering industries since 1911, with experience in England and the United States. He has made excellent use of his knowledge and has produced a book which is eminently readable—semi-popular, semi-technical in outlook, and entirely accurate. In his historical introduction the author points out that the Junkers *Ju/52*, a well known and extensively used airliner is Diesel powered; so are the *Graf Zeppelin* and the *Hindenburg*. These ships are a complete demonstration of the practicability and efficiency of the aircraft Diesel.

We did not realize until we read Mr. Wilkinson's book how many modern aircraft Diesels have actually been developed: In the United States there are the Deschamps 12-cylinder Prestone-cooled rated at 1200 horsepower at 1600 revolutions per minute; the Guiberson 9-cylinder air-cooled radial, rated at 210 horsepower at 2050 revolutions per minute, weighing 509 lbs.; the Packard 9-cylinder air-cooled radial, 240 horsepower at 2050 revolutions per minute, weighing 510 lbs. In England there are the Bristol Phoenix, 9-cylinder 430 horsepower at 2000 revolutions per minute, weighing 1090 lbs., and the Napier Cul-





Squeeze-rivetting units of the new grate decking for bridges; and a finished deck

verin 12-cylinder, with two banks of six vertically opposed cylinders, developing 740 horsepower at 1785 revolutions per minute, weighing 1786 lbs. In France there are the 14-cylinder two-row air-cooled Clerget; the C.L.M. Lille with two banks of 6 cylinders vertically opposed; and the Salmson, another air-cooled engine of 18 cylinders. In Germany there are two Junkers engines (which have been described in these columns), and the Mercedes-Benz, of rugged construction in use in the two large airships. Czechoslovakia is responsible for the ZOD 260-B. Space will not permit anything but mention of these interesting types.

Aircraft Diesels are distinguished from gasoline engines by much higher compression ratios, ranging as high as 17 to 1; much higher specific weight; greater fuel efficiency; the ability to use heavy, non-inflammable fuel oils; direct injection of the fuel spray at a predetermined point of the cycle; and firing of the charge without spark ignition.

Of course, the exponents of the gasoline engine point out that with the liberal use of tetra-ethyl and high octane ratings, the compression ratios and efficiencies of the spark ignition engines have been constantly going up. But the gasoline engines will always involve fire hazards and expensive fuel. However, no theoretical discussion, no laboratory tests, will ever settle the controversy. Only the development of both types and extensive service use will settle the question. In the long run what is most likely to happen is that each type will find its own particular sphere of influence.

Our best thanks are due to Mr. Wilkinson for producing such a concise, interesting, and impartial survey of the whole development.—*A. K.*

EMPLOYMENT

WAGES of petroleum refinery workers were nearly 8 percent higher last year than during the boom year of 1929, a study by the U. S. Bureau of Labor Statistics shows. Employment was only 11.9 percent below that of 1929.

Champion Blood Donor

RAYMOND BRIEZ works in the public markets of Paris, but he also has a thriving business of his own. He engages in the manufacture of blood, and since he entered the business in 1924 he has sold 257 quarts.

The output of Briez's human factory—his own body—is enormous when one considers that it takes only 7½ quarts of blood to fill the blood vessels of an adult man. During 1935, Briez manufactured enough blood to supply himself and to give 98 transfusions. Each transfusion averaged about 10 ounces. Last year broke all his previous sales records.

The champion blood donor of Paris started his manufacturing business in a small way. In 1924, he gave blood for four transfusions. The next year his orders jumped to 38. In 1927, the number of transfusions supplied by him attained the astonishing figure of 94, and from that time until 1935 he averaged from 50 to 60 a year.

No ill effects have been noted, and Briez

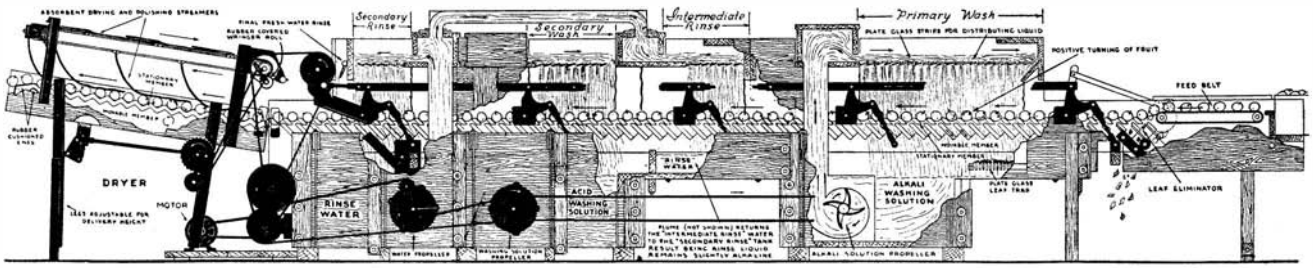


Diagram of a machine for removing spray residues from fruit, showing the several stages of the process

is always ready for another call, according to the Paris correspondent of *The Journal of the American Medical Association*.

Translucent Marble

A NEW marble, christened Lumar, which attains a high point of light-transmission and in which sub-surface beauties of color and texture appear in spectacular fashion, is the outcome of a long period of intensive research into the crystal formation of various types of marble. Of the six varieties of Lumar which have resulted, Lumar Yule, developed from Colorado's own marble, has the most brilliant light intensity.

The objective of the study of the calcite crystals of which marble is composed was

Marble panels lighted from within

to determine the types of marble in which the structure was especially adapted to the transmission of light. The ability of these crystals, which are the same type as those used in optical instruments, to transmit light varies with the direction of the incident beam. The task of the research, therefore, was first to select the proper marbles, and then to evolve a method of processing them which would make the most advantageous use of their individual characteristics. The details of the process are, for the present, a closely guarded secret.

Lumar transmits light in varying degrees of intensity and at the same time discloses in all the vividness of their natural beauty the wide variety of colors and veinings which lie within the solid marble.

Poison Spray Removal

FEAR of poisoning from the tiny residues of lead and arsenic left on fruit by the sprays used to protect it from insects has encouraged the development of better and better methods for removing these poisons. Methods now standard in the fruit industry include washing with weak hydrochloric acid solutions or solutions of water glass. However, the waxy coating on apples and pears holds traces of these poisons on heavily sprayed fruit that cannot be removed completely by ordinary methods. R. H. Robinson, of the Oregon Agricultural Experiment Station, reports in *Industrial and Engineering Chemistry* a new method of making such fruit safer to eat by supplementing the ordinary treatments with a wash of petroleum oil. This solvent dissolves the waxy layer and allows the other treatments to take effect. Federal regulations place the maximum permissible amounts of lead and arsenic trioxide at 0.018 and 0.010 grains per pound of fruit. The danger from such poisons is that they accumulate in the human system and may ultimately build up dangerous concentrations if one eats poorly washed fruit.—*D. H. K.*

Weather Map in Three Dimensions

A NEW type weather map showing meteorological conditions in three dimensions to an altitude of 16,000 feet has been developed by I. I. Zellon, of the United States Weather Bureau in Pittsburgh.

Mr. Zellon's device consists of a small box holding eight glass plates slightly separated. Each plate represents 2000 feet of height, while the basic ground map below the plates is an outline of continental United States.

The new development is helpful in the plotting of upper air weather information obtained by pilot balloons, army airplane flights, and the weather data supplied by airline pilots. This new system of taking weather information is known as air mass analysis because not only are ground data taken but also the nature of a cross-section of the upper air is determined.

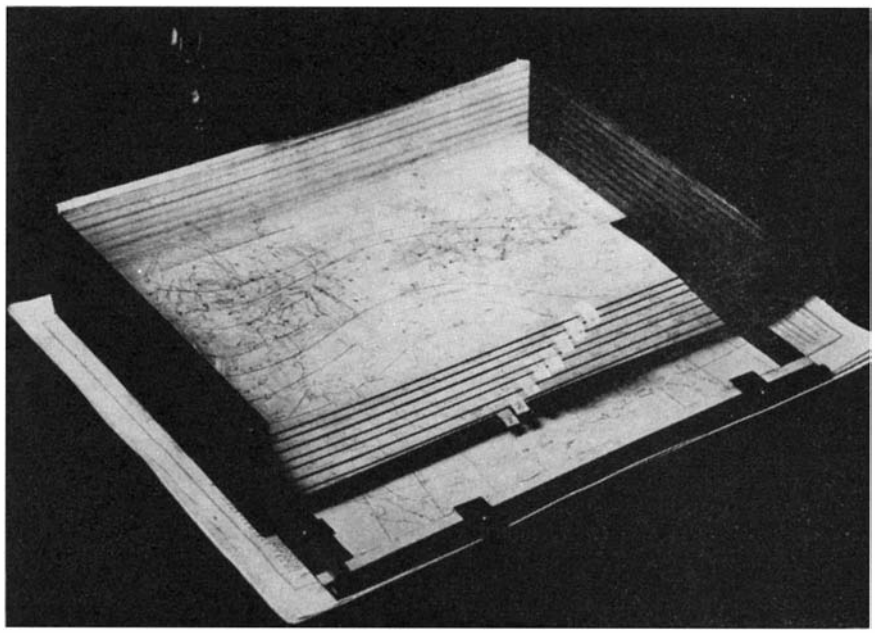
Fast-drying opaque inks of different colors are used for plotting the various aerological data; wind velocity may be red, pressure blue, and so on.

Says the government weather scientist: "The meteorologist will find that he can rather quickly plot on these panes the data from the pilot balloon and airplane stations, adding the analysis of fronts and air masses, for each 2000 foot level. By looking down through the series of plots a graphic picture of the synoptic situation in three dimensions can be gained. Although this gives a somewhat cruder representation of the upper air, in some respects, than a carefully drawn cross-section, it has the advantage of giving three dimensions rather than two, and of being more legible and intelligible to one not a technician in modern aerological analysis. Airplane pilots in particular can learn to read more readily from the mapping frame than from the ordinary surface map or cross-section the information they wish to know; it should be better in this regard than a series of upper air maps laid side by side, if the glass frames be large enough, well drawn, and properly illuminated."—*Science Service.*

Bearded Lady Refeminized

THE first operation on the pituitary gland performed in the hope of refeminizing a bearded lady was reported by Dr. H. Lisser of the University of California Medical School at a recent session of the Association for the Study of Internal Secretions.

Similar operations have been performed



How the three-dimensional weather map is built up in layers

for the removal of adrenal gland tumors which had been the cause of virilism.

The operation reported was successful for the first year. The patient lost her beard and other symptoms of the pituitary disorder from which she suffered, following removal of part of the pituitary gland.

