

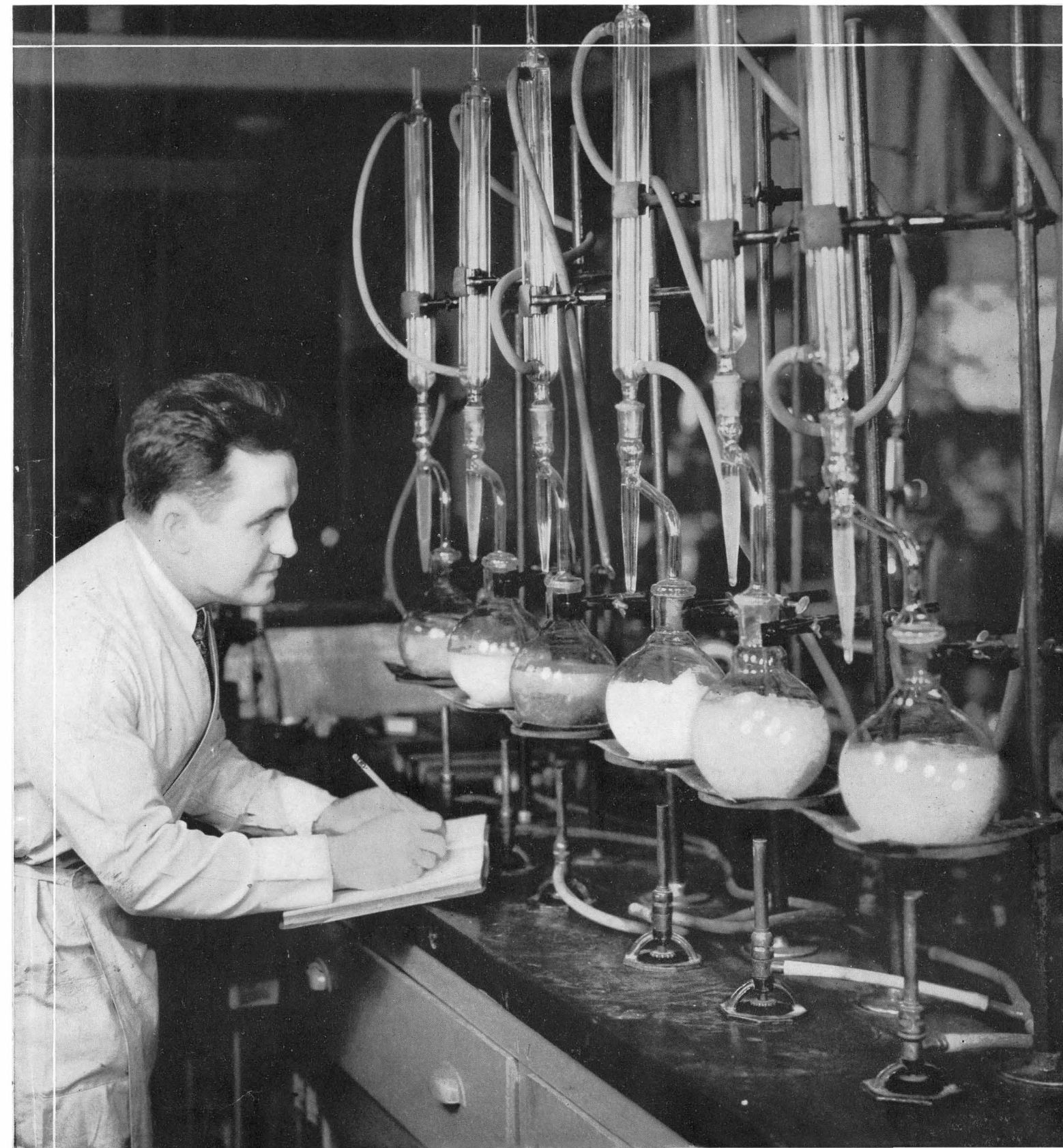
WHAT IS **PRONTOSIL** AND WHERE DOES IT STAND?

SCIENTIFIC AMERICAN

January • 1938

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What Makes the Wheels Go Round?

WHHEELS that grind flour for our bread, saw lumber for our houses, shape steel for our automobiles; that weave cloth for our coats and dresses, make our paper, print our newspapers. Wheels on which we depend for the everyday necessities and comforts of life. What makes these wheels go round?

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SCIENTIFIC AMERICAN

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THE point at which the ingredients of the plastic Catalin (see pages 18 and 19) "kick over" from a liquid and gas to a solid material occurs quickly, and the slightest variation in ingredients or processing would cause undesirable results. As in all chemical processes, every phase in the production of plastics must be kept under close laboratory observation in order to avoid trouble. Our cover photograph shows a laboratory technician making tests of the ingredients of a plastic to be sure that they meet pre-determined specifications.

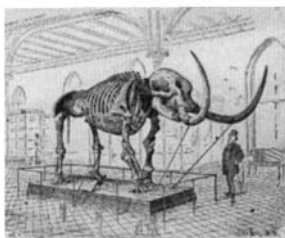
50 YEARS AGO IN . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of January, 1888)

SUB-SEA PHONE—"Lieutenant Boyer, of H. M. S. Malabar, has recently been experimenting in telephonic communication at sea. The signaling apparatus of his invention consists of a gong fixed against the side of the vessel below the water line. A straight tube leads from this gong to the bridge, and in its interior is a rod, by which the hammer can be worked, and the striking may be in accordance with the Morse code. In the center of the gong is fixed a telephone. . . . This forms the receiver. If two ships be fitted with this combination, it is maintained that it is only necessary for one to rap out her message by striking her gong and for the other to receive it on her telephone. The sound waves from the transmitting gong traverse the intervening water and vibrate the diaphragm of the submerged telephone at a distance."

MASTODON—"The mastodon, that great fossil mammal, allied somewhat nearly to the elephant, has become, perhaps, more familiar to the public than any other of the numerous great creatures which once lived in our extended country. This familiarity came about through the frequent discovery of well preserved skeletons of the mastodon. . . . The most perfect, and also the most remarkable, as to size and interesting developments, is the skeleton of a mastodon now mounted in the Geological Hall of the American Museum of Natural History, in Central Park. This example, of which our engraving is a correct picture, was found embedded in a peaty material in the town of Salisbury Mills, near Newburgh, New York."



CHANNEL BRIDGE—"The following details of a proposed bridge across the English Channel are taken from a French contemporary. . . . The plans have already been prepared, and are at present being examined by skilled engineers at the Creusot Works. . . . It is estimated that the cost will be somewhere about 40,000,000 pounds, and the time required before it can be completed seven years or more. The course proposed to be taken for the bridge is from Cran-aux-Oeufs, a little place on the French coast between Ambleteuse and Cape Gris Vert, to Folkestone, on the English side, a distance of about 22 miles. Not the shortest, but the shallowest line will be chosen. . . . The piles required are blocks of concrete and masonry, 160 feet long by 100 broad, and will be placed at intervals of about 550 yards. . . . The causeway of the bridge will be about 160 feet above the sea level, so that vessels of any size may be able to pass beneath it. . . . Such are the outline details of this enormous undertaking, which the projectors state they have full confidence will be before long carried out."

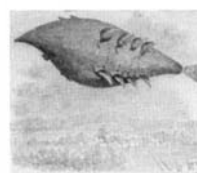
CHOLERA—"An illustration of the practical usefulness of bacteriology was furnished recently in this city. An Italian steamer arrived loaded with immigrants. There had been no cholera on board, but, as the vessel reached this port, a suspicious case of diarrhoea occurred in a child. The symptoms were not perfectly typi-

cal of cholera. Some of the dejections were taken, and sterilized tubes were inoculated and taken to the Carnegie Laboratory in this city. . . . The cultures developed in the way characteristic of Asiatic cholera, and the diagnosis was made. Subsequently other cases of cholera appeared, and the culture diagnosis was abundantly confirmed."

SOLAR PLATINUM—"Professor C. C. Hutchins and Professor E. L. Holden, of the Harvard University Physical Laboratory, have begun a most interesting work pertaining to observations on the chemical constitution of the sun, which have already led to some remarkable results. . . . One result of these researches . . . is the discovery of platinum in the sun."

VACCINATION—"The success of anti-vaccination is aptly shown by the results in Zurich, Switzerland, where, for a number of years, until 1883, a compulsory vaccination law obtained, and smallpox was wholly prevented—not a single case occurred in 1882. This result was seized upon in the following year by the anti-vaccinationists, and used against the necessity for any such law, and it seems they had sufficient influence to cause its repeal. The death returns for that year (1883) showed that for every 1,000 deaths, 2 were caused by smallpox; in 1884, there were 3; in 1885, 17; and in the first quarter of 1886, 85."

AIRSHIP—"A vessel for aerial navigation, which is designed to be a light and yet strong and roomy structure, capable of easy ascension and being readily steered . . . is constructed with a series of



longitudinal tubes, adapted to hold concentrated gas, and bent to assume a generally spherical shape. . . . An outer smooth metallic wall is also provided, having a sharp forward point, in which is a sight opening, a steering apparatus being mounted near by. In the central portion of the ship is a compartment, in sub-divisions of which are electric motors

to furnish propelling power, the wings being designed to partake somewhat of the appearance of a bird's wing, the upper row of wings propelling the ship forward and slightly upward, while the dip and stroke of the wings may be adjusted within certain limits. The rudder is made somewhat in the shape of a fish tail, and consists of two fans arranged side by side in the same plane. The ship is elevated principally through the introduction of the concentrated gas in the longitudinal tubes into the gas chambers."

TRACKS—"According to the *Railway Age*, the year 1887 has surpassed all other years in the extent of railway mileage constructed in the United States."

SUBMARINE—"Lieutenant Hovgaard, of the Danish navy, . . . gives a description of a submarine boat which he has de-

signed, which shall be able to dive below the surface at any moment, continue her course under water for a considerable distance, and remain there for many hours, retaining the while her capacity for continuing her work. For driving her machinery he employs steam above water and electricity in stowage (*sic*) batteries under water."

AND NOW FOR THE FUTURE

- ☞Paranoid personalities, by Paul Popenoe, Sc.D.
- ☞Dental records to identify the dead, by Edward J. Ryan, B.S., D.D.S.
- ☞How a Clipper plane is built—told in photographs.
- ☞The chemistry of alloys, by Prof. Sidney J. French.
- ☞Power from bacteria, by M. K. Elwood.

Personalities in Industry

IN 1927 Dr. John Johnston was called from Yale University, where he was Sterling Professor of Chemistry and Chairman of the Department, to set up a research laboratory for the United States Steel Corporation. A combination of factors, chief among which was an appreciation of future trends, had resulted in a plan to establish a central research laboratory which would deal with major problems affecting all products made by the several subsidiary companies and aim to coordinate the investigations being carried out in the many plants and laboratories of those companies.

The laboratory was started, late in 1928, in Kearny, New Jersey, with a staff of metallurgists and physical chemists who began by surveying the possibilities of improving the quality, and fitness for its purposes, of steel. The primary investigations on which are based the subsequent applications to practice comprise many of a type commonly spoken of as "pure research"; that is, research planned to yield some definite knowledge which may or may not be directly applicable to present-day practice. Many of them have been described in scientific and technical journals, the list of publications now comprising more than 80 papers.

In his papers and lectures discussing the science of steel-making, Dr. Johnston has dealt mainly with the complex chemical and physico-chemical problems connected with the production of steel and the behavior of finished steels. He believes that while heretofore the ancient art of steel-making has been ahead of the science, further marked progress in the furnishing of the steel preëminently suited to each of the multifarious uses of steels will be possible through the further progress in establishing the scientific basis for all of the steps in the process. Among others, the chemical manufacturing industry and the transportation industries have greatly benefited by the development of improved steels with a combination of properties which suits them for special uses.

Born in Perth, Scotland, October 13, 1881, Dr. Johnston studied at Perth Academy, then entered the University of St. Andrews from which he was graduated with the B.Sc. degree in 1903. By examination he was admitted as an As-



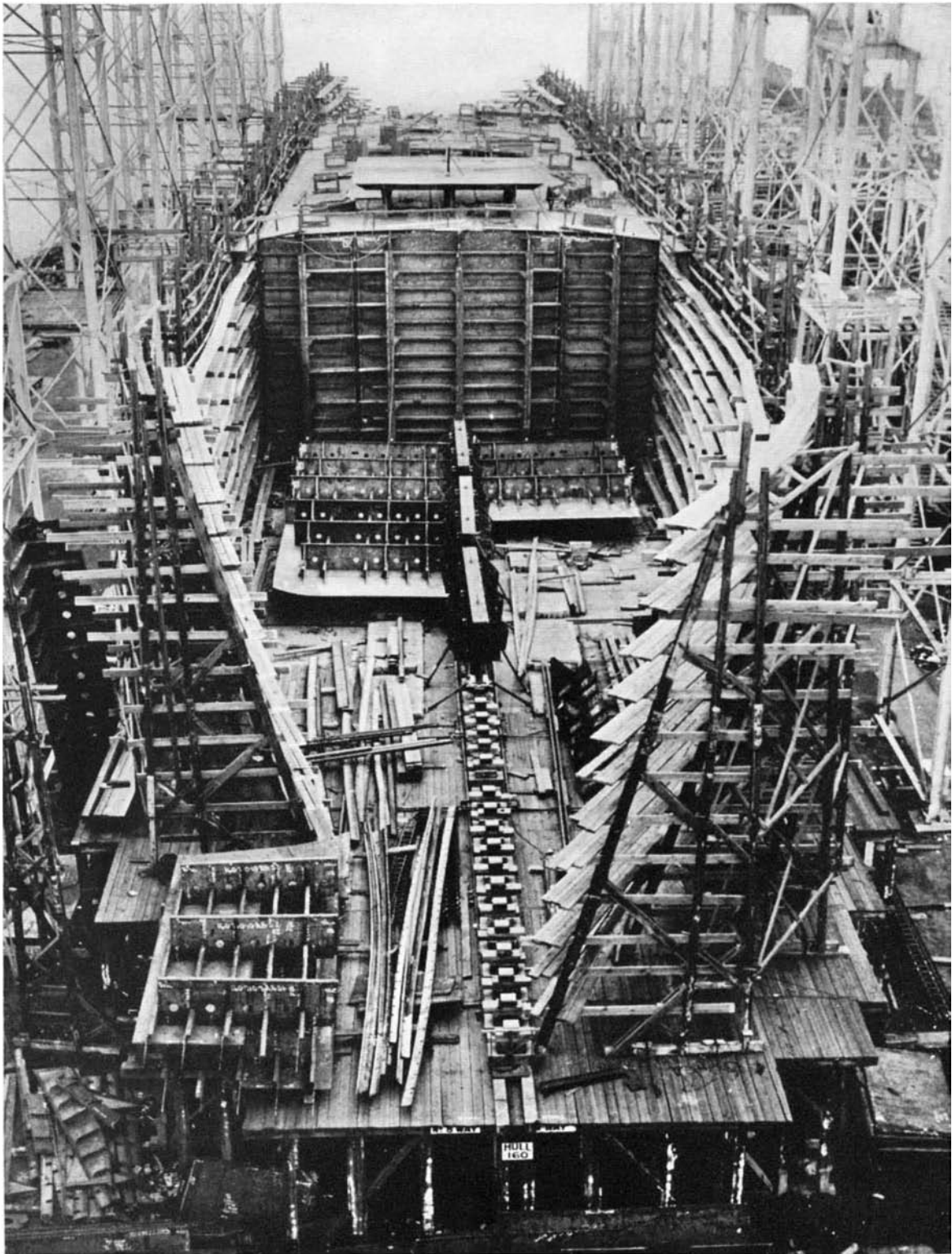
DR. JOHN JOHNSTON

sociate of The Institute of Chemistry of Great Britain in 1903. In the same year he was awarded a Carnegie Scholarship in Chemistry which gave him opportunity to do research work with Professor James Walker from 1903 to 1905. In 1905 he was awarded the 1851 Exhibition Scholarship for two years which he spent at the University of Breslau, Germany, working with Professor Abegg. During 1907-08 he was Research Associate in the Laboratory of Physical Chemistry of the Massachusetts Institute of Technology, working with Professor A. A. Noyes upon the conductivity of aqueous salt solutions.