During the second year after operation the beard grew back and some other signs of the original condition reappeared. A tumor was found in the part of the gland removed.—Copyright 1936, *Science Service.*

New Uses For Pitch

PITCH has been found to serve as a highly satisfactory powdered fuel for the direct firing of rotary lime kilns, says *Chemical Trade Journal.* The pitch is marketed in the form of flakes, produced on rotating cooled drums or on moving water-cooled metal belts.

Another use for pitch has developed with the recent installation of several thousand miles of steel pipe for conducting gas, requiring coatings for protection against corrosion. Coal-tar pitch has been used in large quantities by pipe-layers.—*A. E. B.*

CATARACT

MANY young and middle-aged women who have taken the dangerous fat-reducing medicine, dinitrophenol, have developed cataract of the eye.

Animals' Ears More Efficient Than Best Man-Made Microphones

QUANTITATIVE measurements on the ears of guinea pigs show the animal ear to be a far more effective microphone than those constructed mechanically, according to Professors Ernest G. Wever and Charles W. Bray, of the Princeton University Department of Psychology.

Small currents arising in the cochlea of the inner ear and measured on an oscillograph provide an accurate measurement of the response of the animal to sound, and the results of recent experiments show that the animal is capable of responding to tones of a wide range of frequencies, even though these tones be quite faint, whereas it is a well-known fact that mechanical microphones must sacrifice either sensitivity or range.

That this electrical method of measuring sound effect is accurate was determined several years ago when the small currents were amplified about half a million times and run into a telephone receiver. It was then possible for one person to talk to the animal and another person in a distant room not only to recognize the words but the voice of the speaker.—*Science Service.*

Where Ice Cost is No Item

ACCORDING to the United States Bureau of Dairy Industry, the ice-well method of cooling and holding cream on dairy farms proved a good investment in the Northern Great Plains area last summer. To construct an ice well, a hole approximately 9 feet square and 9½ feet deep is dug on a well-drained location convenient to the milk room and the water supply.

Trophy for Diesel inventions

Small- to medium-sized stones are set in the bottom to a depth of 1½ feet. Two-by-four studs are placed two feet apart against the earth walls. Cheap unmatched lumber nailed to the studding gives an ice storage space approximately eight feet square and eight feet deep. A small structure is built over the well—the floor in sections to facilitate removal—to allow free circulation of cold air when freezing the ice block in winter.

On the arrival of cold weather, water is sprinkled on the stones until a solid bottom of ice gradually freezes in the well. Snow and water may be used at the start if snow is available. Freezing the bottom of the ice chamber cannot be rushed as adding too much water at one time will melt the thin layer of ice in the bottom and allow the water to escape through the stones. Adding the water in thin layers and frequently on good freezing days and nights gives the most satisfactory results.

A 6½ foot block of ice in the well will leave room for a five-gallon cream can between the top of the block and the floor. Experience shows that an ice well, opened for use in May, will last well into September or October.—*Journal of the Franklin Institute.*

Prize Offered for Diesel Invention

INVENTORS with inclinations toward Diesel engines are given encouragement through the offering of a 1000-dollar cash prize for the best Diesel invention submitted before midnight, April 30, 1937. A perpetual silver trophy has also been offered on which each year's winner's name will be inscribed. The thousand-dollar prize and the Diesel Inventors Trophy will both be given by Mr. Ralph Hemphill, president of the Hemphill Diesel Engineering Schools, Inc.

It is anticipated that during the next five years there will be as rapid development in the Diesel engine field as there has been in the gasoline engine field during the last 20 years. Such being the case the offering of a prize of this value for the most outstanding improvement in the design, accessory or testing equipment of a Diesel engine, will foster the efforts of many engineers and laymen that might not otherwise take an interest in the Diesel.

REBIRTH

A CAT may have nine lives but one butterfly, the gold-banded skipper, is born seven times. It actually passes through six metamorphoses in its progress from the almost microscopic egg to the adult insect, each stage having its own peculiar physical structure, color, and way of life.

Vacuum Grass Seed Harvesting

AGRICULTURAL engineers and agronomists of Kansas State College, cooperating with the Federal Soil Conservation Service, have recently developed and tested an experimental machine for harvesting buffalo grass seed. Resembling, in principle, a mammoth vacuum cleaner, the machine sweeps the native buffalo grass sod, picking up by a strong suction the seeds imbedded in the short grass.

The importance of the machine lies in the fact that buffalo grass has proved itself an excellent land covering in the plains states for protecting the surface against water and wind erosion. The greatest drawback has been the slowness of propagation of the grass. It is propagated by roots or by setting out pieces of sod which will send out runners and slowly cover the surface. This method of sodding is both slow and expensive. It was the hope of the Soil Conservation Service that the grass could be propagated by seed and this necessitated a machine to harvest the seed.

The apparatus developed consists mainly of a large engine-driven suction fan mounted on a trailer. The seeds deeply imbedded in the turf are picked up by a suction nozzle connected to the fan by a flexible tube and running close to the ground. A tube on the discharge side of the fan carries the seed to a dust collector and bagger. The material picked up by the machine and caught in bags consists of seed and large amounts of dirt and other foreign material. By cleaning the material with a common fanning mill, a final product containing about 50 percent seed can be obtained.

Tests with the experimental machines gave 95 percent efficiency in harvesting buffalo grass seed from a pasture previously clipped with a mower. Where the grass turf is not too dense, efficiencies of from 50 to 70 percent were obtained without the aid of a mower.

Antidote for CO Poisoning

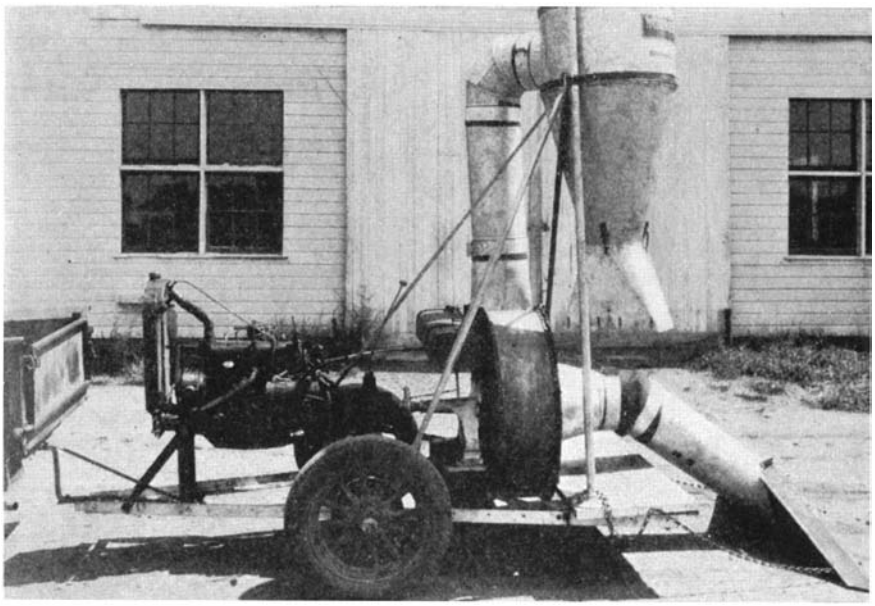
TESTS made by Sam and Joseph Seifert, of the University of Oklahoma School of Medicine, indicate that a compound made from ferric chloride and hydrogen peroxide may be an effective antidote for carbon monoxide poisoning. The compound, hexahydroxyferric chloride, showed 75 percent recovery when injected into rats suffering from carbon monoxide poisoning, according to a report made by these investigators at a recent meeting of the American Chemical Society. Results are encouraging although not yet conclusive.

The deadly effect of carbon monoxide is produced by the combination of this gas with the hemoglobin of the blood to form a compound which is not easily broken up by oxygen and which prevents the blood from carrying life-giving oxygen to the various parts of the body. Many treatments of this form of poisoning have been partially successful and the search is being continued for a sure antidote.—*D. H. K.*

New Non-Poisonous Insecticide

ELIMINATION of the hazard to health resulting from spraying poisonous insecticides on fruit and vegetable plants is promised by the discovery of a new, effective insecticide known as phenothiazine.

A large number of organic materials have been investigated by the Bureau of Entomology of the Department of Agriculture and at last one has been identified which apparently is just as good an in-



Buffalo-grass seed is harvested efficiently with this "vacuum cleaner"

secticide as lead arsenate but offers none of the difficulties of spray residue. This material is phenothiazine, an organic chemical compound synthesized from easily available cheap chemicals by an inexpensive process.

Phenothiazine is manufactured by fusing together one part of diphenylamine with two parts of sulfur at 180 degrees, Centigrade, using iodine as a catalyst. The crude product may be purified by recrystallization from toluene. It is a light yellow crystalline powder which melts at about 180 degrees, Centigrade, neutral in reaction, insoluble in water, and only slightly soluble in cold oil or the usual organic solvents.

This new compound is applied as a dust for dry treatment if desired; but the preferred application is a suspension in water containing a wetting or adhesive medium.

Phenothiazine is non-toxic to man and to all warm-blooded animals. This means that the agricultural user has no problem of preventing stock from access to foliage or fruit which has been treated. If the stock eat such material there is no harm. If there be any residue of the spray on the fruit or vegetable reaching the canner or the home kitchen, there is no danger in this.

If the new insecticide proves even half as good as anticipated, it is likely to supplant the metallic type of insecticides within a year or two.—*A. E. B.*

SKIN PROTECTION

THE coloring matter of the skin provides an anchorage for scurvy-preventing vitamin C and the vitamin, in turn, protects the skin from injury by harmful light rays.

Color Filters in Windshields to Help Color-Blind Drivers

A SIMPLE and "infallible" help for the color-blind automobile driver who gets into difficulties because he cannot distinguish between green and red traffic lights is suggested by Thomas Ross of the University of Washington. In a report to the magazine *Science*, Mr. Ross describes a contrivance that can be fitted to the windshield of the color-blind driver's car.

The device consists of small pieces of special glass which can filter out either red or green light. With the red filter placed above the green one, the driver will know that when he sees a light through the top piece of glass he is seeing a red light. When he sees the light through the bottom piece in this arrangement it is a green light. The device is improved by placing a prism over each filter in such a way that the traffic signal will be visible through both filters at the same time.

This idea has worked in actual trials, Mr. Ross reports. It could be adapted to persons suffering from other types of color-blindness besides the red-green kind. A variation of the red and green filters is also suggested. One of the color filters, says Mr. Ross, might be perforated and parts of the other set in it like polka dots.

"Thus, if the red filter were perforated and the openings were filled with the green material, a red traffic light or other red ob-

(*Please turn to page* 50)

THE AMATEUR TELESCOPE MAKER

Conducted by ALBERT G. INGALLS

LAST month we described a telescope having a sufficiently rigid mounting to stand up solidly against all sorts of outside forces which cause telescopes that have whippy mountings to vibrate and shimmy, and now we show a photograph of another which meets with the same requirements and, incidentally, is a very fine job. It was made by Alan Gee, 2969 Upton St. N. W., Washington, D. C., and C. Carvel Diller, 1423 Buchanan St. N. W., the same city. It is a 12½" instrument and has a solid 3" polar axis. Asked for a description of this unusually fine job, Mr. Gee writes: "The telescope is a 12½" Newt-Cass combination of 57" primary focus and 150" secondary focus. This telescope is a good example of what can be accomplished by co-operation among amateurs. Mr. Diller made the mirror, his first one, but had never made any mountings. As I had had considerable experience in mounting making, I designed the mounting for him. We then constructed it together, the work requiring about a year and a half.

"The telescope has a synchronous motor clock drive, as well as electric fast and slow motions, push button controlled. The electric drives, which I constructed myself, are all ball bearing equipped and operate perfectly. All polar axis motions work through the same drive gear, using a differential for the slow motion and an electric clutch for the fast.

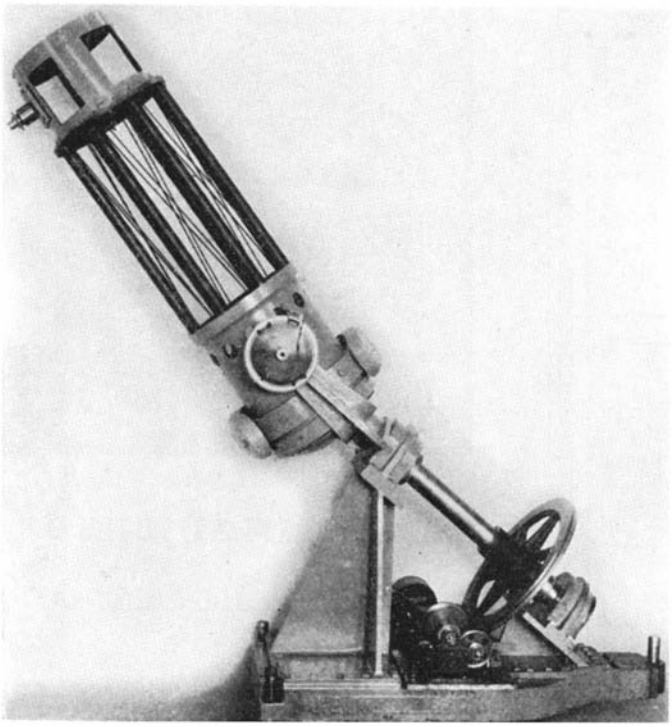
"Interchangeable sleeves for the tube are used for the Newt-Cass transfer. There is no hole in the mirror, so a lower prism is used. The telescope is very rigid and easily controlled.

"Any other amateurs wishing more information about this telescope can obtain it by writing to me."

And Mr. Diller writes: "I am employed in the Glass Section of the National Bureau of Standards and, being associated with experts in optics and engineering, I became interested in astronomy and then in building the telescope. I consulted with Dr. Ritchey, the well-known telescope builder, and my instrument is of the fork type mounting similar to that used by him on the 40" 'scope that he built for the U. S. Naval Observatory here.

"I ground and figured the 12½" mirror by hand, doing the work evenings and in my vacation periods over a time of about five months. I also had the use of a machine shop and the machine work was done nights and Sundays over a period of one year. The patterns and castings for the forks, bearing mountings, and uprights were made by local firms and the large 20" driving gears, as well as the other various gears and worms, were purchased from the Grant and Boston gear works.

"The synchronous motor drives the polar axis through a 20" worm gear. One motor drives for fast, the other for slow motion, through the same 20" gear, by using a differential for one and an automatic clutch for the other. There is a motor drive for declination, and all motors are controlled through a push button unit which is carried in the hand by the observer.



The Diller-Gee, 12½-inch Newt-Cass telescope

"The instrument may be used as a Newtonian or Cassegrain by interchanging the top sleeve, one sleeve having a prism for the Newtonian, the other for the secondary. With the assistance of the Rev. Dr. Sheehy and Mr. Ernest Valada I obtained permission to mount the telescope at the Catholic University."

Data on the clock drive of this telescope will be included in "A.T.M.," Vol. II, the renamed "Supplement."

OLD stereopticon lenses make good finders for telescopes, according to Cyril G. Wates, 7718 Jasper Ave., Edmonton, Alta. "I bought one cheaply in a second-hand store," he states, "and discovered that the front combination was semi-achromatic, covered a very wide field and gave lots of light. With a cheap 1" eyepiece and No. 40 cross-wires it makes a splendid finder. There must be thousands of these old lenses on the market. Remove the rear lens, solder a tube on the back of the mounting, and focus by means of the rack and pinion already found on the lens. Such groups as the Pleiades look fine in the finder."

Readers often inquire what use to make of such lenses, and here is the answer.

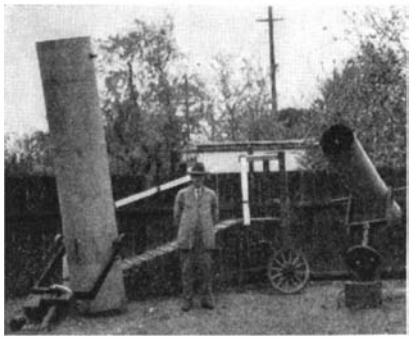
AN English firm (Watson) advertises an odd but interesting stunt: a 15" single lens hung in a front window. "If the observer is 6' from the lens the distant objects appear enlarged 1½ times, and the greater the distance of the observer the greater the magnifying power of the lens. One may recognize the visitor far down the drive and, if desirable, establish an alibi in time, also watch birds and so on." It ought not to be difficult for the amateur to fix up something similar. It wouldn't be achromatic, but probably would distinguish a bill collector in time.

A WRITER in *Nature* suggests that the unsteadiness of the images so often given by reflectors arises largely from the fact that their mirrors are so near ground level where the air is disturbed by temperature differences. As refractors generally give steadier images than reflectors, this is a point to reckon with. The mirror lies closer to the ground than the objective of a refractor. In past generations acres of paper have been covered with published arguments about the superiority of the reflector over the refractor, though many reflector owners concede the point to the opposition, in their franker moments. But it is easier and less expensive to build a fair-sized reflector.

WAY back in prehistoric days, when the telescope making hobby was evolving from the ape stage, we published (Feb. 1929) a letter from Dr. J. J. Byl, 430 S. 13 St., San Jose, Calif., describing his telescope, and in it he wrote: "I am a retired physician well along in years but have great anticipations of joy in so profound a study as the boundless Universe, and I am sure that my days will never be shortened by a loss of interest in life." At that time he had already made a 10" and a 12" telescope. Seven years have gone by and here is what we now hear about the same Dr. Byl, written by Ralph Dietz, 330½ S. Fifth St., San Jose. "I enclose a picture I took of Dr. J. J. Byl and some of his many 'scopes. He is a rather elderly man and all he lives for is to build telescopes. He has on hand, that I know of, two 12", four 10", several 8", one 15", and 'The Howitzer' or 22". The photograph shows the last named two. His mind is running on all six and he will try anything once." (Photograph on opposite page.)

And so Dr. Byl's own prediction very happily turned out to be true. So far as we know, this 22" is the largest amateur's telescope, though Hindle is now building a 30". No doubt when Dr. Byl hears this he will tackle a 31"!

WITH so much amateur talent constantly dwelling on every corner of optics—and having what the professional lacks, namely, the leisure time to think—the whole ground is continually being gone over and over, like a hungry monkey in a cage hopefully pawing over the straw for a few uneaten peanuts. The special ground covered by *tests* seems to be exploited the most, with the result that new tests are



Dr. Byl and his heavy howitzers

being found, and old tests which have been lost sight of or never learned of are being dug up, often several times and independently. An amateur who independently discovers a valuable test which other amateurs or else professionals have long since used, usually feels but little cheered upon being told that, anyway, the high regard with which it has been held "for the past century or two" does flatter his judgment in developing it independently. Every little while, for the past decade, a report of a newly discovered test has been sent in, and it takes courage to reply to a man who believes he got there first that the discovery, even if original, is not the first. Of course, the standing rule in science is that the first fellow who *publishes* gets the credit. Often this works hardships, but it also helps forestall arguments.

There are tests and tests. Some are of major importance while others are of lesser though considerable importance. In a few instances workers have claimed invention or discovery of things that seemed almost self-evident—though the ones to be described below are not to be thought of in that light. Hundreds of other inventions have been re-invented several times. Recently we read of the invention of the safety pin in the last century. But MacCurdy's "Human Origins" shows pictures of safety pins, almost identical with our common modern diaper pins, from Bronze Age deposits in Greece. The invention was evidently lost, and re-invented in the last century. The power loom, metal pens, and many other things were invented long ago, forgotten and then re-invented. But all of this is not meant to discourage amateur opticians from reporting their original ideas, whether they turn out old or new.

Last year, on July 12, Floyd L. Frazine, 868 Central Ave., St. Petersburg, Fla., suggested testing a convex surface by means of interference fringes between it and a concave test plate. Thirteen days later Wilbur Silvertooth, 273 Ximeno Ave., Long Beach, Calif., independently suggested making "a concave master, using the tool for the final convex secondary and figuring to appear flat in conjunction with the test mirror; then polishing the concave and figuring by checking on the concave master until the fringes are straight. But," he

added, "I have learned, since having this idea, that all Cass secondaries by Zeiss are figured by interference against standard masters." Largely on account of the last statement publication was put off, and last March J. V. McAdam, of Hastings-on-Hudson, N. Y., wrote that he had figured out a way to short-circuit hard work: "Fine grind the convex with a concave, polish the mirror, lay it on the tool and observe the interference fringes through the tool." The same general idea.

Well, this makes three who have independently thought of this method, and it is too bad it proved to be an old one. Perhaps other amateurs can give them a cheer, anyway; it isn't their fault that they were born 30 years too late! Still further, Ellison comments: "I too have found that it is not difficult to test Cassegrain convexes from the back, treating them as concaves. There is an error, but it is not great, and can be allowed for." And Hindle: "I have never used this method, on account of the danger of scratching the surface, but I believe the system is extremely old, and in very general use amongst manufacturers for checking the curvature of convex lenses."