In 1908, he received the degree of Doctor of Science from St. Andrews University. The following year he joined the staff of the Geophysical Laboratory in Washington as chemist, where he was occupied with investigations in the fields of high temperatures and of high pressures directed toward the solution of some geological problems. In 1916, he left to take charge of the Research Department of the American Zinc, Lead

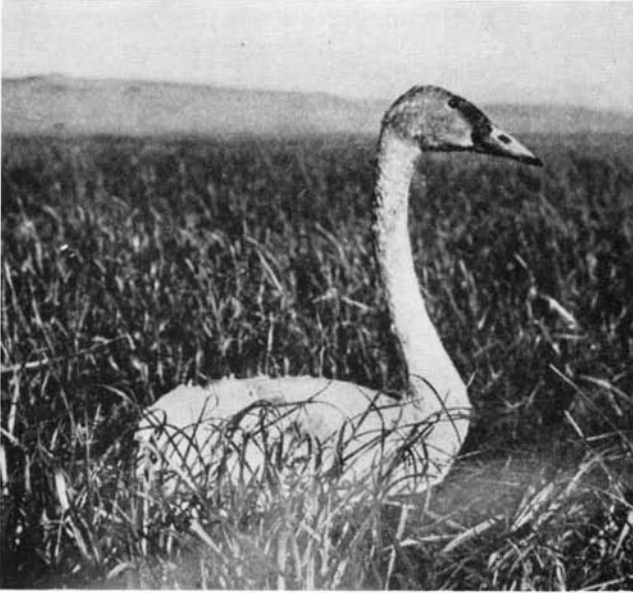
and Smelting Company, in St. Louis, where he was engaged in an endeavor to effect economies in the production of zinc and its by-product, sulfuric acid. During the war period he served the U. S. Bureau of Mines on war gas investigations. In 1918-19, he was Secretary of the National Research Council and Chairman of the Chemistry Division. Following this, he joined the Chemistry Department of Yale University, becoming Sterling Professor of Chemistry and Chairman of the Department. Since 1927, he has been with the United States Steel Corporation as Director of Research. Honorary degrees have been awarded to Dr. Johnston from Yale University (M.A. 1919); New York University (D.Sc. 1928); Lehigh University (D.Sc. 1929).

Dr. Johnston has been a prominent and active member of a number of scientific organizations, among which are the American Chemical Society, of which he is now a councillor-at-large, and the American Electrochemical Society, of which he was president in 1933-34.



**WELDING DOES ITS BIGGEST
MARINE JOB**

SINCE its first experimental application to the construction of ships a comparatively short time ago, welding has advanced greatly. This tanker, on the ways at Chester, Pennsylvania, will be the largest welded ship ever built. With a cargo capacity of 156,000 barrels, it will carry for its owners, The Atlantic Refining Company, more oil in one load than was produced in any one day from 1878 to 1909. Its length will be 521 feet and its tonnage 18,500. Turbo-electric engines developing 5000 horsepower will give the tanker a speed of over 13 knots. Since this picture was taken, the tanker has been launched.



All illustrations courtesy U. S. Bureau of Biological Survey

The trumpeter swan, a magnificent North American waterfowl, persists in small numbers despite man's advance

Conservationists recognized that the end of the buffalo was approaching, and took steps to protect the animals

What Can We Do About

THE problem of our vanishing species of wildlife stirs a great deal of scientific as well as popular interest. Scientists read from the records of the rocks that whole faunas have vanished from the earth not once but at various stages in geologic history; we cannot even guess at the numbers that disappeared without leaving any permanent record behind them. Since rather peculiar combinations of conditions are required for the preservation of animal remains, as well as for another series of geological events, such as elevation by upheaval of the rocks to the surface and erosion that cuts down to reveal the fossil belts, it is a safe guess that the ancient creatures we know of now can be only a small part of the whole assembly of vanished American animals.

We cannot say with any certainty what exterminated them nor can we today say why the ivory-billed woodpecker has practically gone while the smaller pileated woodpecker, similar in at least some of its living habits, has held its own much better. Nor can we definitely state why the Eskimo curlew is gone but other similar forms still persist in some numbers. We do know that invasion by man, with his agricultural needs for new lands to exploit, has destroyed the original homes of some species. This has undoubtedly been a major factor in the decline of the whooping crane and the trumpeter swan almost to the vanishing point, but we cannot be certain that it is the *only* factor. Other creatures, such as the prairie chicken and the sharp-

OUR RARE AND VANISHING SPECIES?

Lessons Have Been Taught by the Disappearance of the Passenger Pigeon and Heath Hen . . . A Greater Public Interest and Support Needed

By **IRA N. GABRIELSON**

Chief, Bureau of Biological Survey
U. S. Department of Agriculture

tailed grouse, were decimated by over-shooting as well as by a rapidly decreasing area of natural range. We know that man and his various activities played a major part in the extermination of some animals that have vanished in comparatively recent times. This very fact has had the effect of creating the hope that it will be possible to prevent such occurrences from happening again.

YEARs ago the Carolina parakeet disappeared and no one realized it until it was too late to do anything but express regret. In July, 1914, the last surviving passenger pigeon died in the Cincinnati Zoo. The death of this last member of a little group of captive birds wrote finis to a species whose numbers were once so great as to darken the sun

as they moved across the country in their migratory flights. The passing of this bird provoked a great deal of interest and rather widespread newspaper comment, not only at the time but at intervals since. So sudden and so complete was the demonstration of the doom of the pigeon that to many observers it had a savor of the mystery of the pre-natural.

Season after season the countless millions of passenger pigeons had returned to the incredibly teeming confusion of the pigeon roosts, and then within the space of but three or four years they were gone and with a suddenness that was catastrophic. A few doomed and dwindling flocks remained to experience a brief stay of execution, but soon all had vanished forever. People who wit-

nessed the tragedy could not convince themselves that it had occurred. The birds, they said, had migrated to South America or they had founded new colonies in remote and inaccessible regions in the Rockies, or in Canada, or on some sea island from which retreat they would some day return, a mighty host, to astonish and delight later generations of Americans. With diminishing frequency the Biological Survey continues to receive communications from individuals who saw these hosts in the days of their abundance, each of whom believes he has discovered a flock of passenger pigeons. For a good many years following the disaster, the more convincing of these reports were investigated, but the results were always the same; whatever the investigator found it was not the passenger pigeon. The rewards, amounting to some thousands of dollars, offered for positive proof that even a single pair of the birds still exists have never been bestowed—and we know now that they never will be.

THERE will probably always be some mystery about the final disappearance of the passenger pigeon but students generally agree that man's invasion of their habitat was an important if not *the* all-important factor. Market hunting destroyed millions and the cutting of forests and opening up of agricultural land undoubtedly disturbed the natural relations of the birds to their environment. This last factor alone may have been sufficient to prevent any recovery of a species already greatly reduced in numbers. Whether these two or some of the other explanations advanced are the real answer may never be known, but it is generally accepted that man, both directly and indirectly, contributed mightily to the disappearance of the teeming millions of these birds.

About five years ago the last heath hen on Martha's Vineyard disappeared; this meant the extermination of this eastern form of the prairie chicken, a loss which did not occur, however, without a real effort on the part of conservationists to save this bird. Massachusetts people put time, money, and effort into the program to save the heath hen, but the action came too late to be successful. I think that in the history of these three species might be read the evolution of the interest of Americans in preserving their wildlife resources. I can see a change from absolute indifference to a live and active interest in the problem of vanishing species.

The buffalo came very close to going

the same route, but energetic action and the spending of considerable sums of money by a few individuals prevented that, and no one now worries about the future of the buffalo, although it is probably beyond reasonable hope that any great number of them can ever again range freely in this country. Still the species is preserved, both in the United States and in Canada, on government preserves and by private individuals. There are in



The tide was turned in favor of the pronghorn antelope by a deficiency of rainfall that stopped man's plow

the western states three great federal buffalo ranges—one in Montana, one in Nebraska and one in Oklahoma—as well as several National Parks on which are kept stocks of this once almost innumerable inhabitant of the western plains.

A few years ago a combination of wet years in the arid sections of the country and the 640-acre homestead act nearly sent the antelope, that fleet inhabitant of the plains country, to join some of the other extinct species. Today, great antelope refuges have been set aside in the western states where, except for some improbable natural catastrophe, it should be possible always to preserve the herds. Antelope cannot withstand human settlement of their home ranges and the long continued deficiency in rainfall in these semi-arid areas, which stopped the plows and reversed the trend of human population, was a boon to the antelope, whatever it meant in human suffering. The antelope are now so numerous in western states that several restricted open seasons have been declared, during which carefully managed hunts are allowed. Other states are con-

sidering similar action. There are many times the number of antelope living on the western plains today that there were 15 years ago. It is not too wildly fantastic to say that there is some possibility of this species becoming too abundant in some areas as deer have become in numerous spots in the United States, and that the probable concern of those interested in this particular form of wildlife will in the near future be directed to limiting the number to the available food supply rather than to efforts further to increase the herds.

THESE few examples reflect the possibilities of preserving and restoring species of wildlife. The first efforts in this direction failed, probably because they came too late. With the buffalo, the efforts were successful in preserving the species, and with the antelope the combination of conditions and public interest has resulted in an increased population over a wide range. For other species the story is not such a happy one as in the case of the antelope, nor so beyond hope as in the case of the passenger pigeon, the Carolina parakeet, and the heath hen.

Let us review just a few of the species whose numbers are at such a low ebb that they might encounter extermination as a result of any unfavorable change in conditions.

The whooping crane, once a very common bird which bred from Nebraska, Iowa, and the Dakotas northward into Canada, and which up to 50 or 60 years ago could be counted by the thousands in flight, is making its last stand. Whether it can be saved or not is a question, but an effort is being made. There has been close and whole-hearted co-operation between the governments of the United States and Canada in an effort to save the few individuals left. These birds breed in certain areas in Canada which are being carefully guarded by the Canadian government. Every effort is being made to protect the survivors while they are in the United States, and one area in southern Louisiana and another on the Texas coast, frequented by these great white cranes during the winter, will shortly become federal refuges. Both of these refuges, which were purchased primarily for winter homes for ducks and geese, will also give protection to the surviving cranes so long as they remain on them. Another little group of whooping cranes is known to winter in certain inaccessible areas in Mexico. Perhaps complete protection of these birds on both their wintering and summering grounds may yet

give them a chance, but their numbers are woefully small and it is still a question whether the efforts to save this bird have been undertaken in time to prove a success.

The California condor is another species in grave danger. Whether any measures which may now be undertaken will succeed in preserving it is still problematical. The point of interest is that intelligently directed efforts are being made to aid the species. An area on one of the California national forests which is known to be the home of the only surviving group of these great birds has been put under a special closing order and is being zealously guarded by the National Forest Service in an effort to give the condors an undisturbed opportunity to breed and restore their numbers.

THE trumpeter swan, the most magnificent of North American waterfowl, still persists in small numbers in British Columbia, in Yellowstone Park, and in the mountains of south-central Montana. Red Rock Lake, one of the newer federal waterfowl refuges, is the main breeding ground for these birds in the western United States. It is an ideal territory for their use and on this refuge and on lakes in Yellowstone Park this great bird is making its last stand in the United States. Formerly it bred from Iowa and Nebraska northward throughout much of the prairie country in Canada, as well as on the mountain lakes in much of the northern United States and southern Canada.

Swans of both the North American species, namely the trumpeter and the whistling, have been protected for years by the federal migratory bird law as well as by a very strong popular sentiment for their preservation. The whistling swan, with its breeding ground beyond

the Arctic Circle, has responded magnificently and it is again possible to see flocks of these swans, numbering not only hundreds but actually thousands of birds; the species appears to be well on the way toward recovery on both the Atlantic and the Pacific coasts. As an example of the numbers that may be found, the following from the 1936 report of the Superintendent at Lake Mattamuskeet Bird Refuge in North Carolina is interesting: "The net results of three separate counts and constant observations by our patrol force indicate there are 15,000 whistling swans."

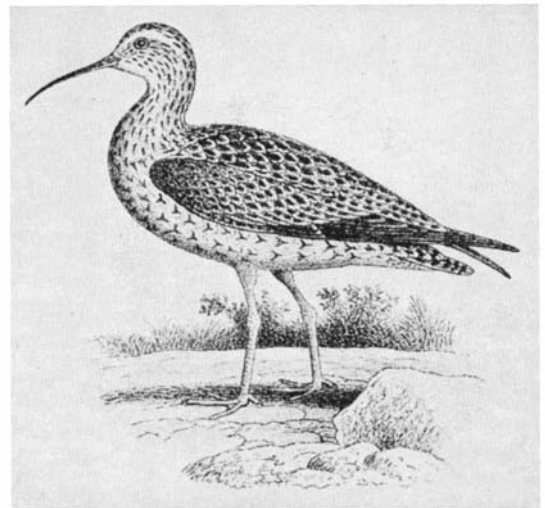
The trumpeter, with a more southerly nesting ground, and more sedentary habits, has not been so fortunate, and has practically vanished. However, there is still hope that present constructive efforts have been started in time to save it. Counts of breeding birds on Red Rock Lake and in Yellowstone Park are interesting. For the breeding seasons of 1935, 1936, and 1937 we have the following careful checks:

	1935	1936	1937
Number of adult trumpeter swans on Red Rock Lake Refuge	28	31	39
Number of young trumpeter swans on Red Rock Lake Refuge	16	26	51
Number of adult trumpeter swans in Yellowstone Park	—	43	42
Number of young trumpeter swans in Yellowstone Park	—	15	26
Total number of trumpeter swans observed in Yellowstone Park and on Red Rock Lake	—	115	158

The great ivory-billed woodpecker, formerly widely distributed in southern forests and swamps, is now scarcely more than a memory, although scattered colonies exist in a few states along the Gulf Coast. There may still be a chance to save this species as there are a few birds left in the vicinity of one of the newer federal refuges and individuals have occasionally been seen on or near this sanctuary. The area involved is the great Okefenokee swamp in southern Georgia, about two thirds of which is now in a federal wildlife refuge and being administered solely for the protection of wildlife. Every effort is being made to preserve as much of the primitive wilderness as is left there, although fire and logging

have left great scars on the swamp which will take years to heal. Conditions there are favorable for the birds and it is hoped that this little group can be preserved.

This refuge, incidental to its purpose of serving as a wintering ground for certain groups of waterfowl, particularly wood ducks and ring necked ducks, will also protect a colony of breeding Florida



The Eskimo curlew is gone, although similar forms of wildlife still persist in numbers

sandhill cranes, the small black bear of the South, the otter, and various other species that were becoming perilously close to extirpation.

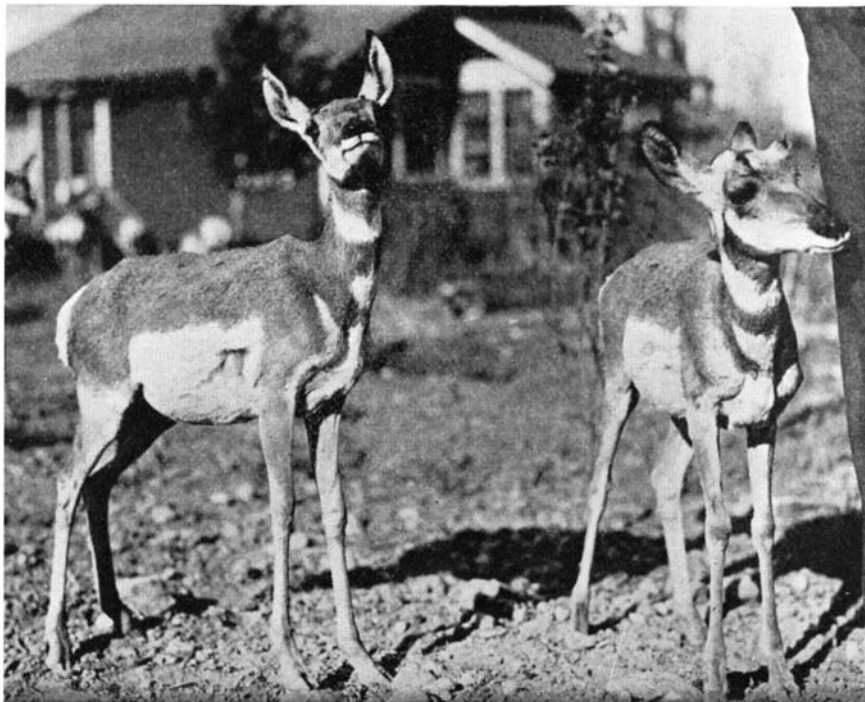
The big white herons which were practically exterminated at one time in south Florida are slowly increasing in numbers on the Florida Keys. The National Association of Audubon Societies has been patrolling these areas trying to protect the birds, and the Biological Survey is making an effort to provide a refuge that will give protection to the main nesting colony. This is not an accomplished fact, however, and when it does come it may be too late to save the birds.

THE situation is not so favorable for some of the shore birds because the birds leave this continent. The Eskimo curlew, that formerly migrated as far south as Argentina, is probably extinct. Some of the others that make the same trip, such as the golden plover and the so-called upland plover or Bartramian sandpiper and Hudsonian godwit, are perilously close to extermination. They have been killed off for human food and great reaches of their habitat destroyed by cultivation and drainage. The Hudsonian curlew, and two species of yellow-legs, also among the globe-spanners, and the long-billed curlew of lesser taste for travel, while still fairly numerous, cannot be said to be safe.

However, the protection and restoration of breeding grounds in the prairie states which are coming as a result of the



Strenuous efforts were made to save the heath hen, but its numbers had been too far decimated



Young antelope doe and buck on a Nevada game refuge

intensified refuge program and which will be further accentuated by an extension of the back-to-grass movement in that territory, have meant new chances for some of these birds. On one federal refuge in Nebraska, 800 pairs of long-billed curlews were reported as nesting last year, and these birds are present and nesting on a number of other refuges in very satisfactory if somewhat limited numbers. The number of Hudsonian curlew coming down on the coast from their northern breeding grounds also has been slowly increasing.

The extension of the refuge system to some of the great coastal marshes on the south Atlantic, Texas, and Gulf Coasts has been of great incidental value to shore birds. On these great refuges, which sometimes extend for miles along the coast, the birds find complete protection and a chance to rest and feed, of which they take full advantage. There is no question as to the marked increase in the number of willets, and a distinct but smaller growth in those of some of the other shore birds.

THE greatest obstacle, aside from overshooting, to the preservation and increase of the long distance travelers among the shore birds, is the plowing up of their South American wintering ground for the purpose of growing cotton and corn. This seriously disarranges their habitat and decreases the possibility of restoring these birds to even a fraction of their former numbers. It will require concerted action by several South American countries to insure the perpetuation of the flight of some of the finest of our shore birds.

The Attwater prairie chicken, a distinctive species found in a few coastal

counties in Texas, has been gradually approaching the danger line, but there is now hope of doing something about it. The last session of the Texas legislature passed a law closing the season on these birds for five years, and definite studies of their needs are being made by the Cooperative Wildlife Research Unit at Texas Agricultural and Mechanical College. This unit, which represents the combined efforts of the College, the State Fish, Game, and Oyster Commission of Texas, the Biological Survey, and the American Wildlife Institute, is making a study of the needs of this bird and the possibility of restoring it. Out of these studies we may hope for a definite program which will give it a chance if there is any hope.

Mammals that have been seriously threatened include several species of whales which are now protected by an international treaty recently signed by 27 countries. This treaty and the publicity which has been given it may very well be the turning point in the history of these great marine mammals, although some of them are dangerously near the disappearing point.

Nelson's mountain sheep, one of the desert forms of this most interesting group of the larger North American mammals, have been reduced to pitifully small numbers. A few individuals surviving on scattered desert mountain ranges are all that are left, but positive steps are being taken to preserve them. A great refuge covering three mountain ranges which still have a small population of these animals has been set aside in southern Nevada and is now being placed under administration, primarily for the protection of this single, but most interesting, form of American wildlife.

No satisfactory solution has yet been found to the problem of preserving the fisher, wolverine, marten, and other fur animals that have been reduced to a very low level because of overtrapping. Long closed seasons, adequately enforced, appear to be the only chance of building up the numbers of these animals, but prospects would be better if the market for them could be simultaneously suspended.

Several of the rarer species of hawks and kites are at a very low ebb, due largely to the prevalent American custom of shooting every hawk that comes within sight, on the very convenient but erroneous theory that the man who kills a hawk is doing a good deed in a naughty world. In most instances it is just the opposite of this, and the deed is a very bad one. Whether anything can be done to change this psychology to a more practical and truthful consideration of the subject is a question. Reams have been written and propaganda put out for nearly 50 years on the value of certain species of hawks and owls, yet the average farmer or hunter continues to kill them whenever opportunity affords. A great majority of the states have passed laws protecting all but a limited number of species of hawks known to be destructive to game birds or animals or to domestic livestock or insectivorous birds, but usually there is little interest and very little popular support for enforcement of this particular provision of law. State game commissions with inadequate staffs of patrol officers and many problems of protecting concentrations of valuable wildlife have more than they can do and they get little support from the public in enforcing these laws designed to protect species other than game.

THESE are only samples of the problems facing those who would do something to save our rare and vanishing forms. The prospects in some cases do not seem too good but there is nevertheless a determined effort to do some constructive work toward this end and more can undoubtedly be done, granted a greater public interest and support.

Efforts that have been made to prevent wild ducks from following the heath hen and the passenger pigeon have already been so successful as to indicate the results that may be expected in other cases when conservationists and nature work toward a common goal. Faced with the fact that man and adverse breeding conditions were severely depleting the ranks of wild ducks, a concerted drive was made to find and apply remedies. To-day, with nature's help, ducks are present on their nesting and feeding grounds in constantly increasing numbers.—The Editor.

OUR POINT OF VIEW

Sulfanilamide

THE regrettable death of some 70 persons, mostly in the South, as the result of taking a so-called elixir of sulfanilamide marketed by a drug house which has since denied legal responsibility but which cannot deny moral responsibility, has left a large part of the public confused and unable to assess the remaining status of the widely heralded drug sulfanilamide and its derivative drug prontosil. Naturally, there is now a widespread fear of this drug and its derivatives. What salient facts, then, are to be drawn from the available scientific data?

Anticipating the conclusions to be drawn below, these are that the elixir of sulfanilamide which caused the deaths was simply a slow poison; that sulfanilamide itself—not the elixifying material added to it that caused the deaths—will apparently continue to deserve the very considerable enthusiasm it has already aroused among doctors; but that it should not be sold indiscriminately to the general public for self-medication.

The many deaths that occurred were not in any sense caused by sulfanilamide. In order to put the sulfanilamide into potable solution the pharmaceutical house took on itself to add to it about 72 percent of a liquid, diethylene glycol. This, like many other substances, is poison if enough of it is taken, though not poison by another standard. "There is no evidence," the *Journal of the American Medical Association* states, "that its use in industry or as an ingredient of cigarettes is harmful. It is not to be taken in any considerable dosage internally." The now notorious elixir did, however, contain a considerable dosage. Ironically, the directions on the bottles of this medicament read, "Continue at this dosage until recovery."

Fortunately, every remaining drop of the elixir was finally traced down and seized by the government. Fortunately, also, no more is ever likely to be made up. Therefore, as far as assessing the value of sulfanilamide is concerned (after seeing to it, as we must, that the same ghastly thing does not happen again) we are where we stood before the tragedies. And so, in regard to the actual value of the drug, we quote from the noted journal named above: "Seldom has any new drug introduced in medical practice aroused the enthusiasm that has developed for sulfanilamide. Much of this enthusiasm is warranted. The drug is truly remarkable, as in-

dicated by startling results reported in the treatment of various infections." There is, therefore, nothing to be gained and no doubt much to be lost in blackballing or blacklisting sulfanilamide at present. That should not be thought of.

However, the enthusiasm for the new drug should not be allowed to run entirely away with itself, for sulfanilamide is not perfect. In the *Journal of the American Medical Association*, as long ago as September 25, there were several articles by various physicians who pointed out certain toxic manifestations that can result from it in some cases. These were not sensational warnings—only ordinary ones. In other words, the drug is highly useful but must be handled with intelligence—specifically, more intelligence than was being used by the public even before the infamous elixir was put on the market.

Another conclusion reached by numerous doctors is that this drug ought not to be sold over the counters of drug stores to everyone, and ought not to be used indiscriminately by everyone in self-medication.

Behind and under all these considerations is the unfortunate fact that our existing federal drug laws are sadly inadequate to cope in advance with such situations as the one which recently arose. There was, and still is, nothing to prevent some other drug house from making a similar or worse blunder. The new Food and Drug Act, which was so sadly emasculated by a recent Congress and which has not yet been passed by Congress, should cover up such gaps in our ability to safeguard ourselves. However, when this bill comes up for further consideration, the many deaths that occurred will at least be a help in preserving some of its backbone.

In final analysis, the persons guilty of the recent deaths are the people of the United States. Here we are, the 125,000,000 of us, certainly our own masters, since nobody from without can dictate what we do, and obviously, it is to our interest not to poison ourselves. If we cannot will it that way and *make it come that way*, then whatever happens to us is our own fault. Let us dust off the spiked club.

Germ Warfare

RUMOR had it, during the World War, that the widespread epidemic of the fatal, so-called "Spanish" influenza was of German origin. The story was that the Germans had promoted this disastrous epidemic and, to prevent the

world from knowing of their deed, had drawn a red herring across the trail by dubbing the disease Spanish. It was neither German nor Spanish; the rumor was simply propaganda.

Today there are many people who talk of bacterial warfare with as much credulity as those wartime rumor-mongers displayed. Or is it "gullibility"? Such an attitude among laymen is understandable. We should expect military men to spend no more time on the subject than that required to give one good hoot of derision. Recently, however, there was a discussion of germ warfare in the German military publication *Deutsche Wehr*, based on a report of an Italian medical officer. Apparently some Germans and Italians are studying its possibilities as a paralyzer of the enemy's morale.

The German article states that the most efficacious microbes would be those of spotted typhus, yellow fever, typhoid, paratyphoid, plague, cholera, and smallpox. The theory is that germs would be spread by dropping bombs or glass tubes containing them from airplanes over the enemy's hinterland and directed against civilians, for the use of this weapon "against soldiers would entail great dangers to the attacking troops."

Talk of germ warfare became so insistent during the World War that the League of Nations later set up a commission to study wholesale contagion and infection. The commission reported that a man-made epidemic would be "limited by our present knowledge of hygiene and microbiology" and, further, that "such epidemics would not have any decisive effect upon the issue of hostilities." So far as experts know, this holds as true today, and effectually answers the German article—until much more is learned of the subject!

Apparently study will continue. What the demonic breeders of ghastliness will have to do before success (awful death to their enemies!) rewards their efforts will be to discipline their germs. Regiments of them might then be turned toward the enemy and given the command "Charge!" Or perhaps obedient germs could be ordered to bite only the enemy. Otherwise, the scourge would inevitably backfire, no matter how far inland the germs are distributed. For unadulterated horror, bacterial warfare would certainly prove a most effective way of destroying foe and friend alike, but for war with some slight (*very slight*) semblance of humanity, explosives will still do a better job against the soldier enemy.



An air view of the New York metropolitan area, with Manhattan Island in the center, New Jersey and the Hudson River at the left, and the East River and Long Island at the right. The route of the three-part tunnel system is shown by white lines

IN, OUT, THROUGH NEW YORK

Three-Part Tunnel System . . . New Jersey to Long Island . . . Under Hudson River, Manhattan, East River . . . Outstanding Engineering Features

By R. G. SKERRETT

PICTURE an island 13 miles long and averaging about two miles in width, densely upbuilt, and with a resident population of 1,730,000 persons. Such, roughly, are some of the primary features of New York City, officially the Borough of Manhattan, and but a single subdivision of the City of Greater New York composed of five boroughs having a combined population of approximately 7,370,000 people.

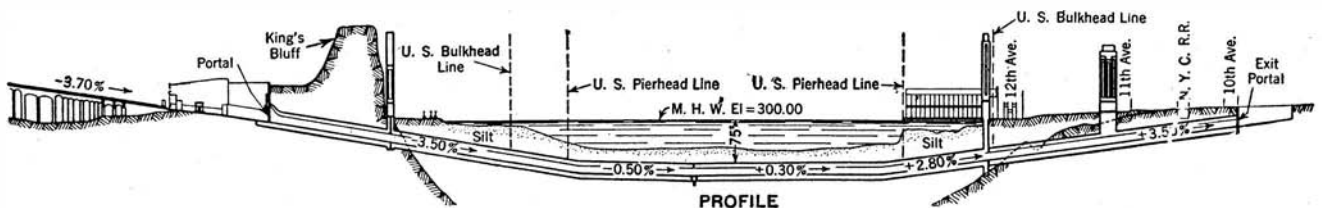
To be a little more explicit: the Borough of Manhattan is the financial, commercial, industrial, shopping, and entertainment center of the more than 12,000,000 people who live within the so-called metropolitan zone—an area that embraces populous parts of northern New Jersey, western Connecticut, and the southeastern area of the state of New York. In and out of Manhattan there is a daily ebb and flow of 3,290,000 vehicles every 24 hours, traveling either above, on, or under the three rivers that make Manhattan an island. Over four of the East River bridges, this traffic tide has totaled more than 90,000,000 vehicles annually of late; between Manhattan and nearby New Jer-

sey, the to-and-fro movement of vehicles has aggregated during the last year fully 31,500,000 crossings.

In Manhattan, traffic moves in cross-currents; streets are limited in their widths; the increment of motor vehicles is arbitrary and continuous; inevitably, thoroughfares become veritable bottle-necks for the passage of the crowding, multiplying pleasure cars, motor trucks, and motor buses. As the centers of concentration are approached, the vehicles cover shorter distances between the flashing of traffic signals, progress is correspondingly retarded, and vehicles designed for speed can make but little use of that inherent capacity. This restraint imposes on business, because of time lost, a daily penalty of something like half a million dollars.

To help solve the vehicular problem of the metropolitan zone, so far as its focal center in the Borough of Manhattan is concerned, the states of New York and New Jersey, through the Port of New York Authority—a bi-state organization—financed and built the Holland Tunnel under the Hudson and the George Washington Bridge over the same river. These two facilities permit a continuous flow of traffic across the Hudson far downtown and far uptown, a condition previously impossible with ferries.

In the past year, the Holland Tunnel and the George Washington Bridge have afforded quick runs for 60 percent of the vehicles crossing the Hudson, leaving the remainder to be transported by ferries. It is a curious fact, familiar to traffic



Courtesy Civil Engineering

Cross-section of one of the tubes under the Hudson, one of which is now practically completed. This drawing gives some of the main dimensions and shows the structural features. The New Jersey shore line is at the left, Manhattan at the right

experts, that each added permanent crossing, besides providing relief, actually attracts traffic which did not exist previously. Experience has shown that the owners of motor vehicles will willingly pay a premium to use a shorter, faster, and more convenient route; as between a free route and a toll route, the public does not hesitate to pay if time or distance may be saved. This attitude helps to explain why traffic through the Holland Tunnel in 1928, the first full calendar year after those tubes were placed in service, totaled 8,744,674 revenue vehicles, and 11,877,304 in 1936. The George Washington Bridge, in 1932—it was placed in service late in 1931—was crossed by 5,509,946 revenue vehicles and by 7,057,384 in 1936.