A similar case of independent discovery was that of Joseph E. Boehm, 3511 N. Seminary Ave., Chicago, who tested a 14" perforated primary against an 11" flat placed inside the focus. His letter was referred to Hindle, since the latter was known to be especially interested in tests, but without knowledge on our part that the same test had actually been published by him in *English Mechanics* (April 20, 1923). Another case of independent discovery. Boehm found the test invaluable to short focus mirror workers, he states.

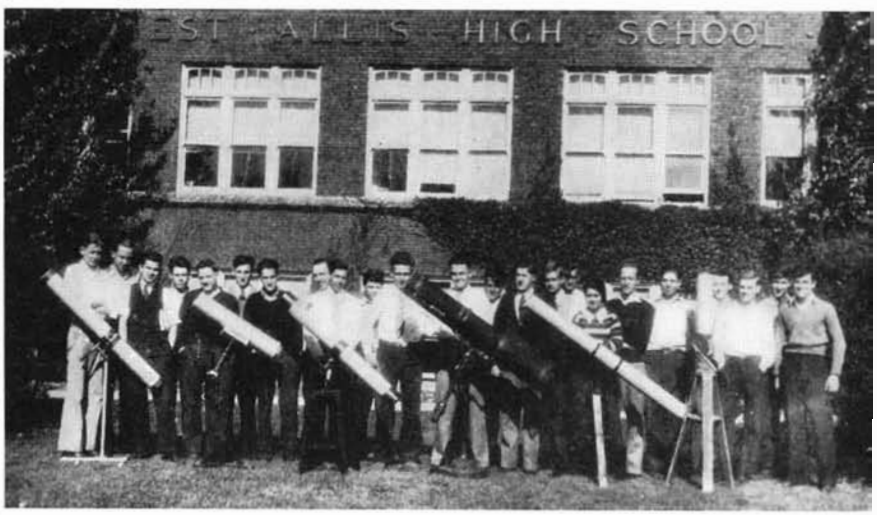
Several amateurs discovered different ways to make the Ronchi test quantitative, but it now looks as if Ronchi himself published the first method. If we could read Italian we might be more certain about it.

About 1933 Alan R. Kirkham suggested a test in which the pinhole is placed at the focus of a paraboloid, the rays being reflected as parallel rays and received by another paraboloid, then brought to a focus and cut by the knife-edge. This was published only as a multigraphed sheet which not everyone saw, and in 1935 William Mason of Lorain, Ohio, proposed exactly the same test. Even then we failed to publish it, and later that year James Hart Wyld of Princeton University made the same proposal. By that time Kirkham had actually tried it and, when shown Wyld's letter, he wrote, "This is my test, but I'll be darn glad to give it away; I don't remember who gave it to me or I'd kill him. The main trouble is collimation, also diffraction effects." We did not publish this, and not long afterward S. H. Sheib of Richmond proposed the very same test. That makes four separate optical geniuses or else one optical genius and three geniuses in mind reading.

We now publish these various notes on tests in order to forestall others who may be devoting good time to the re-invention of these earlier ideas, but not, however, to discourage anyone from discovering an important new test which would add to the prestige and standing of the amateur telescope maker and be an aid to science.

MANY different dodges have been worked out to avoid spending long hours in polishing telescope mirrors. J. J. Stoy, 501 City Hall, Atlanta, Ga., states that he polished a 12½" Pyrex mirror in less than 9 hours, by using a suggestion of another TN, Mr. H. E. Bussey, in his city. "Settle No. 303½ for 60 minutes, first stirring it thoroughly. Siphon off the water. Settle 24 hours and dehydrate. Mix the residue in 3 tablespoonsful of water and 1 of glycerine, to neutralize the evaporation effect as far as possible. Grind in 10-minute wets, alternately with mirror and tool on top. Mix the water and glycerine before putting in the emery; otherwise, trouble."

TO answer those who inquire about the new book (Supplement, or "A.T.M.," Vol. II) on which we are still working, and ask when it will be ready: at present (May 28) about a score of major contributions are in and "ready for printer." Three still remain to come. Hence it is yet impossible to name the date.



The Physics "A" class at the West Allis High School, West Allis, Wisc., where telescope making is used as project work to create added interest in light and optics. It proved possible for each member of this class to make a 4-inch telescope at a cost of but $1.25. Each telescope was different from the others, and was made largely from pick-me-ups. A motion picture film of grinding, polishing, and testing telescope mirrors is available through H. R. Stamm, of the Science Dept.

CONVENTIONS of amateur telescope makers and astronomers: At the Harvard College Observatory, Cambridge, Mass., Saturday, July 18, sponsored by the Amateur Telescope Makers of Boston, Arthur G. Hall, Sec., 63 Commonwealth Road, Watertown, Mass. At *Stellafane*, near Springfield, Vermont, Saturday, August 8, sponsored by the "mother club," The Telescope Makers of Springfield, R. J. Lyon, Sec., Springfield, Vt. Anyone who is a telescope maker or only an amateur astronomer is cordially invited to come to these open, informal conventions.

A *Science Service* photograph of Leonid Surodeikin, worker at the Leningrad Optical Institute, U. S. S. R., preparing equipment to be used in the July eclipse. Data about the job being done are not given, but a thin glass disk is obviously being polished on a typical pitch lap

New organizations: Amateur Telescope Makers of Spokane, R. H. Dellar, Sec., 1017 Cedar St., Spokane, Wash. San Diego Astronomical Society, James T. Hyatt, Sec., 4041 Oakcrest Drive, San Diego, Calif.

New publication: Astronomy Club Bulletin, Saint Lawrence University Astronomy Club, Canton, N. Y. Entirely astronomical.

Exhibition: International Astronomical Exposition, Sociedad Astronómico de España y América, Señor Don Federico Armenter de Monasterio, Secretario General, Calle Cortes 573, Barcelona, Spain, in October. R. L. Beardsley, 2515 W. 21 St., Los Angeles, Calif., who is a member of this organization, states that the society wishes to get in touch with American amateur societies and supply dealers who will exhibit. Leo J. Scanlon, 1405 East St., Pittsburgh, Pa., plans an exhibit and is open to suggestions regarding material, which is to be sent to Spain Aug. 1.

Summer school of astronomy: Harvard College Observatory, Cambridge, Mass., July 6-Aug. 15. "The elementary aspects of astronomy are by no means neglected. It introduces the student to the variety of astronomical instruments."

One hundred amateurs wanted, once and for all time, to verify or destroy claim that a 6″ telescope can "read a watch at half a mile." Send reports to Exaggeration Dept., in care of Ye Olde Scribe, this magazine.

CAMERA ANGLES

Conducted by JACOB DESCHIN

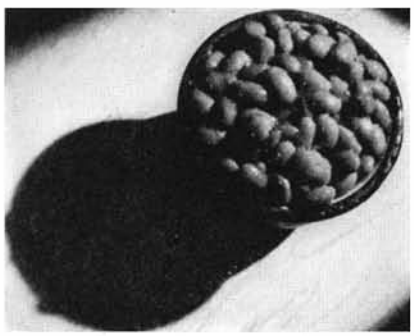
Things To Eat

THE photography of objects gastronomic is not necessarily the monopoly of commercial workers. They often do a beautiful job of picturing a salad, a cake or a pair of chops, but often, too, the performance is a very poor one. So let not the hobbyist balk at what appears to him to be out of his range. If he composes his picture properly, places the light or lights at a suitable angle and uses the right kind of film he has nothing to fear. It must not be overlooked, also, that part of the effect of a well-made commercial food picture is the subject itself, which in most cases is made up and arranged by a chef or cook specially schooled in the arts and wiles of tickling the human appetite via the eye.

Personally, however, it is the feeling of this department that no masterpiece of a head chef of the most regal restaurant in existence can beat the appeal of Johnny taking a first bite out of a slice of bread well covered with jam, the first cut of a freshly baked lemon meringue pie, a basket of eggs just in from the farm, a pot of beans, or whatever you may be having for supper tonight. Yours truly once whiled away the time it took to cool a bowl of soup to a reasonable temperature for eating purposes by taking a picture of it, which is, incidentally, one way of having your soup and eating it, too.

The principal requirements of a good food picture are that it should show texture and form, have a range of tones sufficiently long to reproduce the subject adequately and that it should have an appetizing, "mouth-watering" atmosphere about it. It should look real, "good enough to eat." Lighting for texture is merely a matter of directing the beam at a cross angle so that the smallest detail will throw a shadow. Thus, in the picture of the bread reproduced here, a spotlight was used, the beam being directed at the surface at such an angle that the light just "grazed" it.

In the case of the pot of beans and "Three of a Kind," cross-lighting would be no advantage since, the objects being round and smooth, there is no texture to record. Good general lighting at the normal 45-degree angle will serve to give full illumination for the subject as a whole as well as to create the highlights that give roundness and form. In making the picture of the beans a spotlight was used to throw the shadow of the pot and a weaker general light on the other side to "fill in" the shadows of the beans to some extent. As to



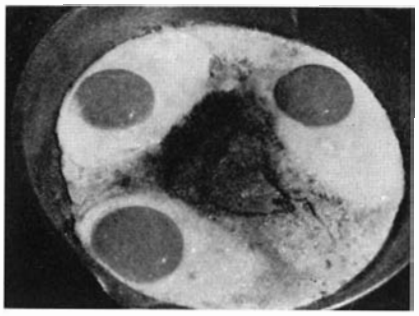
Beans and Shadows

choice of film: for purposes of contrast it is best to use orthochromatic, but where fuller color correction is required, as when reddish tones are to be included, panchromatic film should be used. Choose the slower speed when using the latter as it will give better contrast than "superpan." The "slower" film will not be a drawback as most food pictures that you take will probably require time exposures.

Inasmuch as reproduction of photographs by the half-tone process, and the reduction in size to fit the columns, necessarily degrade print contrast quality to some extent, the illustrations are not to be considered as exact reproductions of the originals.

In general, you will find that in food

"Lighting for texture is merely a matter of directing the beam . . ."



Three of a Kind

photography the most important thing is lighting, for which reason you will probably do more experimenting indoors, where you can direct the light as you will, than outdoors. However, the outdoors is not to be neglected, as at certain times of day, in the morning and later afternoon, you will find on farm and city market-places ideal lighting conditions for many food subjects.