The Holland Tunnel links the lower part of the Island of Manhattan with Jersey City; between that subaqueous crossing and the George Washington Bridge is an interval of 10 miles. The center of gravity of motor traffic and the most congested areas of New York City lie approximately midway between these crossings. Therefore, trans-Hudson motor traffic has either to use the ferries or to travel long distances north and south to avail itself of the George Washington Bridge or the Holland Tunnel. In that north-and-south movement to utilize the permanent crossings, motor vehicles in Manhattan unavoidably add to street congestion and intensify traffic-regulating difficulties.

It was thus obvious to the Port of New York Authority that the midtown area of

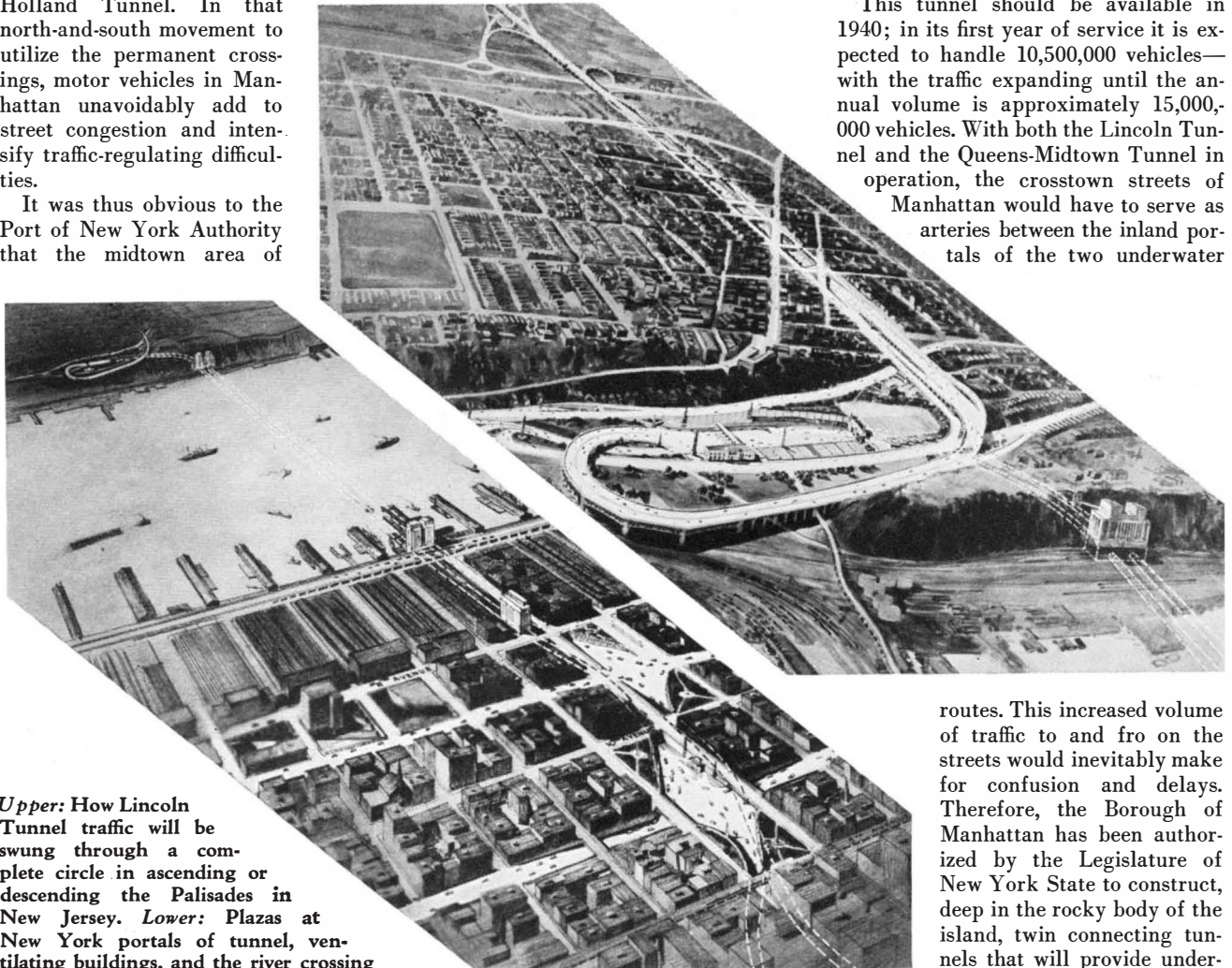
Manhattan should be linked with New Jersey by a second twin-tube vehicular tunnel, inasmuch as the Holland Tunnel by 1931 was operating normally at 80 percent of its capacity, and on holidays and other peak periods the twin tubes were overtaxed and imposed delays. Because of the depression, funds for building the Lincoln Tunnel, from West 39th Street in Manhattan to Weehawken, New Jersey, were not available until the latter part of 1933. Actual construction started in March of the year following, and was concentrated in driving and completing but one of the two tubes that will form the Lincoln Tunnel, which is located three miles north of the Holland Tunnel.

BY building one tube first and making that ready for service in December of 1937, the initial financial outlays were reduced accordingly, and one tube would thus be ready for traffic and earning money while the second tube was in process of construction. One tube will provide for a single traffic lane in each direction, and in the course of a year should facilitate the passage of from 5,000,000 to 6,000,000 vehicles. When the second tube is finished in 1940—work on it is now under way—both lanes

of one tube will be used by westbound traffic, and the two lanes of the other tube by eastbound traffic. The two tubes annually will handle traffic totaling 10,000,000 and more vehicles. The Lincoln Tunnel, when completed, will have entailed a total outlay of 74,800,000 dollars.

Because the tunnel will induce additional traffic, the municipal authorities recognized that a vehicular tunnel under the East River, on the opposite side of the island, should be built to accelerate through traffic between New Jersey and Long Island as well as interborough traffic between New York City and the sister boroughs of populous Queens and Brooklyn—within the limits of which there are resident more than 4,000,000 people. The New York City Tunnel Authority was created to design and to construct what is officially known as the Queens-Midtown Tunnel. This will cross the East River between 42nd Street, Manhattan, and Borden Avenue, on the water front of Queens, and will be near existing highways that connect with the northern limits of the adjacent Borough of Brooklyn. Work is proceeding on this tunnel; under-river driving of the twin-tube shields will start in January, 1938. It will probably cost, when completed, 58,365,000 dollars.

This tunnel should be available in 1940; in its first year of service it is expected to handle 10,500,000 vehicles—with the traffic expanding until the annual volume is approximately 15,000,000 vehicles. With both the Lincoln Tunnel and the Queens-Midtown Tunnel in operation, the crosstown streets of Manhattan would have to serve as arteries between the inland portals of the two underwater



Upper: How Lincoln Tunnel traffic will be swung through a complete circle in ascending or descending the Palisades in New Jersey. Lower: Plazas at New York portals of tunnel, ventilating buildings, and the river crossing

routes. This increased volume of traffic to and fro on the streets would inevitably make for confusion and delays. Therefore, the Borough of Manhattan has been authorized by the Legislature of New York State to construct, deep in the rocky body of the island, twin connecting tunnels that will provide under-

ground arteries for much of the traffic entering and leaving Manhattan via the two new tunnels, and be the preferred route for vehicles intent upon making the best speed possible between the New Jersey (western) side of the Hudson River and the Long Island (eastern) side of the East River. Its cost is estimated at 30,000,000 dollars. If funds are made available shortly, that vitally essential link can be excavated and made ready for service also in 1940.

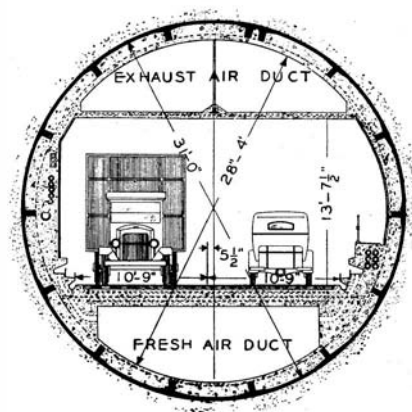
The unified project of two subaqueous tunnels and an interconnecting land tunnel calls for a total outlay of 163,-165,000 dollars. This tremendous sum will be well spent if it achieves the expected traffic relief prophesied by the experts.

The projected tripartite route will have a total length between New Jersey and Long Island of about 4.75 miles; and it will be entirely feasible for through-bound vehicles to maintain a speed of 30 miles an hour in making that run. Today, on one of the most used East River bridges, especially during busy hours and peak periods, delays occur ranging from a few minutes to half an hour; when that traffic is bound westward to the Hudson River side of Manhattan, the loss in time is apt to be increased when intercepting north-and-south traffic is heavy. The three inter-linked tunnels beneath the two rivers and through Manhattan will change all this for the better. The consequent economies and the revenue through reasonable tolls should pay handsomely for the initial expenditures.

THE first or south tube of the Lincoln Tunnel, which was recently put into use, has a length of 8215 feet between its east and west portals. The north tube, which generally parallels the south tube, will have a length between portals of 7400 feet. Both tubes, however, have an under-river length of 4600 feet; the difference in over-all lengths is because the Manhattan portal of one tube is nearer the water front than the other. The New York portals are connected with sunken, flaring approaches which are reached by new sloping streets that adjoin the approaches at right angles and rise so as to provide easy access to the regular thoroughfares of neighboring sections of the town. Vehicles can approach or leave these portals without disrupting local traffic.

On the west side of the Hudson, the line of the tunnel is abruptly confronted by the rocky Palisades that rise to a maximum elevation of nearly 200 feet above the sur-

face of the river. The town of Weehawken, at the foot of and on the east shoulder of the Palisades, demanded access to the Lincoln Tunnel; similarly, communities along the crest of the Palisades insisted that they be able to get easily to and from the tunnel; finally, other places on the western side of the Palisades, north and south, were equally urgent that connections be provided for



Typical section, with dimensions, of one of the Lincoln Tunnel tubes

them. Therefore, instead of driving the tunnel due west right through the Palisades, which would have cost less but would have side-stepped some of these New Jersey communities, the tunnel makes a 90-degree swing southward on reaching the New Jersey side of the river, pierces a towering tongue of rock, and issues into the open in a low area at the foot of the Palisades. Within that area is an expansive "mixing basin" for tunnel traffic. Between that basin and a sunken highway, up and over the Palisades, there is a steel-and-concrete inclined loop of ingenious design that swings the vehicular streams through an arc of 270 degrees and makes an easy change of grade either in starting traffic upward over the Palisades or downward

into the plaza outside the west portals. The sunken road over the Palisades, cut 20 feet deep in rock, is paralleled by two surface roadways which connect with important thoroughfares and afford access to the sunken approach artery. The feeder system takes care of Weehawken and connects with numerous important trunk highways. From end to end, the new route over the Palisades has a length of nearly two miles, and the maximum grade does not exceed 4 percent. This approach system will cost about 10,000,000 dollars.

TWO shields were used to drive the south tube. The New York shield worked its way westward from an inland shaft a distance of 910 feet through solid rock, rock and earth, and water-bearing ground, successively, to reach the foundation caisson of the ventilating structure at the Manhattan water front. The New Jersey shield started eastward from the bottom of the Weehawken ventilating shaft, and worked its way under the river to the Manhattan caisson, a total journey of 5050 feet. For 4600 feet, the shield made its way through the silt of the river bed, admitting 20 percent of the displaced material into the lengthening tunnel as the shield forced itself forward; the remaining 80 percent was shoved mainly sidewise and upward along the lines of least resistance. The intaken silt was distributed in the lower half of the tube to give the tube sufficient deadweight to neutralize its buoyancy; to avoid using the air locks at the shoreward end to transport the muck to the surface, and, finally, to steady the tube and provide a firmer footing for the shield when power was applied for a forward shove. This muck was left undisturbed until the tube reached from shore to shore and the tunnel was no longer charged with compressed air, as was required during driving. Indeed, be-

cause of the procedure adopted, the sandhogs worked generally at a much lower air pressure than the depth underwater would ordinarily have necessitated.

The two shields used were virtually identical in dimensions and basic features. Their cylindrical steel shells have an external diameter of 31.7 feet, an over-all length of 19 feet, a cutting edge of cast steel at the forward end, and, near the rear end, each has 28 powerful hydraulic jacks, arranged circumferentially, that can push rearward against the last assembled ring of the lining to shove the shield forward 30 inches to provide space for the insertion and assembling of the segments of still another ring.



A tough, doughy slab of muck squeezing through an opening in a shield, like tooth-paste from a tube

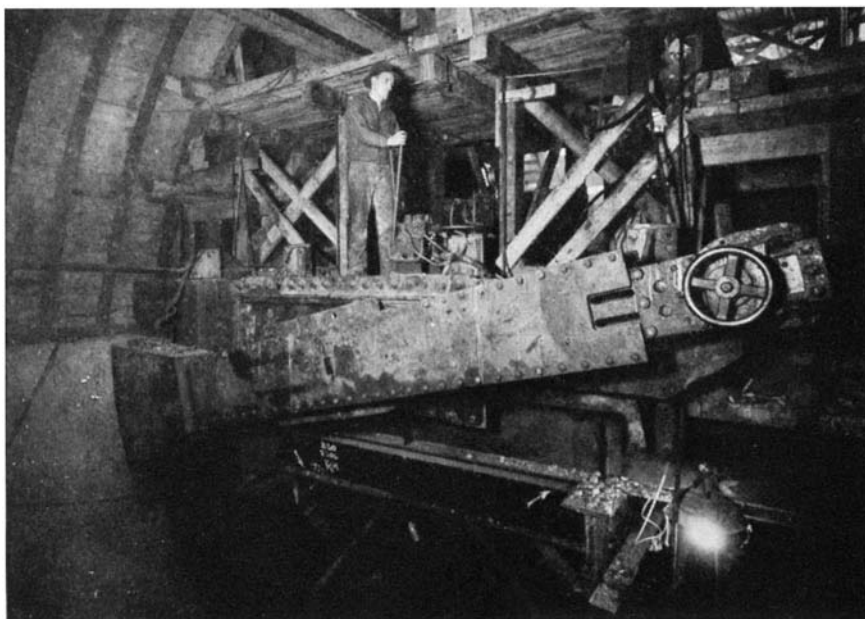
The silt admitted to the tunnel entered through two openings in the great circular bulkhead at the forward end of the shield.

As the thick ribbons of muck came inward, men sliced them with wires into blocks that were dropped on belt conveyors which, in turn, distributed the chunks on the tunnel floor, from side to side. Each shield carried, pivoted at its longitudinal axis, a rotating erector that could pick up, one by one, segments of the lining and place them in their proper order to form a unit ring. A special grip at the end of the working arm made for operating speed. To hasten the bolting of the segments to one another and to the adjoining completed ring, the contractor developed unique hydro-pneumatic tighteners to avoid much slower handwork. Four of these powerful machines were mounted at the forward end of a large trailer that could be attached and pulled along by the shield. Each tightener worked within its given arc, so that there was no confusion as each one of them was brought into action. The tighteners contributed very largely to the rapid progress made in driving the tunnel under the river.

Each of the under-river cast-iron or cast-steel lining rings has an external diameter of 31 feet; in place and bolted, a ring weighs about 21.5 tons. A ring is made up of 14 identical segments and a key member; 145 bolts, each with a large nut and two washers, are required to secure a ring circumferentially and longitudinally. A lining ring was inserted for every 2.5 linear feet of the tunnel shell. Every bolt had to be made tight so that the tunnel lining would be a rigid structure and sealed against leakage. The top of the tunnel lies 75 feet below mean high water.

IN driving the older Holland Tunnel, the maximum linear advance through the bed of the river was 25 feet in 24 hours. In driving the south tube of the Lincoln Tunnel, through the same silt, as many as 18 shoves were made in 24 hours and 45.5 feet of tunnel lining was placed. The under-river shield started on its eastward trip September 29, 1934, and on August 17, 1935, it passed through the west "eye" of the New York caisson, and came to rest with an ultimate precision of line that was only $\frac{1}{4}$ of an inch out from grade and with but $\frac{3}{8}$ inch of departure laterally. Like a titanic mole, the shield advanced unseeing through the river bed following a descending course to midstream and then mounted again by an easy grade until it reached the caisson. The companion tube will be 75 feet to the north, between centers.

Roadways in each tube will be 21.5 feet wide—18 inches wider than the roadways of the Holland Tunnel. The two broader traffic lanes in each tube will



Illustrations, except one noted, courtesy Port of New York Authority

Erector on the shield that drove the south tube under the Hudson. It can be swung through a circle to place steel ring segments anywhere in the tube-lining ring

increase the margin of safety and make it easier for vehicles to swing out of line in getting past a stalled car. The ceiling of the finished tube is surfaced with glass tiles set in special bronze grips which, in turn, are anchored to the concrete ceiling slabs which form the underside of the ventilating duct through which vitiated air is withdrawn from the tunnel. The fresh-air duct is beneath the roadway with discharge ducts at the sides of the tunnel just above the roadway. The sidewalls are covered with glazed tiles, and the curb on one side and the outer face of the patrolmen's sidewalk on the other side are of glazed terra-cotta. This use of glass and glazed tiles will make it easy to clean the exposed surfaces. The glass in the ceiling is cream colored and has a pebbled surface capable of diffusing a very high percentage of reflected light without glare.

The suction fans and the fresh-air blowers of the ventilation system are being placed in three buildings: one at the east base of the Palisades, in Weehawken, and two on the New York side of the river. The New Jersey plant will ventilate the tunnel between the west portals and mid-river; the two New York plants will provide proper ventilation between mid-river and the Manhattan portals. For the two tubes there will be a total of 26 fresh-air blowers and 30 exhaust fans, and there will be reserve units available even when the ventilating plants are operating at their designed maximum capacities. Electric apparatus, placed at intervals along the tubes, will detect and record any vitiation of the atmosphere and thus indicate the number of ventilating units necessary at all times. The tunnel is being equipped with the most approved traffic

signaling system and is to be generally illuminated with sodium-vapor lamps that will increase visibility.

We cannot now deal in detail with the Queens-Midtown Tunnel, but we can say that it will be more difficult to drive because of the mixed formations of rock, sand, gravel, and silt in the bed of the East River. Nor can we give at this time particulars about the Midtown-Manhattan Tunnel, which will require the driving of capacious twin tunnels through solid rock at a maximum depth of 100 feet below the street surface in order to under-run existing and projected rapid-transit subways. These will be discussed later. Each will be important in its own right and each will necessitate employment of unique engineering methods by reason of the unusual problems that will be encountered. As has been shown, however, each will also be a vital part of the whole—a unified system which, while costly, will solve a traffic problem of the first magnitude. Furthermore, they will doubtless give to New York engineering experience which will influence decisions regarding such tunnels in the future, wherever they may be constructed.

WHAT is being done in the Port of New York and within the metropolis is an object lesson as a whole of the tremendous outlays being forced upon populous centers to ease the growing tide of motor vehicles into them, through them, and out of them so that these conveyances can make more effective use of the driving power with which they are equipped. Each and all of us, directly or indirectly, are paying for loss of time resulting from traffic congestion and its consequent delays. The bill daily or annually is an enormous one.

RA-MOSE AND HAT-NUFER*

By **AMBROSE LANSING**

Associate Curator of the Department of Egyptian Art of the Metropolitan Museum of Art; In Charge, Metropolitan Museum Excavations in Egypt

and **WILLIAM C. HAYES**

Assistant Curator of the Department of Egyptian Art of the Metropolitan Museum of Art

(In Three Parts—Part Three)

OUR first efforts to open the Canopic chest were checked by a locking device similar to that already encountered on Hat-nufer's coffin. In the chest the binding elements were not tenons but tongues projecting laterally from the ends of the transverse cleats on the underside of the lid, which fitted into L-shaped mortises on the inner surfaces of the sides of the box (Figure

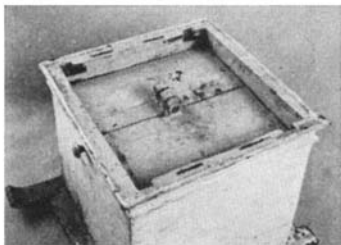
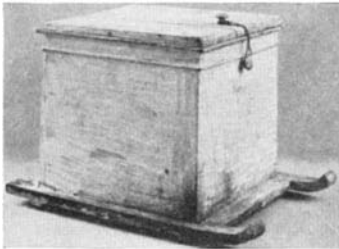


Figure 15: The Canopic chest. Inside were the Canopic vases for the entrails, as per the Egyptian custom

15). As with the coffin, there are vertical guiding tenons in the sides of the lid and, of course, the essential tumbler near its front edge, which in this case had dropped down behind the front edge of the box when the lid was slid shut. The removal of what proved to be the outer lid of the chest revealed an inner lid. These two "doors" rested on the two crossed partitions which divide the interior of the chest into four compartments, and were locked down by a boxwood bolt passed through wooden staples at the centers of their contiguous inner edges. The bolt was fitted with a small ebony tumbler which was intended to fall between the first and second staples when the bolt was shot home, thus making its removal impossible. Fortunately for us, however, the tumbler had failed to function, so that the bolt

*Courtesy the *Bulletin* of the Metropolitan Museum of Art.

was easily withdrawn and the interior of the chest at last revealed.

Its contents constituted a distinct anticlimax. The four Canopic jars and their stoppers are of pottery. The jars are unscribed, and both they and the stoppers vary considerably in size and proportions. Three of the stoppers are in the form of human heads, as was usual at this time, but the head of the fourth stopper is that of a canine animal (the Genius Dua-maut-ef), with long snout and upstanding ears. As if to give it further prominence, this stopper is whitewashed. The jars, packed in sawdust, natron, and linen wadding, occupied the four compartments in the interior of the chest. One of the wads, when unfolded, proved to be a shirt, similar to those found on the bodies of Ra-mose and Hat-nufer, of fine linen, very pale in color, but with vertical stripes of dark brown running through it. Each jar contained one of the human organs.

The three linen chests were opened next. Of these, two (*E* and *F*, see Figure 16) are plain, rectangular boxes with flat lids, made of heavy and somewhat rough sycamore boards. The third (*J*) is not only more elaborate in form but is

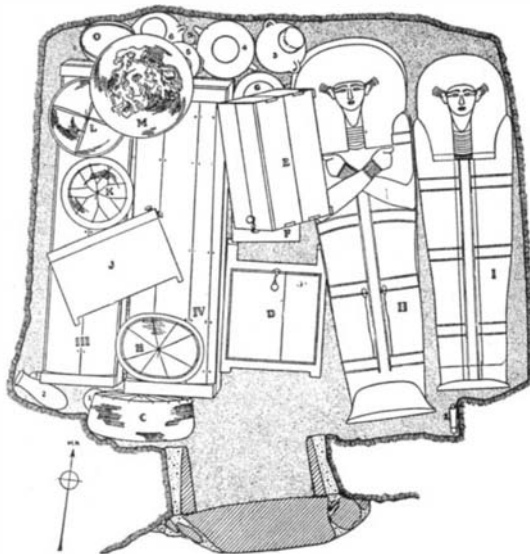


Figure 16: Plan of the tomb, with numbers and letters mentioned throughout the text

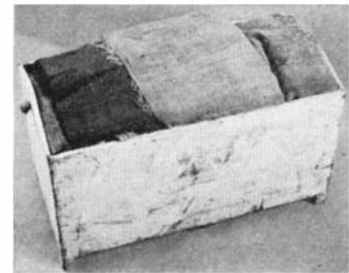
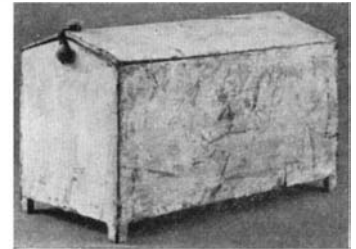


Figure 17: Chest *J*, of whitewashed pine, and filled with linen sheets

of better material (pine) and is more carefully constructed and finished. It has a gable lid and stands on four short legs (Figure 17). All three chests are whitewashed inside and out. Each chest was equipped with two stout knobs, one on the end of the lid, one on the corresponding end of the box; and by means of these the lid had been lashed in place

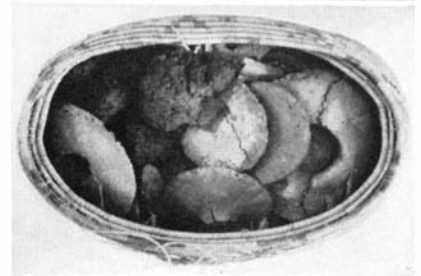
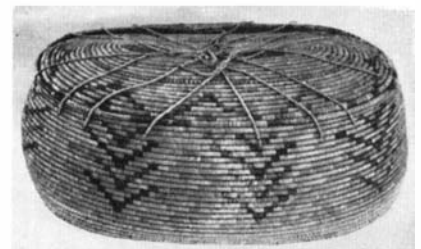


Figure 18: Basket *C*, with bread and fruits that were very dry but intact

with cord, the knotting of the cord between the knobs being secured by a stamped mud sealing. Chests *E* and *J* were fairly clean and fresh, but chest *F* had evidently been in use for a long time before its introduction into the tomb. A hieratic inventory written on the underside of its lid shows, indeed, that it had at one time contained a quantity of metal tools, vessels, and other objects. Under this list were the partially erased remains of an earlier but similar one, at the beginning of which are preserved the name and title of Sen-Mut's brother, the "web-priest of Amun, Minhotpe."

The chests contained, between them, seventy-six long, fringed sheets, or "bolts," of linen cloth, each sheet folded to form a neat rectangular bundle. The cloth differs in spin and weave, so that the sheets vary in texture from a very coarse material like burlap to a remarkably fine, filmy, weblike cambric and in color from dark brown to almost pure white. Each sheet is woven in one piece, in lengths ranging from 4.5 to 16.5 meters. In addition to weavers' marks worked in the fabric, 29 of the sheets bear identification marks in black ink. Nearly all the latter are marks of the

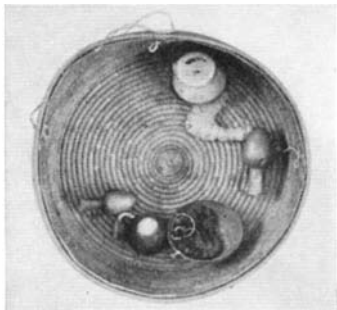


Figure 19: Basket *L* and its odd batch of small personal belongings

government and temple linen store whence, we may assume, Hat-nufer drew or purchased the cloth. The only private name which occurs among these marks is that of an individual named Boki. There is not much doubt that the sheets—clean and neatly pressed—represent not embalmers' equipment but Hat-nufer's supply of household linen. Their amazing state of preservation allowed them to be unfolded, measured, and refolded at will.

Four of the five baskets, or hampers (*C*, *K*, *L*, *O*), and the basketry tray (*M*) are made of halfa grass by the common sewn-coil technique, and are decorated with geometric designs in black and



Figure 20: A silver wine service. Their size is shown by Figure 19

red. Their bottoms, inner rims, and other parts which were required to stand special wear or strain are whipped with palm-leaf strip. Basket *H*, the only undecorated example, is entirely of palm leaf. All are outstanding examples of a craft which has survived in northern and central Africa from the most ancient times to the present day with little change in technique or decoration.

By untying a single knot at the center of the lid of each basket we were able to release the series of cord loops by means of which the basket had been securely sealed for 34 centuries. The contents of the baskets varied a good deal in type and interest. Basket *C* was packed with loaves of bread, dates, and raisins disposed in three small pottery dishes, and lumps of black matter, also containing raisins, which look as wedding cake might if kept for 3000 years (Figure 18). The bread is of two kinds, one light brown with a hard, glossy crust like that of modern Vienna rolls, the other dark, grayish brown, with a rough surface. Of the four types of loaf the most interesting is a long, flat form of fancy shape, possibly intended to suggest a human figure.

BASKET *H*, the most carefully sealed of the lot, contained nothing but a jumbled mass of dirty, oil-soaked bandages, probably used in the process of embalming Hat-nufer's mummy. The entire contents of basket *K* consisted of five linen sheets, clean, pressed, folded into bundles, and altogether similar to those from the boxes. When the removal of the lid of basket *L* (Figure 19) re-



Figure 21: Hat-nufer's razor is still almost sharp enough to shave with

vealed another such sheet, we began to become a trifle discouraged with the baskets and their contents. But below this sheet, which turned out to be the biggest found in the tomb—more than 50 feet in length—lay a group of objects of considerably greater interest. Fore-

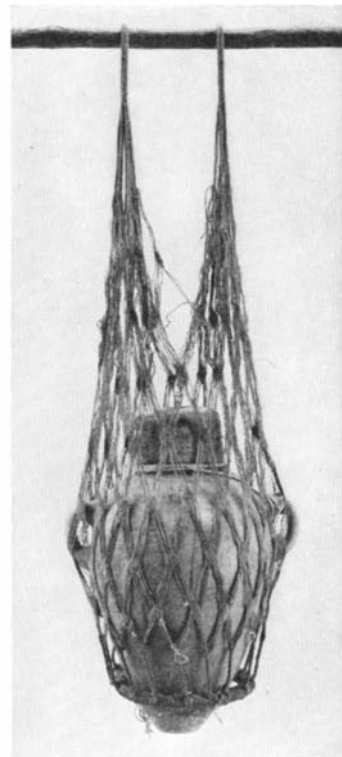


Figure 22: A net sling used for carrying the large jar within it

most among them was a set of three small vessels of beaten silver (Figure 20), consisting of a hemispherical bowl with a low stand soldered to its underside and a pair of little pitchers—one, as usual, slightly larger than the other—with handles of silver wire. The lower end of the handle, where it is attached to the side of the pitcher, is, in each case, in the form of a lily, or sedge, plant, one of the emblems of Upper Egypt. With the silver vessels was a bronze razor (Figure 21), equipped with a nicely carved boxwood handle and carefully wrapped in narrow linen bandages. In the silver bowl lay a necklace of faience lenticular beads, and near by, two little unguent jars of pottery, their mouths covered with pieces of linen cloth.

Lying bunched together in the basketry tray *M*, were a net sling of linen cord and a tufted linen square, perhaps a chair pad, or possibly a donkey saddle. The pot sling is an unusually good example of its type and is of all the more value because of its perfect state of preservation. The net was undoubtedly used to transport the larger pottery vessels into the tomb, and in Figure 22, it is illustrated in position around one of the three amphorae.

The lid of basket *O* had been removed in antiquity, apparently after the basket

had been brought into the tomb, and very carelessly replaced; and of the original contents of the basket only a few objects were found, lying in loose disarray at the bottom: a lidless alabaster jar, a small serpentine kohl jar, also minus its lid, an ebony kohl stick, and a small, colored grass basket. The lid of the basket had also been pulled off and the basket was empty except for one blue faience lenticular bead—apparently one of the many beads which we may assume the basket once contained.