Stirring Rod Rack

A CONVENIENT arrangement for keeping thermometers and stirring rods so that they are quickly accessible when required is a rack through which a number of holes have been drilled with a circumference large enough to accommodate the various items. This rack should preferably be fastened to the darkroom wall so that its location is definitely established. It may consist simply of a strip of wood to form the shelf, through which the holes are bored. The shelf should be supported by brackets or appropriately thick pieces of wood at each end and another shelf attached below it at a distance a bit more than half the length of the rods and thermometers. An arrangement like this will be particularly useful for storing the glass type of thermometer that seems so often to become accidentally broken because there is no place for it. Also, it will obviate groping about for rods and thermometers when they are most urgently needed. And last, but quite important, it's a neater business all around than having these gadgets lying about loose with no place they can call home.

Camera Money

"YOU tell us everything except how to make money with our cameras," one of our readers once remarked to this department. In an effort to repair this omission, this department replies that the ability to make money with a camera is dependent to a large extent on a more or less thorough comprehension of what editors of magazines and newspapers want. You can get a pretty good idea of this by studying the particular magazines or newspapers to which you wish to submit your pictures. Sunday supplements and rotogravure sections in your own or neighboring town or city are the best prospects to aim for. News pictures, unless you happen accidentally on a scene of real news importance and can get it to the newspaper fast enough, are not worth bothering with as news cameramen are pretty alert people and you would have to go some to compete with them. You should keep to the feature type of picture which can be used almost any time. Freak pictures, unfamiliar places about town beautifully photographed, cute baby pictures, odd hobby pictures, unusual winter scenes, are some of the types in demand. There are a number of juvenile weeklies throughout the country that accept short articles of successful young people together with a characteristic photograph, and other magazines buy photographs without articles, though these must be well captioned.

In addition to publications, there is the contest field. A variety of worth while prizes are offered for good photographs submitted by amateurs; advertisers are always in the market for fine baby pictures to use in their advertisements; post cards of scenes about town can be sold to visitors and townsfolk, and many avenues will open to the amateur who makes an effort to do a little pin-money "business" with the neighbors. Many a person who wouldn't dare step inside of a professional studio will gladly "sit" for the amateur.

The prices paid by publishers vary from about 50 cents to five dollars, with three dollars being about the price paid by the papers of medium circulation. The juvenile weekly magazines pay from one dollar to two dollars. Editors demand glossy prints because they feel these reproduce better than those printed on matte papers, and payment by newspapers is generally on publication; some of the smaller magazines follow the same practice, although the general magazine practice is to pay on acceptance. Each picture should be well captioned so that there is no mistake as to what the picture is about and each photograph should bear the photographer's name and address. Enclose return postage if you want the pictures back when rejected.

You can't make a lot of money this way, but you may be able to get enough to buy odds and ends of gadgets you want to buy now and then but which might not be within your reach otherwise.

New Reflex

A MIRROR reflex camera recently introduced by the Mimosa American Corporation is distinguished by the fact that its winding knob does four things at one turn of the knob; namely, winds the shutter, moves the film one frame, actuates the film counter, and sets the mirror for use. Film size is 2¼ by 2¼. It has a focal plane shutter with speeds varying from one second to 1/1000th and self-timer. Lenses are interchangeable up to 40 cm. focus, the purchaser having a choice of one of the following three standard lenses: 10 cm. Meyer Trioplan F:2.8; 10.5 cm. Zeiss Tessar F:3.5 and the 10.5 cm. Meyer Makro-Plasmat F:2.7.

Filing Data

MANY times it must occur to you as you read photographic articles and manufacturers' literature that this and that piece of information might some day prove useful. If you let it go at that, simply relying on your memory, you will find yourself wishing now and then as you are working over some difficult problem that you had copied down a particular formula you had read somewhere because now that you need it you just cannot remember it.

If you have had this experience you will appreciate the advantage of filing away valuable data as you read it either by

clipping it or copying it in a notebook. But do not keep these jottings lying loosely about; file them away, preferably in some card index arrangement. Formulas and other helpful photographic data can be pasted on a card or written out on it. Have a convenient heading for each card so that the cards may be filed under general headings; as each classification grows, you should subdivide the headings to expedite finding the reference when you need it.

You cannot always clip or copy all that you want. In that case, whether it is a book or magazine, make out a card, with the proper heading, say "Portrait Lighting," and on it indicate title and substance of article, name of author, name and date of magazine, as well as page number on which the article appears. This indexing arrangement is advantageous whether the magazine is your own or was read at the public library.

"One-Camera" Magazines

THE vogue of the special monthly magazines devoted to a single camera or line of cameras, so well introduced in the interests of Leica and Zeiss, has been adopted by the Rolleiflex and Rolleicord distributors in a quarterly packed with valuable information for users of these cameras.

Itinerant Photography

THE recent publication of a booklet extolling the pleasures of itinerant photography recalls to this department a camera adventure on a bicycle trip in Bulgaria one autumn when a trio of shepherds, after being photographed, made it clear by various signs that they expected the photographer to pull a picture out of the black box immediately afterward. They seemed rather crestfallen when the photographer wheeled off soon afterward without producing the picture.

Whatever one may think of the money-making possibilities of this rôle of Yankee peddler turned photographer, those of a romantic turn of mind will see its attractions right off. Men have sold books "on the road" and have sung and fiddled their way through Europe all for the joy of the adventure involved. So whether you need the money or not—preferably if you do not—you might do worse than consider itinerant photography as one unusual way of spending your vacation this year.

Tongs

THE use of tongs in picking films and papers out of developer, rinser, and fixing bath is an excellent practice to adopt. There is no chance of getting the fingers stained and the necessity of frequent rinsing of the fingers is obviated. Tongs may be obtained in wood or bamboo and the cost is very little.

Beach and Water

THIS is the time of year when pictures at the beach and on the water will take a good part of your film budget. If you are not careful about selecting the most striking subject-matter, you will find yourself using up considerably more film than the results justify. Enthusiastic appreciation of a beach or river scene is apt to lead to indiscriminate guess shooting in the hope of obtaining one perfect picture out of the lot.

But that isn't the way to do it. Shoot only when conditions are right, giving proportionately more time to study and observation of the scene than to the actual snapping of the shutter. Try for delicate rather than harsh contrasts and to this end avoid the middle part of the day when the sunlight is strongest. A beach or river scene, particularly at sunset, can be very beautiful, but thoughtlessness and carelessness will practically always give disappointing results.

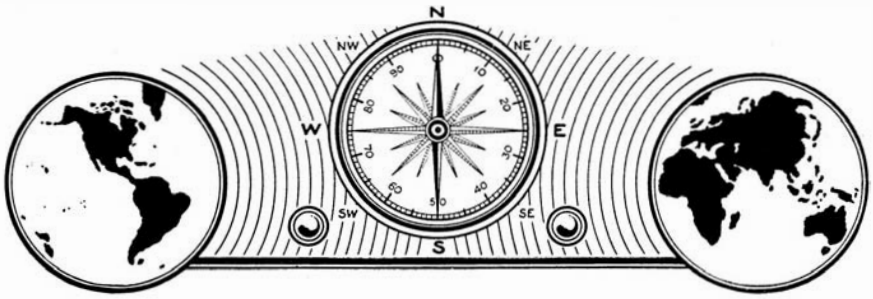
Photographer Into Antiquarian

THE camera-hobbyist who likes antiques but either cannot afford to purchase them or prefers to photograph them both for their picturesqueness and historical value may fully justify this predilection in

". . . pictures of old things . . ."

a number of ways. There are the antique shops, with their window or sidewalk displays, for one thing. Sometimes the light strikes certain pieces in a particularly attractive way and then you have an opportunity to get a reproduction of the object that is at the same time a record and a pictorial achievement. Old houses, old streets, old signs, old statues can be had for the searching. In your walks about town you will stumble upon many odds and ends of architectural detail that will make interesting additions to your growing collection.

Collecting pictures of old things is the next best thing to collecting the old things themselves and you can in time accumulate a collection that will be worth while from the historical and the antiquarian points of view as well as the pictorial. If you go in for photographing old buildings and streets, there may come a time as the world moves forward when these will be eliminated to make way for new buildings and modern streets. Then the pictures you have made will have become valuable documents not only to yourself but as historical links in the town's growth, that will be perused with great interest by the town's historians and antiquarians in later years. In filing pictures of landmarks, it is well to put down all necessary data as to date picture was made and other particulars that might be helpful in studying the picture long after the landmarks have been torn down.



WORLD-WIDE RADIO

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

"HINDENBURG" FREQUENCIES

OWNERS of all-wave receivers will have ample opportunity to receive 'phone transmissions from the dirigible *Hindenburg* during her scheduled transatlantic flights this summer.

The radio transmitter on the *Hindenburg* is equipped to operate on numerous frequencies but has been heard the majority of the time on the following frequencies: 5.8 mc, 10.2 mc, 12.9 mc and 14.4 mc.

Since the transmitter is continually changing in its distance from the points of reception during the flights of the *Hindenburg*, it is not practical to employ a fixed frequency for a certain time of the day, as done by land stations. The frequency used will depend upon the distance of the dirigible from these shores, the higher frequencies being used when the ship is the greatest distance away. Consequently, when she is some distance out, the transmitter is more apt to be heard in the vicinity of 12 or 14 mc, whereas when she nears our shores, the transmitter will more than likely operate in the vicinity of 5 or 10 mc.

The transmitted frequency is varied to take advantage of the "skip distance" of radio waves at various frequencies at different times of the day and night. This is the usual procedure in all short-wave radio communication.

ULTRA-SHORT WAVES

IT has been the general belief for some time that signals transmitted on wavelengths below 7 meters were limited to the optical horizon. Theoretically, such signals cannot be received beyond the line of sight, as they are not presumed to be "bounced back to earth" in the manner of the longer wavelengths. Such signals are supposed to pierce the ionosphere and continue out into space at a tangent with the surface of the earth.

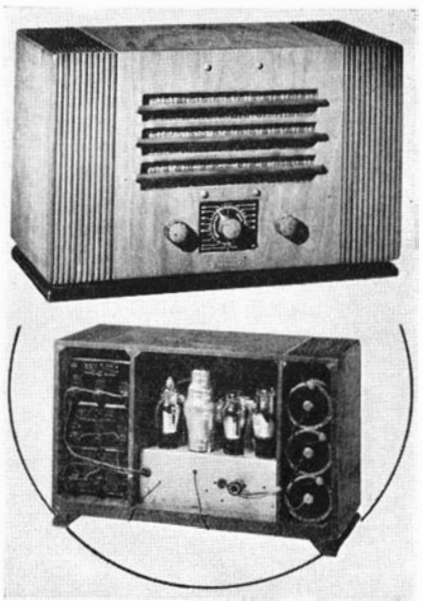
Yet such signals have been heard at distances that discredit this theory. Commercial U.S. transmissions in the vicinity of 7 and 8 meters, which are supposed to be confined to a very small area, are heard regularly in England. Radio amateurs have covered great distances with equipment operating on 5 meters. A west-coast amateur station is heard quite consistently on the east coast and in the south, and it has been reported that an amateur in upper New York State has carried on a two-way conversation with another amateur in England, both operating on a wavelength of 5 meters.