A brief survey of the objects from Hat-nufer's coffin and from her boxes and baskets immediately disclosed the fact that the group, while impressive, was not complete. There were still missing from it several of the more important items which we had come to associate as a matter of course with the burials of well-to-do ladies of the early and middle



Figure 23: Hat-nufer's hand mirror is of polished bronze

XVIII Dynasty. These include full-sized mirrors, a large kohl jar, a toilet box or dish, and the very common decorated faience bowls for flowers. It was not until later that we found the missing objects cached in the foot end of one of the cheap rectangular coffins, to the miserable occupants of which they clearly did not belong. Perhaps their presence there was due to some exigency which cropped up at the time the tomb was being sealed, or even to an attempt at pilfering by one of the undertakers, which threatened to be discovered before he could remove his loot from the tomb. In regard to the latter supposition it should be recalled that basket *O*, from which the objects could have come, had been roughly pulled open and was found more than two thirds empty. However that may be, the group of articles from the foot end of the rectangular coffin is of a quality consistent with the rest of Hat-nufer's possessions and includes just the items which we had noted as lacking from these. There are two mirrors, both of bronze, the larger with a wooden handle in the form of a papyrus stalk and umbel, the smaller entirely of metal, with a

similar handle, in this case ornamented on each side with a relief head of the goddess Hat-Hor (Figure 23); a circular wooden toilet dish with a swivel lid, decorated with an incised design of concentric and contiguous circles (Figure 24); a pair of wooden castanets carved in the form of elongated human hands; a large alabaster kohl jar and lid, the lip of the jar broken away and missing;



Figure 24: A circular wooden toilet dish having an incised design

a bowl of deep blue faience, decorated with a lotus-flower design in black outline (see Figure 25); two blue faience saucers with black decoration (Figure 25), one with the title and prenomen of Thut-mose II; and seven staraboid beads of glossy blue faience, two of them also inscribed with the prenomen of Thut-mose II.

The two large alabaster jars (shown in Figure 26) from the floor of the chamber by the north end of coffin IV are well-known XVIII Dynasty types. Both are distinguished by their fine surface polish and the beauty of the ornately grained, translucent alabaster of which they are made. Their tops were covered by pieces of linen cloth, lashed about their necks with cord, the knots secured by stamped mud seals. One jar is unengraved, but engraved on the side of the other is a short column of hieroglyphic inscription giving the personal name of Hat-shepsut



Figure 25: A bowl and two saucers of faience decorated with black

(for whom the jar may have been originally made), accompanied by her early titles as Queen of Egypt. The latter jar has not been opened, but the other was nearly filled with a thick resinous gum, which, amazing as it may seem, was still soft at the time the jar was opened by us.

The three great pottery amphorae (3, 4, 6, Figure 16), found stacked along the north wall of the chamber, are of interest mainly for the oval stamp impressions on their heavy mud sealings and the ink labels which they bear on their sides. Nine of the stamp impressions bear the name and title of Hat-shepsut as queen, but on four others are her title and prenomen as king. The labels give the names of the various wood oils contained in the jars. The label on amphora 4 is preceded by the date "Regnal Year 7" (of Thut-mose III). The squat, long-necked pottery jar No. 5, equipped with two inverted-U handles, also bears the year date 7, accompanied by designations of the month and day and followed by a description of the contents of the jar. These dated ink inscriptions form an excellent index of date for the tomb, which, we now know, was sealed late in the seventh year of the reign of Thut-mose III (1494 B.C.).

WE are fortunate in this tomb in having not only the names of the oils contained in the jars but also copious specimens of the oils themselves, which can be analyzed chemically and so give us more exact meanings of the names than have hitherto been known.

Other pottery vessels, found on the

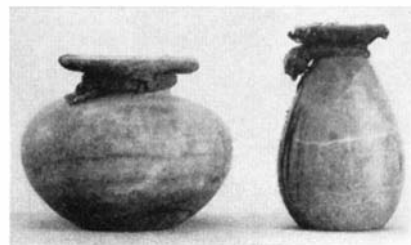


Figure 26: The gum found in one of these jars had never hardened

floor of the chamber by the south end of coffin III, include a long, drop-shaped jar (2), decorated with a red slip and bands of black, and two small pottery dishes in soft brown ware.

These completed the possessions of Hat-nufer.

(The End)

BOTH industry and business are now seeking from science an explanation of the long-period swings in business activity, which must have some cause. In a coming article this subject will be discussed. Its author refers to the effect of climate and weather as a "dictatorship over man, a fact which is being increasingly realized."—Editor.

PHOTOGRAPHING TRAFFIC FROM THE AIR

THE captive balloon, long familiar as a war-time device for keeping watch over enemy activities from the air, has been given an important peace-time job—that of surveying city traffic. In this new use, it promises to become a valuable weapon in the war upon accidents, for it will enable traffic engineers to study at their leisure actual driving conditions at key locations and draw conclusions as to safety measures that should be put into practice or changes in traffic regulations that should be made.

As a traffic surveyor, the captive bal-

loon is not as large as its war-time ancestor, nor does it carry an observer. Instead, it is only 12 feet in diameter and carries a camera which is operated by remote control from the ground. Until recently, it had been used only at a number of typical intersections in Milwaukee and Milwaukee County, accord-



Above: Aerial camera and balloon in operation; guy ropes held by nearest man and one just visible in distance. Milwaukee Journal photo

Left: While the inventor, Carl V. Bergstrom, stands on a ledge, his picture is taken from below to show camera. Milwaukee Journal photo

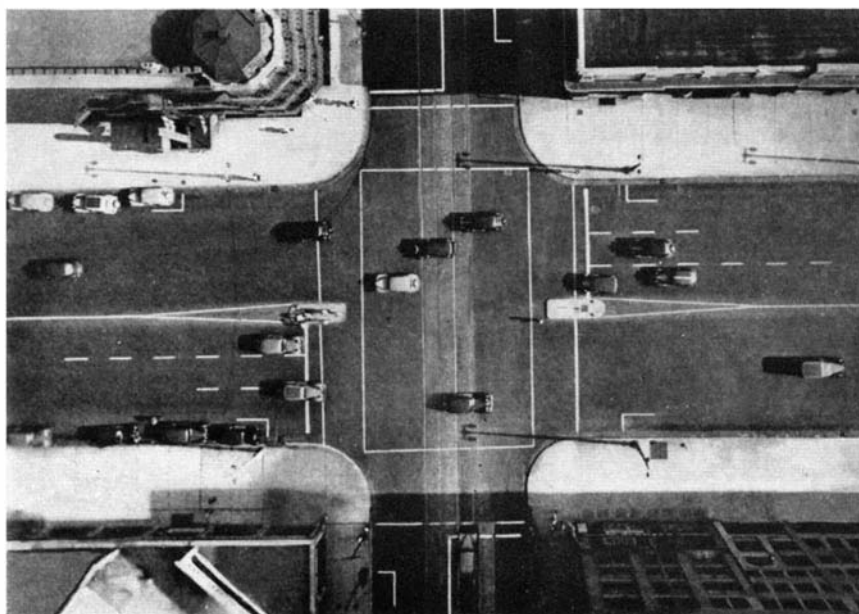


Left: One man steadies the balloon while two make necessary adjustments to the camera before an ascension

Right: The car and trailer which carry the inflated balloon, camera, and all needed auxiliary equipment



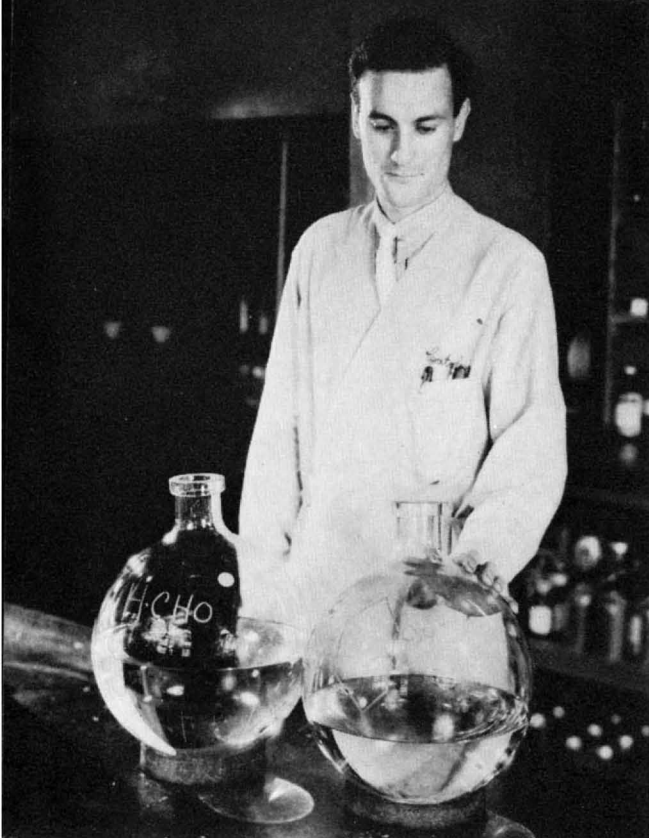
Below: A picture tells more than a draftsman's sketch and is much cheaper to make. A Milwaukee corner



ing to its inventor, Carl V. Bergstrom, a Traffic Engineer in the Bureau of Electrical Service, of Milwaukee, who discussed its use in *Public Safety*.

The camera, which is a view model making a five by seven inch picture, and the balloon and necessary guy and control cables, are transported by means of a passenger automobile and small trailer. The balloon is guyed to the trailer in such a way that a speed of 20 miles an hour can be made. On arriving at an intersection to be photographed, the camera is fastened to the lower end of a pendulum assembly which, in turn, is attached to the bridle of the balloon by means of a universal joint, and the balloon is permitted to rise, control being maintained by guy ropes. It is maneuvered until it is directly over the center of the intersection and then the plate is exposed. Batteries and a push button operate the shutter.

A PLASTIC



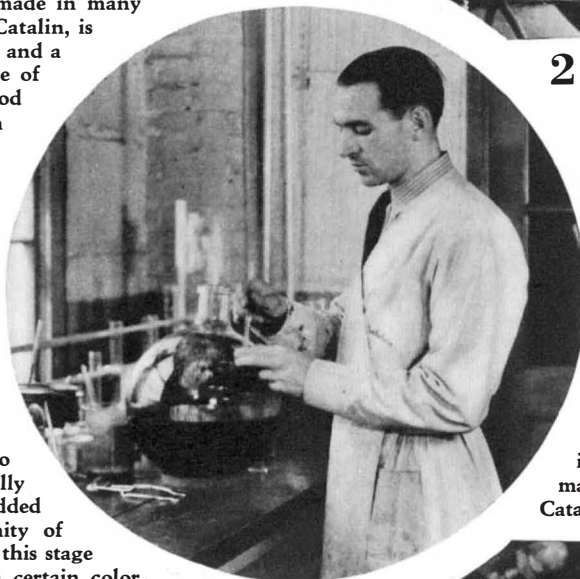
1 Plastics, those colorful synthetic compounds that have invaded so many fields of industry, are made in many ways, from many ingredients. One of them, Catalin, is chemically born of a mixture of a clear liquid and a gas captivated in water—phenol, a derivative of coal, and formaldehyde, a derivative of wood alcohol, which, in turn, is derived from such sources as wood pulp, cornstalks, even hay

3 While the mixture is cooking, the color chemist prepares the required batch of coloring material of the desired shade. By proper control at this point, the finished plastic may be produced in colors ranging from water-white, resembling glass, to pastels, vivid hues, black, or white

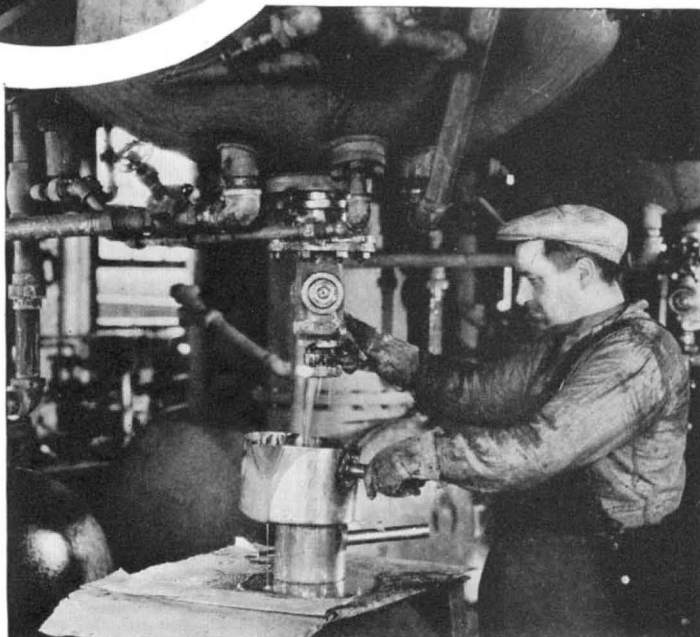
4 Below: Just before the cooked mixture is to be drawn off from the kettles, a carefully measured amount of coloring material is added and thoroughly agitated to assure uniformity of color throughout the material. So accurate is this stage of the production that the exact shade of a certain color may be reproduced at any time required, even years later



2 The liquids (see photograph No. 1) are mixed in this battery of nickel-lined kettles where the compound is cooked at low temperature until it reaches the consistency and color of honey. The kettles, only the tops of which are shown, each hold 3000 pounds of liquid resin



5 Below: The cooked and colored plastic is drawn off from the bottom of the kettle into ladles, from which it is transferred to lead molds where it is formed into rods, cylinders, and other regular or irregular shapes. The pour must be made in small batches, as the cooked Catalin begins to harden and set quickly



IS BORN



6 Making one form of mold into which the liquid Catalin will be poured. A steel arbor of the proper shape is dipped into molten lead. The lead "freezes" to the steel and is then stripped off, ready for use. Molds are used only once. The form shown is for making rods from which buttons of identical size are cut

9 After the molds have been filled, they are placed in low-temperature curing ovens for a period of about 50 hours. This treatment makes the finished product less brittle, preserves the colors of the delicate dyes. *Below:* After curing, a pneumatic hammer forces fluted plastic rods from one type of multiple mold



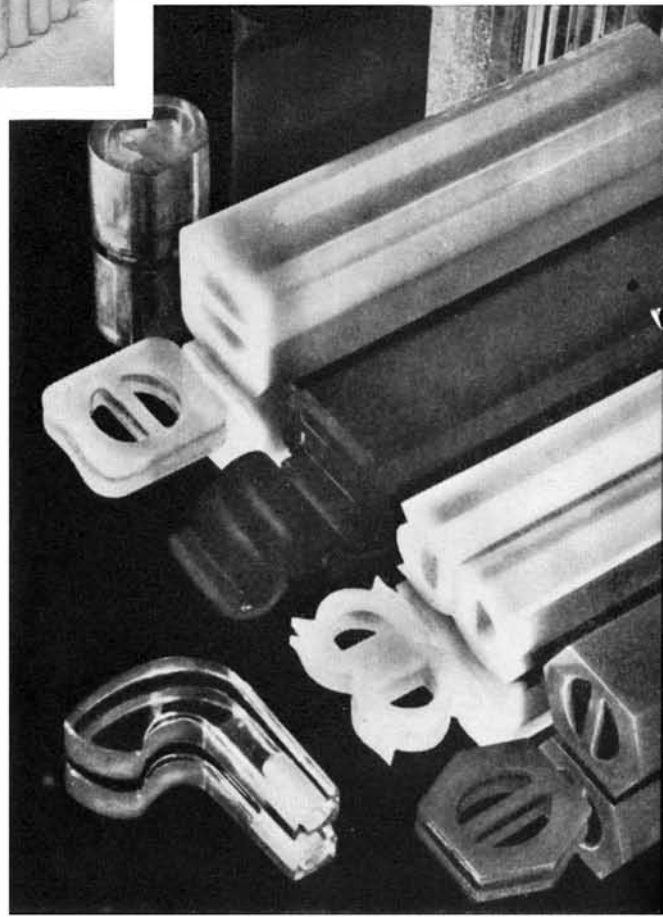
10 Molded, cured, and partly sliced, the variety of forms (*right*) show a few of the hundreds of possibilities for plastic products. Umbrella handles sliced from lengths of curved stock, belt buckles and dress ornaments from fluted hollow rods, are suggestive of many other uses. Teething rings and dental plates, doorknobs and toothbrush handles, steering wheels and fountain pens, all can be cast in Catalin or cut to form with the same tools and technique as are used in many branches of wood or metal working

By A. P. PECK



7 It is frequently desired to produce a batch of plastic in which two or more color combinations are blended in irregular mottled patterns. This effect is obtained by an intermediate process after the thick liquid is withdrawn from the kettles and before it is cast. In the photograph, the mottler is skilfully blending two colors to simulate onyx. Measuring by eye, he produces remarkably uniform results in successive batches

8 *Left:* The molds and the cooked plastic are ready. Small quantities of the mixture are conveyed in ladles to the molding bench where the heavy liquid is poured into the waiting lead molds. In the photograph is a series of cylindrical molds; the finished Catalin cylinders will be cut into short lengths and the edges smoothed to form fancy bracelets



THE NEAREST STARS

By HENRY NORRIS RUSSELL, Ph.D.