Such receptions have been a bit too consistent to be classed as freaks. Now Dr. Ross Hull, Associate Editor of *QST*, has presented an acceptable theory based on 15 months of research, that these ultra-short waves are affected by atmospheric conditions, such as the moisture content of the air, temperature gradient, and so on, much more so than the longer waves. Under the proper atmospheric conditions, these ultra-short waves are reflected back to earth just as the longer waves are, with the difference, presumably, that waves below 7 meters are bent back to earth right in our lower atmosphere, rather than from the ionosphere which is found some 60 miles above the surface of the earth.

Dr. Hull's theory is in accordance with recent researches carried on in England in conjunction with the transmission of micro-waves below 50 centimeters in length. It has been found that certain atmospheric conditions, such as moisture content of the air, have a definite effect on these tiny micro-rays.

BATTERY-OPERATED RECEIVERS

THERE is a general belief that the battery-operated receiver cannot compare with the a-c operated set. As a matter of fact, the operating efficiency of the modern battery set is by far the greater of the two.

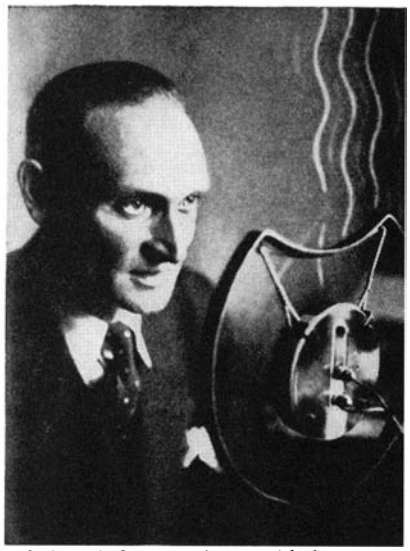


"Kadette," an example of a battery-operated broadcast and short-wave portable superheterodyne receiver

There is little the a-c set can do that the battery set cannot also accomplish. Both have equal sensitivity and selectivity; both are equipped with automatic volume control; both have dynamic type loudspeakers; both have the same handling convenience. For that matter, they even look alike.

Netherlands' Station Active

THE Dutch short-wave station PCJ, at Eindhoven, Holland, operating on a frequency of 9.59 mc, is very active these days and is laying down a fine signal in the United States. The programs are of good



Edward Startz, the world famous announcer at station PCJ, Holland

quality and very little fading has been encountered on the signals.

Until recently, the PCJ programs directed to North America have been heard only on Sunday evenings, from 7 to 8 P.M., eastern standard time. North American programs are now heard Wednesday evenings as well, from 8 to 11 P.M., eastern standard time.

Mr. Edward Startz, the famous announcer at PCJ, makes announcements in Dutch, English, French, German and Spanish.

Amateur's Ace Band

THE recent floods focused the attention of the public on the radio amateur, with the result that many all-wave listeners have experienced for the first time the numerous thrills that crop up in this unique hobby.

The 20-meter amateur 'phone band, which extends from 14,150 kc to 14,250 kc, is of particular interest for two reasons: first, the band may be used only by holders of Class A licences—an advanced grade; second, it is a long-distance band and it is possible to pick up signals from foreign countries with the simplest of receivers.

Amateurs operating radiophone stations in the 20-meter band come from all walks of life. There are numerous dentists, doctors, and ministers, a banker, a well-known musician, a well-known publisher, a movie sound technician, a few cotton growers, and so on.

During the summer months, this band is particularly good from six in the evening until after midnight. During one evening, from 7 till 10, amateurs in the following countries were heard: Cuba, Bermuda, Canada, Nova Scotia, Barbados, Jamaica, Panama, Venezuela, Nicaragua, Brazil, Argentina, England, Belgium, Holland, Spain, Canary Islands, and Egypt!

If you enjoy DX, and you dislike waiting long to find out the location of the transmitter, by all means try the 20-meter band in the early evening. But tune above and below the limits of 14.15 to 14.25 mc, as the foreign amateurs operate outside the American 'phone band. You'll find them just above and below these frequencies.

Diversity Reception

IN an attempt to outwit the fading of signals transmitted at short wavelengths, radio amateurs have turned their efforts to the development of practical systems of diversity reception. This is an arrangement comprising two receivers and two aerial installations.

Diversity reception has been used commercially for many years. The commercial systems are highly complex and cannot be readily duplicated by the amateur or the all-wave listener, but there are simpler systems that will give an improvement over single-area reception.

Diversity reception is based on the fact that a radio signal does not go through an equal and simultaneous fade over a very wide area. On the contrary, the fade may be said to travel from one area to another with the result that during the period when the signal is of low level at one point, it is comparatively high at another point.

Therefore, if two antennas, well separated from each other, are used to feed separate receivers, the signal level will be up in one or the other of the two receivers in the majority of cases, with the result that at least one of the received signals will rarely fall below the noise level. By interconnecting the automatic volume control circuits of the two receivers, the stronger of the two portions of the identical signal being intercepted may be made to "kill off" reception in the receiver in which the signal level is low so that neither receiver can reproduce background noise. This balance between receivers is maintained at all times and the receiver to which the control is given is the one intercepting the higher signal level.

For best results the two antennas comprising the pick-up of a diversity system should be spaced more than 200 feet apart —the greater the spacing, the better the results. However, a fair system can be arranged by stringing the two antennas from the same pole, but running the wires in opposite directions. The automatic volume-control circuits of the receivers need not be interconnected, but the results will be more pleasing if they are. If the receivers are operated separately, with no interconnecting circuits, the receiver intercepting the signal of low level will run "wide open" and hence amplify local noise.

A more appropriate scheme for those who do not wish to go to the trouble and expense of installing a complete diversity reception system is the use of two well-separated antennas of the doublet type with their feeders connected to a double-pole double-throw switch which can be operated rapidly. With this arrangement, it is easy to switch from one to the other antenna when fading commences.

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page 39*)

ject viewed through the resulting filter would appear bright with dark spots. A green object, on the other hand, would appear dark with bright spots. This is a type of discrimination which would be easy for the color-blind person."

MOTH TRAP

A NEW method of protecting clothing and other wool fabrics against the attack of moths depends on the use of a poisoned bait to attract the moths away from the wool to be saved and to kill the larvae before they can damage the material. A mass of wool is saturated with an arsenic compound and greased thoroughly to invite moths to lay their eggs. This poisoned bait is hung in the closet with clothing and is said to be so attractive to the insects that they will leave valuable woolens untouched. As soon as the eggs hatch, the larvae feeding on the poisoned wool are killed before they can do any damage. Such treated wool is marketed in convenient form under the trade name, Moth Wool.—*D. H. K.*

ORCHIDS FOR MEN

THE orchid, as a flower, is associated with wealth, lavish display, and a certain amount of culture. It has distinguished, though sometimes bizarre, appearance, gorgeous colorings, but most important, it is necessarily expensive, and is likely to remain so. It is a fit floral companion to the diamond, to ermine, and to the limousine. The orchid, as a cut-flower, is not to be raised in gardens, but is a hot-house product, to be cultivated only by specialists says the *Industrial Bulletin* of Arthur D. Little, Inc.

Orchids are of many types, ranging from the beautiful "lady's slippers" of our pine woods, which grow in the ground like other plants, to the most showy and flamboyant plants which grow epiphytically in the moist forests of the tropics, where they perch high in trees. These absorb their food mostly from the air by means of remarkable dangling roots. It is only selected, cultivated forms of the tropical orchids that are of interest commercially for their flowers.

Many years ago, the plants were brought bodily to the temperate zone, where they survived, with difficulty, for a year or two, in greenhouses. After many disappointments, it was found possible to raise orchid plants from seed, and, beginning in 1856, to breed them for "points." The technique of germination was not, however, really perfected until within the last 15 years. This means not only improvement of the scant, bedraggled, and insect-infested foliage of the wild plant, but improvement of the flower itself, especially as to coloring and time of blooming. Today, cross-breeding or hybridizing is done on a large scale, not only by rich men's gardeners, as in the earlier days, but also by large commercial interests. All of the finer hybrid types today possess authentic pedigrees.

Orchids range through all the colors of the spectrum, and through a great variety of shapes and odors. Though many orchids

are odorless, those that are provided with scent may duplicate almost any other flower. On a fact-finding smelling tour through a large orchid house, odors of peony, rose, narcissus, and jasmine were found to be conspicuous, but somehow none with the so-called "orchid" odor of the perfumes could be located. Vanilla, the flavoring material, is obtained from the fermented and then dried pod (so-called "bean") of a vine-type orchid native to Central America, and is one of the few commercial products of this family of plants.

As a result of improved understanding of breeding and raising orchids, the plants may now be produced in great numbers, and in healthy condition, at a reasonable price. There is a move to promote orchid-growing as a hobby in this country, as it has been in England for nearly a generation. Single plants of many species, selected for suitability, and ready to bloom, may now be had for as low as five dollars to 20 dollars, with some of the commoner ones down to two dollars. These bloom once a year, the flowers usually last a month or more, and the plants even may be raised on a partly shaded window sill, if protected so that they do not get chilled below 40 or 45 degrees, Fahrenheit, at any time. They have not been developed yet so that they stand drafts well, or thrive in dry air, but they can be raised in homes even without conservatories.

A display of orchids may appeal more to men than to women. To many women, an orchid is a real decoration to wear, to be valued for the sentiment behind it, or for the distinction which it gives, but is not so truly likable a flower as some clean-cut compact flower such as a gardenia. To men, any sprawliness of the flower may be overlooked in view of its unique character, and its numberless variations of color and shape. It is perhaps more than a coincidence that recent articles on orchids are mostly in magazines read chiefly by men. Further, orchid raisers tell of men who have been seen to visit their exhibitions nonchalantly, while with ladies, only to come back alone, later, to revel in the details of the individual plants and in the strange exotic atmosphere.

LEFT-HANDEDNESS

LEFT-HANDEDNESS is half again more frequent among boys than it is among girls, in a group of 7651 school children observed by Dr. M. Schiller, city physician of Stuttgart, Germany.

VERSATILE SYNTHETIC RUBBER

THIOKOL, a synthetic rubber-like material made from dichloro-ethyl ether and sulfur, has been found to be 25 times more effective than rubber in holding helium in the bags of balloons and dirigibles, according to tests recently made. One of the important properties of this synthetic material is its ability to resist oil and gasoline, which has led to its adoption as standard material in all gasoline and oil hose used by the United States Army Air Corps. The gasoline tanks on the *China Clipper* and other giant flying boats in the transpacific airmail service are lined with Thiokol to prevent leakage and to seal any accidental punc-

tures. Although the properties of the compound closely resemble those of rubber, its method of fabrication is practically identical with that of the synthetic resins.—*D. H. K.*

Buildings Built Right Withstand High Winds

TESTS in the Forest Products Laboratory of the Department of Agriculture show that diagonally sheathed walls of wooden buildings stand about twice as much end thrust as walls sheathed horizontally and braced, and from four to eight times as much as horizontally sheathed walls without bracing.

SOIL WEALTH

IN certain types of soil, says Professor Rudolf Gistl, of the Munich Technical School, one-celled green plants of the class known as algae are the chief source of energy-food for the nitrogen-fixing bacteria that enable profitable crop plants to grow.

Poison Ivy

WITH the arrival of the picnic season, Dr. James F. Couch, of the Bureau of Animal Industry, United States Department of Agriculture, stated in a recent radio talk that the specific poison in poison ivy is a compound related to phenol (carbolic acid) known as toxicodenrol and that the method of protection and of treatment must be based on this fact. He suggests that a person sensitive to the poison should bathe his exposed skin with a 5 percent solution of ferric chloride in a mixture of equal parts of water and glycerol before going near the weed. This solution confers substantial protection against the poison. Another protective solution to be used similarly is a 5 percent solution of ferrous sulfate (copperas) in water. The materials may be obtained at any drug store.

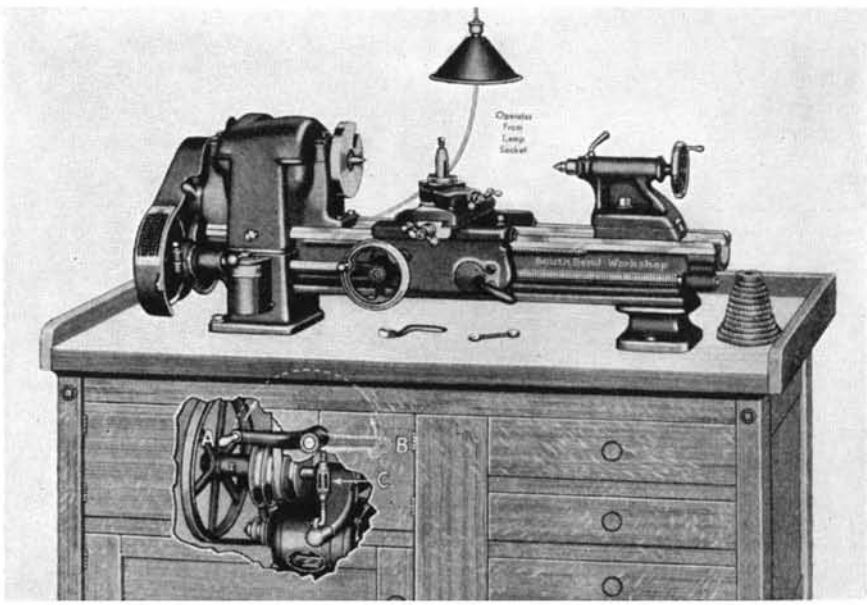
After exposure, washing with an alkaline soap, particularly yellow laundry soap, neutralizes and dissolves the poison and if done soon enough after exposure is effective in preventing a rash. Various oxidizing agents also destroy the poison by converting it into a harmless resin, according to Dr. Couch, and of these the most effective is a 5 percent solution of potassium permanganate in water. Hydrogen peroxide has also been used but it is usually painful in its effects on the irritated skin. The brown stains made by permanganate can be easily removed from the skin by washing with weak oxalic acid solution (1 percent), or with solutions of photographers' hypo or sodium sulfite.—*D. H. K.*

Underneath Lathe Drive

A NEW nine-inch belt-driven lathe is mounted on either a frame or cabinet bench while the underneath motor drive unit and motor are supported on a pivoting frame under the bench top. The belt tension release crank handle controls the position of the frame and countershaft. When the tension release crank handle at the front of the cabinet is moved in a semi-circle, the entire driving unit is lifted vertically about 2¾ inches, so that the spindle belt may be shifted. Any adjustment in the tension of the spindle belt can be secured by a turnbuckle attached from the crank handle to an arm of the countershaft. A hinged cover encloses the headstock which can be raised upward when desiring to shift the cone pulley belt.

This new South Bend "Workshop" lathe is available in either flat belt or V-belt style. The former has a three-cone headstock providing six spindle speeds which range from 39 to 630 R.P.M. The V-belt style has a four-cone headstock with eight spindle speeds which range from 44 to 585 R.P.M. Both cut screw threads from 4 to 40 per inch, and with a fine screw thread cutting attachment the number is increased to 80 threads per inch.

Several new features of the adjustable type underneath motor drive include: Down drive to the lathe spindle, insuring a powerful, silent, and efficient drive; completely enclosed mechanism with no moving parts exposed; screw type belt tension adjustment for any desired pulling power, belt tension release for shifting belt to change spindle speeds; and an absence of overhead obstructions to impair vision.



Underneath drive for home workshop lathes has many advantages

CURRENT BULLETIN BRIEFS

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

MOLYBDENUM IN INDUSTRY is a thoroughly illustrated, well written pamphlet describing the advantages to be obtained by alloying molybdenum with steel and iron. *Write for Bulletin 736A to Scientific American, 24 West 40 Street, New York City.—3-cent stamp.*

PLAIN TALK, by John W. Studebaker, United States Commissioner of Education, is a pocket size volume that makes a strong plea for the preservation of American ideals of democracy, in which the author stresses the point that we must "save democracy through education." *National Home Library Foundation, Washington, D. C.—25 cents.*

POWER TOOLS is a catalog of various types of power tools for home use, including saws, sanders, lathes, shapers, and so on, which gives valuable information on machines of this type and how they should be used. *Write for Bulletin 736B to Scientific American, 24 West 40 Street, New York City.—3-cent stamp.*

SWIFT & COMPANY YEAR BOOK 1935 is more than a "house organ" of a large packing company. It contains also timely articles on such subjects as "Livestock and Meat," "The Produce Business Must Be Flexible," "How Purchasing Power Is Created," and so on. It is illustrated with several full color plates. *Swift & Company, Public Relations Dept., Union Stock Yards, Chicago, Illinois. —Gratis.*

MORE FACTS ON TECHNOLOGY AND EMPLOYMENT is a masterly survey of the place of the machine in employment and unemployment problems, which takes the stand that statistics prove the machine's contribution to employment and a higher standing of living. *Machinery and Allied Products Institute, 221 North La Salle Street, Chicago, Illinois.—Single copies Gratis. Quantities at $5.00 per hundred.*

INSTRUMENTS FROM THE EXECUTIVE VIEWPOINT illustrates and briefly describes the parts which instruments and controls play in the modern industrial plant, touching upon the problem from the standpoint of efficiency and economy. *Write for Bulletin 736C to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

AN ECONOMIST'S APPRAISAL OF DOMESTIC ELECTRIC REFRIGERATION, by Warren M. Persons, Ph.D., is a thorough-going analysis of the electric refrigerator and its place in homes of the United States where electrical equipment is being used in constantly increasing quantities. *Write for Bulletin 736D to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

SERPENTS OF THE NORTHEASTERN STATES, by Raymond L. Ditmars, describes and illustrates the various reptiles found in this area, giving the common as well as the scientific name of each. It has an excellent short section entitled Identification of Snakes, which is subdivided into non-venomous and venomous serpents. Has a frontispiece in full color. *Mr. H. R. Mitchell, Manager, New York Zoological Society, 185th Street and Southern Boulevard, Bronx.—50c plus 3c postage.*

RESEARCH FOR INDUSTRY is a well illustrated pamphlet putting forth the place of Ohio State University in industrial research. *Engineering Experiment Station, The Ohio State University, Columbus, Ohio.—Gratis.*

THE HOME WORKSHOP is described as a handbook for the home shop mechanic. It illustrates a number of well equipped workshops and shows some of the examples of work that have been accomplished in such locations. It gives several handy tables such as decimal equivalents and standard sheet metal and wire gages. *Write for Bulletin 736E to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

SAVE MONEY is the title of a little pamphlet addressed particularly to the manufacturers of flavors and bakers' specialties. It gives a series of modern recipes that are the results of extensive experimental work by a practical food technologist. *Write for Bulletin 736F to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

THE TOLL COLLECTION SYSTEM OF THE PORT OF NEW YORK AUTHORITY is a reprint of an address by Billings Wilson. It outlines the findings that have been made regarding toll collections at five locations in and around New York harbor. *Billings Wilson, Ass't Gen. M'gr., the Port of New York Authority, 111-8th Avenue, New York City. —Gratis.*

SMALL REFUGES FOR WATERFOWL is a description of some of the work that has been done in conserving game waterfowl of the United States and might well serve as a handbook for the furtherance of this commendable work. The booklet contains a list of other pamphlets on allied subjects which are available gratis. *More Game Birds in America, 500 Fifth Avenue, New York City. —Gratis.*

AIR TRAVELER'S GUIDE is a beautifully illustrated booklet which shows how vacationists in the United States can reach many of the important places of interest by air. It contains some striking photographs and splendid descriptions of the sections illustrated. *Write for Bulletin 736G to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

SYMPOSIUM ON INDUSTRIAL FUELS is a compilation of papers presented before a group of engineers, giving the historical background, future availability of raw materials, tests and their significance, the utilization of materials, and so on. It covers liquefied petroleum gas, manufactured gas, fuel oils, coal, and coke. *American Society for Testing Materials, 260 South Broad Street, Philadelphia, Pa.—75c per copy. 10 or more copies 60c each.*

Books SELECTED BY THE EDITORS

DESERTS ON THE MARCH

By Paul B. Sears

THE story of man's destruction upon the face of his own Mother Earth. "No man, no nation," the author asserts, "can spend resources faster than they are built and escape the inevitable reckoning." This is what we have been doing to our greatest source of wealth, the soil of these United States of America—mismanaging it, robbing it, hogging its most easily grabbable richness, maltreating it, and kicking it around as if it were the furniture in a rented house instead of the only soil we are ever going to have. The peasants of Italy and China know better how to treat Mother Earth than we.