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

EVERYONE knows that we must know the distance of a star before we can work out its real brightness, or the actual rate at which it is moving relative to the sun, and it is almost as widely known that the distances of hundreds—nay, of thousands—of stars have been determined in one way or another, so that we can perform the required calculations. These are simple enough: to allow for the average effects of the minute errors which still affect our observations, though not so simple, is practicable. But, when our calculations are all made, and their degree of reliability ascertained, we must think carefully before we apply our results to the stars in general.

For example, it is now quite certain that a majority of the stars visible to the naked eye are 300 light-years or more distant, and that a large fraction, if not an actual majority, of them are at least 50 times as bright as the sun. Is this true of the stars in general? One must meet this question like a Yankee—with another question. "What do you mean by 'in general?'" If you mean the stars picked out by apparent brightness in the heavens, the statement is correct; we have studied a number quite large enough to give a good sample.

BUT if you mean the stars in a given region of space, the statement is very far indeed from the truth. A large majority of such stars are much fainter than the sun. How do we know this? And why do our carefully prepared lists provide us with such an awfully bad sample? The first answer is easy—we find it out by tabulating the properties (brightness, in this case) of the stars which are known to be within a relatively small distance of the sun, such as 20 or 30 light-years, and forgetting the rest for the moment. The question why this method of picking out stars gives us such an extraordinary different sample from the other is more interesting. It does so because there are enormous differences in real brightness from star to star. Suppose, for example, that, on the average, in the region of space surrounding the sun, there are 50 stars as bright as the sun for every one of 100 times the sun's brightness. How many of each sort will be comfortably visible to the naked eye (that is, brighter than the fifth magnitude)? A star of the sun's brightness will satisfy this condition if it is within (approximately) 30 light-years' distance; but a star 100 times

brighter will be visible if it is anywhere within 300 light-years. Within this larger sphere (if the stars are uniformly strewn in space), there will be 1000 times as many stars like the sun as there are in the smaller sphere. Hence our apparently fair and simple method of selection gives a most outrageous preference to the stars of greater luminosity. We will get 20 of them in our list of naked-eye stars to one of the other kind—though the real proportion throughout the region of space concerned is 50-to-1 the other way! This is but a mild example of the effects of "observational selection;" some stars are 10,000 times as luminous as others, and stand a million times better chance of getting into our star-catalogues, so long as these are selected on the basis of apparent brightness.

To get a full list of the stars in even the nearest parts of space—say within 20 or 30 light-years from the sun—is therefore no easy matter. There are about half a million stars in the sky between the tenth and eleventh magnitude in apparent brightness. The enormous majority of these must be objects of considerable, or high real brightness, and at great distances. A few dozen among them all will be inherently faint stars which lie close by. To pick them out seems at first to be hopeless; and so it would be, if we had to "go it blind" and measure parallaxes at random for star after star until we happened on a big parallax. But, fortunately for the progress of astronomy, the stars are in motion—and, other things being equal, a star which is near us will appear to move faster across the sky than a distant star. "Other things"—in this case the velocities with which the stars are moving, relatively to the sun, at right angles to the line of sight—are, of course, not always, or even usually, equal. But the range in these velocities, though considerable, is nothing like the enormous range in the real brightness of the stars, so that if we make a list of stars of large proper motion, the preference which we unavoidably give to fast-moving stars will not be hopelessly overwhelming. What is most important for our present purpose is that there will be very few stars whose crosswise motion is actually small, so that, though

near us in space, they appear to move slowly in the sky. The reason for this is that this motion has two degrees of freedom. One part (or component) is eastward or westward in the sky, and the other northward or southward; and if their combined effect is to be small, each one separately must be still smaller. If, then, we can get a list of the stars with large proper motion, say more than 0".5 per year, it will include almost all the stars of very large parallax (greater than 0".25), and the major part of those with considerably smaller parallaxes.

NOW stars with large proper motion are easy to find, by comparing photographs taken many years apart, with the powerful aid of the blink microscope, which almost automatically picks out a single star which has moved among thousands which have not. Millions of stars have thus been examined, and thousands of motions detected (most of them smallish) but, among them, there are a few hundred stars with rapid motions. These, whatever their brightness, are promising objects for the parallax observer. The completion of work now in progress—such as the very extensive campaign pursued by Luyten at Minnesota, with Harvard plates—should give us a practically complete proper motion list down to the 15th magnitude, and so lead to a fairly thorough knowledge of the nearest stars.

What we know at present is summarized in a very interesting list which has just been published by Miss Louise Jenkins of the Yale University Observatory. This includes all the stars which are known, by direct measurement, to have parallaxes exceeding 0".1—that is, distances less than 33 light-years. There are 127 objects in the list—not counting the fainter companions of the 19 double and 5 triple systems, which raise the total number of stars known to be within this distance to 156.

We do not get anything like this proportion of double and triple systems among stars selected by apparent brightness. The reason is obvious. Most of these stars lie at much greater distances. If the nearest stars were removed to such distances, some of the closer pairs could no longer be seen double, and many of the fainter companions would

be lost to view, even with large telescopes. Hence the list of near-by stars, short as it is, gives a better idea what proportion of the stars are double than do the far longer lists of stars "including everything" down to some limit of apparent brightness, and hence affected powerfully by observational selection.

Observational selection has still had a very considerable influence upon the list of the nearest stars. This appears clearly when we pick out those whose distances are less than half the originally assigned limit (and parallaxes therefore greater than $0''.2$). By this change, we have cut down the volume of space in which we are looking for stars to one eighth what it was before, and should expect to get one eighth as many stars. We actually find 32 systems (six double and two triple), or 42 stars in all. If this is a fair sample of the larger volume, we should have found 256 systems, or 336 individual stars, in the longer list. We actually get less than half as many, so that the list must be very incomplete, especially for distances greater than 20 or 25 light-years. When studies of proper motion and parallax have been thoroughly extended to stars of the 15th magnitude, a larger number of these objects will doubtless be picked up.

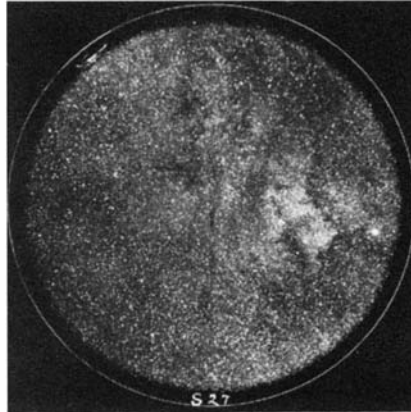
If we divide our inner region into two equal volumes by a sphere $12\frac{1}{2}$ light-years in radius, we find 21 systems with 29 stars in the inner part, and 11 systems with 13 stars in the outer shell. Part of this large difference may be due to chance, but it is highly probable that, even for these very near stars, our present list is far from complete. The whole number of stars within 33 light-years is probably as great as 500.

IN the present list of near stars, there are seven of the first magnitude: Alpha Centauri, Sirius, Procyon, Altair, Fomalhaut, Vega, and Pollux. This list is complete, for the remaining 14 stars brighter than magnitude 1.5 have been observed and found to fall outside our limit—most of them far outside. Among the naked-eye stars (brighter than $6^m.0$), there are 49 in the list (not counting the fainter components of doubles) which is just 1 percent of the whole number in the sky. Our list is probably fairly, but not quite, complete in this case.

The list of 59 stars between the 6th and 11th magnitudes will probably be considerably increased, but, even so, it is certain to include only an exceedingly small fraction of the 800,000 stars in the sky within these limits of apparent brightness. Only 19 stars fainter (apparently) than the 11th magnitude have so far been found to be our near neighbors. Were our list complete, it might be 20 times as long, but it would contain a far smaller fraction of the many

millions of stars in the heavens than any of those which precede it.

The range in real brightness among these stars is enormously great. Even among the five nearest stars, we have Sirius, which is 28 times as bright as the sun, and the tiny star Wolf 359. This star is known only by its number in the catalogue of proper motion stars discovered photographically by Wolf, and has the very large motion of $4''.67$ per year. Its apparent magnitude is



North America nebula in 16° field, photographed with an $f/1$ Schmidt camera by Charles and Harold Lower. The North American nebula appears half way between the center and right edge of the photograph. It is a fortuitous arrangement of star clouds resembling the North American continent in its outline

13.5—so that it sends us a little less than a millionth part as much light as Sirius does; yet it is actually nearer than Sirius, its parallax being $0''.403$ and its distance 8.0 light-years, as against 8.4 for Sirius, so that the real disparity in brightness is a little greater even than it looks—the ratio being 1,200,000 to 1. Sirius is bright not mainly because it is big, but because it is hot. There is good reason to believe that it is rather less than twice the diameter of the sun, and gives out about eight times as much light per square mile. Wolf 359 must be a small star, but it is also one of the coolest stars we know about (except for certain variables). Recent observations, reported at the Williamstown meeting of the Astronomical Society, show that it is far brighter when photographed with red light than it appears to the eye. This indicates a very low surface temperature, probably below 2500 degrees, as against 6000 degrees for the sun. The corresponding surface brightness would be something like $\frac{1}{4000}$ of the sun's, and, as the star gives out about $\frac{1}{40,000}$ of the sun's light, we may roughly estimate its diameter as $\frac{1}{6}$ or $\frac{1}{7}$ of the sun's. If its temperature were 2000 degrees, its diameter would come out about half the sun's. The truth may lie between these two estimates.

A star similar in brightness and motion to this, but lying in the outer half

of the region which we have chosen as our limit for the "nearest" stars, would be of the 16th magnitude visually and not much above the 18th photographically, and have a proper motion of $1''.4$ per year. By comparing plates made at only a few years' interval, it could be picked out easily from a hundred thousand ordinary stars; but to get plates showing good images of such very faint stars, over a large region of the sky, would demand longer exposures than it has yet been practicable to give for such work. Such very faint stars, then, can be detected only when they are near among the nearest. We are lucky to have caught a single one so far.

Whether there are still fainter stars among our nearest neighbors will not be easy to find out. Random searching is not likely to be profitable, but one chance is worth taking. A good many of the nearer stars have faint companions, sometimes close enough to count as a "double star," oftener some distance away, but recognizable by their sharing the principal star's motion. The fields surrounding these stars in the sky, therefore, afford much better hunting-ground than random samples of the sky, and it might be profitable to photograph them with long exposures, and repeat this after a few years—two or three would be enough to reveal such a companion by its displacement. It would pay, too, to examine the nearest stars visually with great telescopes on good nights in search for close or faint companions. Kuiper has already discovered several interesting pairs in this way.

FOUR more of the ten nearest stars at present known are less than $\frac{1}{3000}$ as bright as the sun. Among them is "Proxima Centauri," the faint distant companion of Alpha Centauri, moving along with it in space, and probably a little nearer to us than the bright double. All these stars are red, and they are probably both small and cold, like the one we have discussed.

Even from this small sample, there can be no doubt that these individually inconspicuous stars are the most abundant of all kinds, if the search is made throughout a given region of space. When we pick stars by apparent brightness, we introduce odds against including such stars as Wolf 359, which, compared with stars like the sun, run nearly 10,000,000 to 1. Compared with Sirius, the odds would be more than 1,000,000,000 to 1, if it were not that Sirius, if at such a distance that it appeared of the 13th magnitude, would be in a part of space where the stars are thinly scattered. This reduces the odds, but leaves them so heavy that it is not surprising that we have so far discovered but a single one of these very faint stars.—*Princeton University Observatory, November 4, 1937.*

HEADACHE HEADQUARTERS

WHEN a manufacturer is ailing, he calls in his doctor; when he has trouble with his product or process he may call in the Mellon Institute of Pittsburgh. No problem in industrial research is too difficult for it to tackle. Mellon Institute showed the 364,000,000-dollar Union Carbide and Carbon Corporation and the 400,000,000-dollar Koppers Company and associated concerns how to adapt deadly war chemicals to peaceful commerce. For a smaller company it developed a water conditioner that renders dishes germ-free (dish-conditioning) and suggests that every dish-towel in America may some day become obsolete.

By improving the things that millions use and consume, the Institute promises to become the most significant monument to Pittsburgh's late grandees. It was founded by Andrew W. Mellon and Richard B. Mellon. The new structure into which the organization moved last May is the most complete research laboratory in the world (see *Scientific American*, July, 1937). Its 200 scientists use 300 chemical or mechanical work-rooms. By a turn of the hand they obtain steam, gas, compressed air, suction (for creating vacuum), water at any temperature, tropic or arctic weather conditions. They have solved headaches for 4000 companies, developed 650 new processes. Some 700 United States patents have been granted on the results of their labors and many of these have been revolutionary.

Mellon Institute works through industrial fellowships which are financed by individuals, companies, or associated groups. Donors of fellowships may use all facilities of the organization but they pay according to the needs for personnel and special apparatus. Contracts run for at least a year. All patent and other rights belong to the fellowship donor.

The Institute chooses the best available scientists to head the fellowship activity. Most of them are young chemists or engineers with brilliant records. They come from universities, company laboratories, government and associa-

Mellon Institute . . . Sponsored Research Cures Industrial Headaches . . . Solves Problems . . . Develops New Products, Processes . . . 700 Patents

By FREDERICK TISDALE



East colonnade of the magnificent new building of the Mellon Institute of Industrial Research at Pittsburgh

tion services. Discoveries eventually worth millions to the country are sometimes made by groups whose head "fellow" gets around 6000 dollars a year, but there always is a chance that these men may graduate into good jobs with grateful clients. Mellon Institute requires about 1,000,000 dollars a year for running expenses. Fellowship donations help make up this figure.

SPECIALISTS working in such huge modern laboratories are displacing the colorful lone inventor who groped (and hoped) in poorly-equipped scientific hide-aways. Mass attack by trained men now solves the technical difficulties of industry. Co-operation among them speeds results.

Since the organization's most important field is industrial chemistry, its handiwork often goes unrecognized by

the consumer. A housewife discovers that by adding a spoonful of "Calgon" to dish-water, her glassware and china dry miraculously bright and clean without the aid of a towel. This substance forms a perfect solution of soap with any water, no matter how hard, and enables it to drain off without leaving any film or dirt. Mellon Institute discovered that the addition of sodium hexametaphosphate to dish-washing compounds gave the magical results.

At Coney Island a pants presser treats his girl to a skinless hot dog, never suspecting that distant Mellon scientists made the delicacy possible. Probably he does not know either that the clothes pressing machine he uses daily also is indebted to Institute engineers for up-to-date improvements. It took 10 years to perfect a cellulose casing for wieners that would take the place of animal intestines. E. O. Freund, who

later organized the Visking Corporation, of Chicago, backed the venture. Success involved devising a machine that forced out cellulose of definite properties in an endless tube, much the same as rayon filaments are produced.