This book—a most readable book at that, with smoothly flowing style—is truly a "history of human stupidity." Dust storms that result from breaking up the prairie sod, erosion from cutting all the trees of the forests—deserts truly on the march—are the presagers of oncoming heavy diminution of national wealth. The author's remedy is no patent brain trust panacea but simply "get vegetation back on the ground." His discussion is not frantic but calm, and thus most effectual.

This is a book which is waking up the nation to a waste that is even bigger than boondoggling—the ebb of our chief and very basic resource.—$2.65 postpaid.—*A. G. I.*

LAND WITHOUT SHADE

By Hans Helfritz

AN account of adventure in the scarcely explored southern portions of the Arabian peninsula. The author, denied admittance to the interior via the front door, went along the coast and sneaked inland via the back yard. He was caught, imprisoned, and enjoyed numerous other changes of fortune. The reader gets a good picture of life in the raw in Arabia. Good reading, and well translated by Kenneth Kirkness.—$3.65 postpaid.—*A. G. I.*

HOW TO MAKE A GHOST WALK

By Joseph Dunninger

IF you have ever had any inclination to determine how so-called psychic mediums perform some of their stunts, here is the book for you. Written in a delightfully humorous vein and constantly poking fun at the pseudo-science of those who delude the gullible, this book gives away many of the secrets that have been so carefully hidden for generations. Briefly, it tells how to develop "psychic forces," how to tip tables, produce "spirit" messages on slates, how to read sealed messages, and how to produce many of the cabinet manifestations of the professional medium. This reviewer wonders how Dunninger's cockroach (page 35) in the text became a genteel ladybug in one of the illustrations. Possibly the malevolent spirits of which he writes were responsible!—$1.15 postpaid.—*A. P. P.*

THE BALANCED DIET

By Logan Clendening, M.D., Prof. Clinical Med., Univ. of Kan.

THE widely known author of "The Human Body" and other books that have received wide and deserved acclaim, now gives us an ideal popular book on diet—ideal because it is not too technical but not too superficial, not too long but not too short (200 pages), and in brief, because it seems to be pitched at just the right level to be of the most good to the most people. Here are the chapter headings: What is a Balanced Diet?; Fundamental Principles; Elements of a Balanced Diet; Water; Inorganic Minerals; Vitamins; Spices, Condiments and Beverages; Common Foods; Diet at Different Age Periods; Diet in Diseases; Food Fads; The Economics of Food; Food Tables.

The author evidently agrees with the food philosophy expressed by the verses, "Methuselah ate what he found on his plate, and he lived over 900 years." But he recognizes that people will go in for food-consciousness, so why not at least give them some fad-free food science? The result is a book full of simple hoss sense.—$1.65 postpaid.—*A. G. I.*

THROUGH THE TELESCOPE

By Edward Arthur Fath, Prof. Astron., Carleton College.

THIS is a painless popular astronomy —a most readable short account of all the astronomy which the average man, if not a professional or at least a hard-boiled amateur astronomer, is likely to wish to know. Like the same author's textbook of astronomy, it has that special quality of written style of being crisp and sharply in focus—almost equal in this respect to that of the French language, but so difficult to gain in English. Two lengthy passages in this book vividly describe something seldom or never described in any book—plain, common,

nightly observatory practice when visitors are absent. We follow every move of Clyde Tombaugh's finger as he proceeds on his routine hunt for Pluto; and, likewise, we are transported to the Mt. Wilson Observatory and are secretly present as an astronomer takes and develops several long-exposure astrophotos. We watch him patiently guiding, and then we see him as he almost falls asleep and off his high perch. Few amateurs but will find these parts revealing and informative. This book is also very attractively produced.—$2.90 postpaid.—*A. G. I.*

FISH AND GAME NOW OR NEVER

By Harry Bartow Hawes

TAKING up the cudgels of conservation from the standpoint of the hunter and fisherman, Mr. Hawes calls particular attention to the way in which a land of plenty has been reduced to a point where wild life is threatened with complete extinction unless something radical is done to offset the menace. How and why this has happened and what must be done if future generations are to be permitted the joy of the chase, are all carefully set forth in a dispassionate yet forceful manner.—$3.20 postpaid.—*A. P. P.*

THE PHILOSOPHY OF PHYSICS

By Dr. Max Planck

THE famous dean of the world's living physicists sets down in this book of 125 pages his outlook on physics and world philosophy, causality in Nature, the origin and effects of scientific ideas, and science and faith. To readers who have some small background in the philosophy of science these chapters would make good reading.—$2.15 postpaid.—*A. G. I.*

SNAKE-HUNTER'S HOLIDAY

By Raymond L. Ditmars and William Bridges

DITMARS, the famous snakologist, escaped from his job in New York long enough to take what he calls a "summer vacation" catching snakes in tropical Trinidad and British Guiana, and Bill Bridges of *The New York Sun* went along with him to do the story of the adventure and, if possible, to avoid getting any unnecessary snake bites. The result *was* adventure, with snakes, snakes, and more snakes—also a book written by Bridges, with a foreword by Ditmars, in which the reader is taken along too, and given all the horrible details while lying snugly in a hammock. The narrative is snaky from start to finish, and the reader will thereafter be likely to dash for cover at sight of every garter snake.—$3.65 postpaid.—*A. G. I.*

For sale by
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GENERAL CHEMISTRY

By Horace G. Deming

CHEMICAL progress during the past few years is adequately reflected in the pages of this text book, the fourth edition, thoroughly revised and brought up-to-date. Space has been given to the developments in atomic structure, crystal structure, catalysis, and photo-chemistry. An appendix covering metric units, temperature scales, balancing equations, and so on, is of special value for reference. The emphasis throughout the book is on the industrial applications of fundamental principles. 770 pages plus a table of logarithms and the periodic table.—$3.70 postpaid.—*A. P. P.*

PIGEONS AND SPIDERS

By Maurice Maeterlinck

ADMIRERS of Maeterlinck's romantic style of presentation will enjoy this little book dealing with the water spider, also with common pigeons, in the space of 120 pages.—$1.90 postpaid.—*A. G. I.*

COSMIC RAYS THUS FAR

By Harvey Brace Lemon, Prof. Physics, Univ. Chicago

A SHORT, compact, thoroughly authentic popular summary of our present knowledge of the cosmic radiation, written by a professor who is close to some of the principals in cosmic ray research and who has a flair for popular interpretation.—$2.15 postpaid.—*A. G. I.*

BACK TO NEWTON

By George de Bothezat

THE author of this book is opposed to the theory of relativity and says, with regard to his own arguments against its concepts: "I pride myself upon having achieved, for the first time in the history of human thought, a clear and complete understanding of the three great issues of Infinity, Absolute Time, and Absolute Motion." Also this: "The question of uniform time will be found settled, once and for all, in this Essay, with a rigor standing above any possible disputations, this of course for those endowed with sound and impartial judgment."

There is not much "relativity" in these claims. They seem quite absolute, in fact!—$2.65 postpaid.—*A. G. I.*

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HIGHWAYS
and
BUYWAYS

The advertising pages of this magazine are the highways of commerce. There you will find the products and services of firms who are glad to place their goods on display where the greatest number of people can find out in the shortest possible time whether those goods are worthy or not.

True, sometimes you can find good values off the highway—among the "unknowns" and the "just-as-goods". But why take the risk—when you can use the advertisements as a dependable guide to value, and save a lot of time in the bargain?

When a manufacturer places himself on record in the printed page, he is forced to guarantee you consistent quality and service—or the disapproval of millions quickly forces him out of the market. That's why you have such a friendly feeling for old and well-known advertised names—you know you can depend upon them.

Read the advertisements regularly and know what you want before you start out to shop. It pays to make the advertising highways your buyways.

TO MEN WHO DON'T WANT TO WAIT 5 YEARS FOR A $10,000 SALARY

THERE ARE a few ambitious men in every company who have decided that it is 1936 or never. They are sick and tired of being spoken of as "men with a future." Whether their goal is $5,000, $10,000 or $20,000 a year, they want *this year* to begin to realize some of their financial ambitions.

These men feel equipped to contribute substantially to their company's problems. They understand their particular end of the business. They are of executive calibre. And they know there is a special need for sound, constructive thinking in every business today.

What is holding them back?

In most cases, very little. Usually nothing that they cannot acquire with a modest investment of effort.

There is a practical formula that has been of great value in helping men take on the increased responsibility of leadership. The Alexander Hamilton Institute offers it to you. Through its famous Course of business reading, the Institute will give you a sound perspective of all business. It brings you a working knowledge of banking and finance, of advertising and merchandising, of cost finding, and commercial law, and plant administration—the kind of all-round knowledge that a man must have for outstanding success in times like these.

Such an outstanding success is within your reach because the Alexander Hamilton Institute has put it there. It has assembled the experience of the great leaders of modern commerce and made it available to you in convenient, compact form. Among these men are such outstanding names as: ALFRED P. SLOAN, Jr., General Motors; C. M. CHESTER, Jr., General Foods; DAVID SARNOFF, Radio Corporation of America; LEE H. BRISTOL, Bristol-Myers; M. H. AYLESWORTH, Radio-Keith-Orpheum — plus many others equally famous.

What a Business Man Must Know Today

This helpful book is offered free to men who want to speed up their business progress. Over a million copies have been distributed. The coupon below will bring a copy to your desk.

What type of men use the Institute? You have a right to know. Of the 400,000 men whose business progress has been speeded by the Institute, more than half are Members of Boards of Directors, Presidents and Business Heads, Vice-Presidents, Treasurers, Secretaries, Controllers, General Managers or Professional Men.

For example, among the Institute's subscribers are: the president of one of the largest tobacco companies, the chairman of the board of one of America's biggest chain of newspapers, the chairman of the board of a leading food company, the president and general manager of one of the great motor car organizations, the president of a famous soap-producing company, to mention only a few.

Men who don't want to wait ten years for success are invited to take the first step toward a major executive position now. Send for "What a Business Man Must Know Today." This is the title of a recently prepared book that describes precisely how the Alexander Hamilton Institute's formula works.

If you are one of the men who are determined to get where they want to be *this year,* this book is for you. It comes without cost or obligation. The coupon is for your convenience.

Alexander Hamilton Institute
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