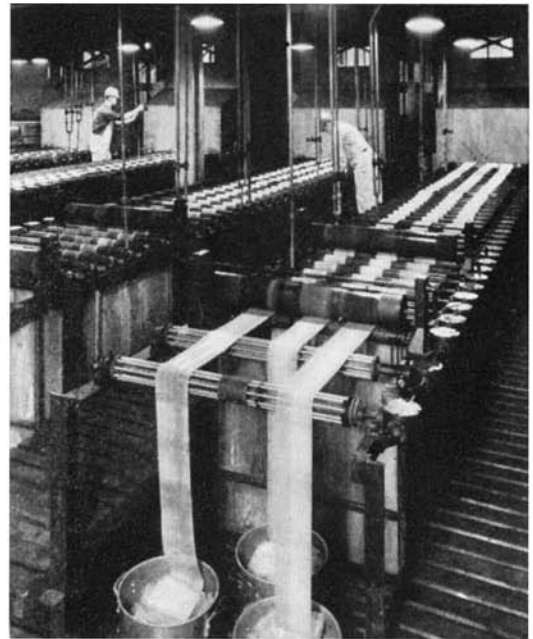
This cellulose comes from cotton linters, is a cousin of Cellophane. Meat does not stick to cellulose as it does to animal casings. Therefore the frankfurter's cotton shirt is removed after the sausage is cooked, smoked, and stuffed in the orthodox manner. The result is a nude "frank" ready for boiling and the valedictory smear of mustard.

Thirty-one men, 15 of them Mellon scientists, made daily sacrifice of their beards in a shaving clinic under the Magazine Repeating Razor Company fellowship. It was found that a tooth-type guard traveling ahead of the blade rumbled the skin, thereby preventing a

close cut in the grooves and causing painful nicks on the summits. A bar guard which stretched the skin smoothly and raised the whisker for better contact with the blade was developed. Also, the most generally agreeable angle between blade and skin was scientifically determined (see *Scientific American*, November, 1937).

Research on the fundamentals of sleep for the Simmons Company illustrates the ingenuity required for designing special apparatus. A sort of posture meter was invented to register how long a subject lay in each position. It consisted of a noiseless motor which slowly moved a tape under the bed. On this rested a pen which was attached to the

“Fly-Tox” was developed at Mellon Institute. It was the first insecticide of this type to be distributed nationally to consumers. Formerly, manufacturers could rely only on the “death chamber” to establish the insect-killing qualities of their poisons. It is a specially constructed room, six feet cube. For a test 100 flies are imprisoned in it. Then 12 cubic centimeters of the insecticide are sprayed in. After 10 minutes the flies (mostly in a stupor on the floor by now) are taken out, put in a cage, and the inter-



Making the casings, above, for the “skinless” hot dogs, a product of Mellon research. The girls are peeling off the skins of the “franks” after cooking



ture is rich in calcium value. It is superior to spinach which interferes with calcium utilization.

Millions munch their morning toast without appreciating the Institute’s contribution to commercial bread making. “Arkady” yeast food revolutionized this branch of the baking industry. It literally feeds the yeast (with necessary nitrogen, lime, and oxygen, which other-

bedsprings. The pen-point drew a straight line as long as the sleeper lay still, jogged whenever he moved. Comparison with a time line on the tape registered how long each posture was kept.

Exact positions were observed and timed by a camera aimed through a hole in the wall. Whenever the subject moved and disturbed the bedsprings, an electromagnet snapped the shutter. Each exposure took in a wall clock, thereby recording the time and duration of different postures. Subjects included 150 persons, of both sexes, of varying ages, intelligences, and states of health. It was discovered that normal persons change posture 20 to 60 times during a typical night. The only healthy person who “slept like a log” was insane. Simmons Company was given the analysis of two million measurements to guide its designs of sleeping equipment.

Mellon Institute developed flake coffee as a by-product of packing experiments for Continental Can Company. Ground and roasted coffee was passed between heavy rollers. Resulting flakes were about as thin as a piece of paper. Flaking crushes the coffee cells, yields about 96 percent of desired essentials, compared with about 60 percent from ground coffee.

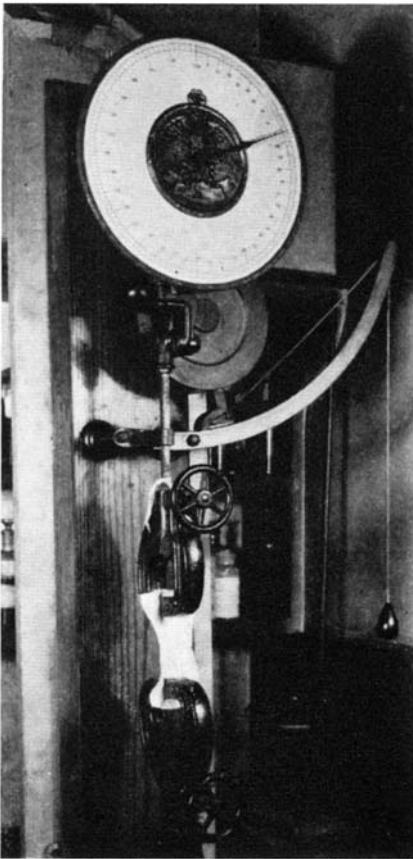
val until death timed. A good fly poison will put 95 of the 100 flies on the floor after 10 minutes and kill 60 within 24 hours.

Chemists felt that a simpler and more accurate test could be devised. Mellon Institute developed standards for the ingredients, particularly pyrethrum extracts—from a variety of chrysanthemum flower. By this method, manufacturers now predetermine with scientific precision the lethal qualities of their insecticides.

For Heinz, the Institute developed “Rice Flakes” breakfast cereal. Pure cellulose, recovered from the rice hulls, is added to give it laxative qualities. Heinz strained foods was another activity. These retain in puree form practically all the vitamins. They are in great demand for babies, children, persons on soft diets. One of the combinations of strained green vegetables contains lettuce, kale, asparagus. This mix-



Manner in which the bursting strength of hoisery is determined in the Mellon laboratories



Machine employed in making strength tests on various textiles

wise must be slowly taken from the other dough ingredients). There is a saving of one half in yeast used or about one half in time required to make the bread. "Arkady" cuts the fermentation time from five hours to two and one half.

Kaufmann's Department Stores, Pittsburgh, uses the Institute for development of merchandise standards. Results guide the store in buying from manufacturers, and tags inform customers as to the quality.

In one of the Institute's laboratories, a lever monotonously raises and drops on an inner-spring mattress a small barrel containing 100 pounds in weight. The blow travels 10 inches, 10 times a minute. On one mattress the meter registered 50,000 thumps without causing serious damage. Silk stockings and other fabrics are tested with a machine having an expanding rubber disk, thus registering the pressure necessary to burst through them. Gaged weights on individual threads determine tensile strengths. On the rocking arm of another apparatus, cloth is rubbed at set tensions and weights, a counter indicating how long it would take trouser seats to acquire a shine or upholstery fabrics to wear through. Fading resistance of dyes is determined by exposing cloth samples to a carbon arc lamp producing the same quality of light as the sun. A machine designed for determining air resistance of parachute fabrics has been adapted to show the air porosity of summer clothing textiles. It measures

the time required for a given amount of air to pass through the weave.

Mellon Institute pioneered in disclosing the causes of cloth failure during laundering. Standard washing formulas were given the industry and scientific reasons were established for explaining fabric injuries to customers.

THE Institute's development of silk strings for tennis racquets should be welcomed by the nation's sheep—not cats, as popularly supposed—as promising relief from a painful responsibility. Through research, slag waste from steel operations has been adapted for building purposes. Experiments on 350 types of brick walls disclosed among other things the trouble caused by moisture seepage above and below, developed types of metal flashing to prevent it. A fellowship discovered that the addition of 10 percent copper powder to magnesium oxychloride cements (used in floors, tiles, stucco, and so on) produced an amazing new cement which, unlike the original mixtures, grows stronger under exposure to water and weather; it's called "Hubbellite."

Mellon has been active in the development of plastics, new and mysterious big business. Its early product, Redmanol, was later combined with Bakelite's operations. This is a phenolic, at present one of the important synthetics in the plastic field. Its antecedents are carbolic acid (or phenol from coal via coke) and formaldehyde (compound formed from wood alcohol and oxygen). Other plastics developed at the Institute include Plaskon, Vinylite. They are competing with older materials in table tops, airplane windows, table wares, automobile accessories, electrical fittings, machine casings, gift novelties, costume jewelry, and many other commonplaces.

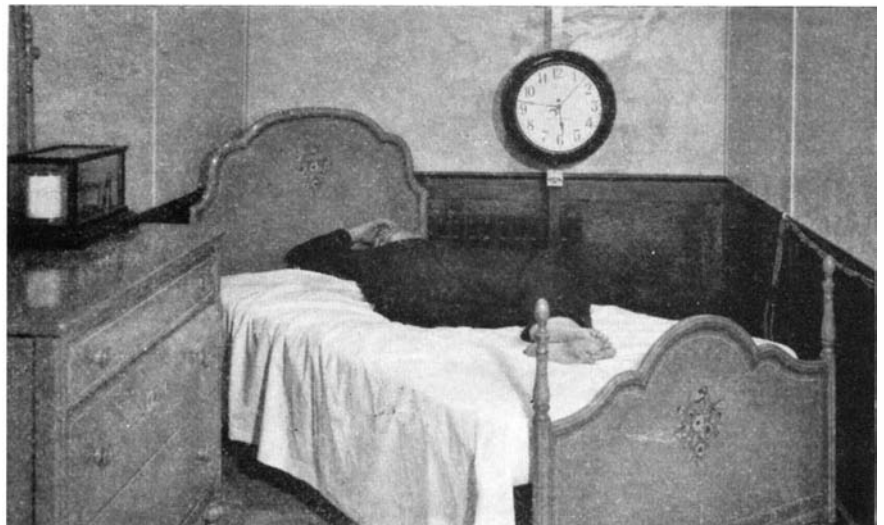
While industrial research is Mellon Institute's back-log, it also busies itself directly in behalf of humanity. An ex-

ample is its air pollution study which began in 1911, the year the Institute was founded. "Snap shots" of air are taken by a suction pump which traps samples in a chamber of about a half-pint capacity. An electric precipitator also may be used. Each particle in the air carries a charge of electricity; plates in the device act as a magnet to draw down each tiny floating bit.

Particles are counted, measured under a microscope. A tobacco smoke particle magnified 5000 times is about the size of a pin point. Safe air contains 200,000 to 300,000 particles per cubic foot. Very dirty atmosphere runs as high as 500,000,000 particles. By co-operating with industry, Mellon Institute has helped reduce the precipitation of soot in Pittsburgh to under 1000 tons per square mile per year. Its findings guide cities to more intelligent anti-smoke ordinances, industrial plants to better firing equipment.

Since pure air is as important to health as pure water, the rise in steel activity in the Pittsburgh area always means more work for the community's doctors. Lung ailments increase. Ravages of pneumonia in Pittsburgh incited Mellon Institute to seek a cure. It recently announced a treatment that cut the mortality in half when tried in 200 pneumonia cases. Starting from German discoveries in 1911, Mellon experimenters under Dr. W. W. G. Maclachlan produced the effective drug. It was awesomely christened Hydroxyethylapocpreine. In practice they just call it "Number 71."

This drug is a derivative of quinine. Cinchona chemicals originally used caused blindness in doses strong enough to kill germs. Mellon Institute overcame the difficulty by adding a group of atoms known as the hydroxy radical to the complex quinine molecule. Twenty thousand white mice were the heroes of this successful microscopic war.



An experimental sleeping room used in studying a sleeper's changes in posture. The clock timed each change on each of the pictures that were made

FLOATED ON MUD

Sailing Vessel, Now an Aquarium, Was Raised to a Permanent Location by Mud . . . Nine Feet Up . . . Cofferdam Used . . . Sand as a Foundation

By HAROLD CHAMBERLIN

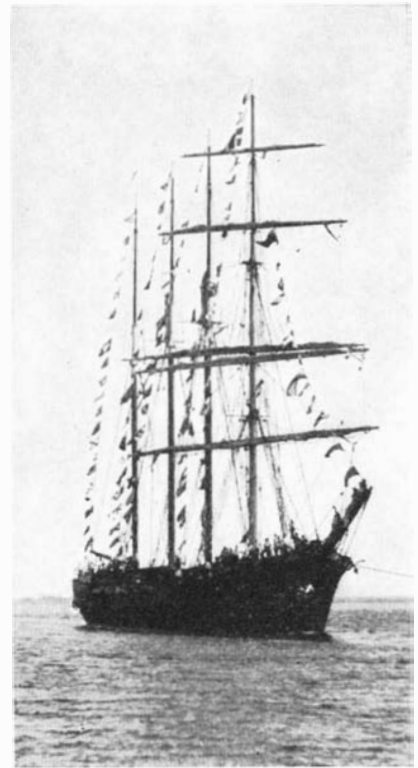
HIGH and dry and safe and sound on the Miami waterfront the good ship *Prins Valdemar*, German blockade runner of World War days, has come to her final anchorage at last. Like every other incident of her long and varied history, the closing chapter in the seafaring life of *Prins Valdemar* was of unusual interest, for instead of sinking to her end she took an elevator with mud as the motive power and was raised to her resting place.

For years the once proud vessel was tied to the seawall in Miami harbor, her decks paced curiously by visiting tourists who thrilled at her story while inspecting unusual specimens of marine animals displayed by the aquarium housed aboard her. Now *Prins Valdemar* has said goodbye to the sea. Her owner had a problem, however, to move her 250 feet of length and 4,000,000 pounds of dead weight into the position desired, for he wanted to raise the ship nine feet above high tide.

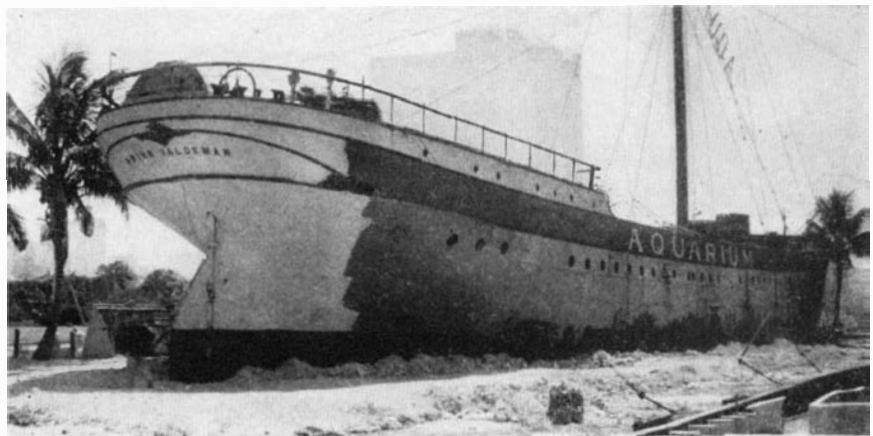
By building a cofferdam out from the land and surrounding the vessel, it was possible to float the boat up six feet, but the three feet additional presented a problem. Finally this was solved by floating her in mud. In salt water the

vessel drew 15 feet, but in thick fluid mud the draft was reduced to 12 feet. Therefore, after the ship had been raised six feet in water inside the coffer dam, the water was gradually displaced with mud.

Every day as the task proceeded, the vessel would rise as the greater specific gravity of agitated mud took hold of her. Every night as the mud in the mixture settled to the bottom some of the lifting power would be lost and the ship would sink back. In the end, however,



Prins Valdemar in the coastal service during the Florida boom days



Above: A view of the stern of the vessel, showing the cofferdam, the old waterline, and the "mud-line." Below: *Prins Valdemar* is now on solid foundation



she was hoisted the required distance and heavy sand forced in beneath her keel to hold her solidly in place and provide a firm foundation.

Built in Sweden of English iron, *Prins Valdemar* sailed the seas when forests of tall spars still spread canvas to the winds. During the war she once ran the Allied blockade successfully, then barely escaped capture a second time by hustling into a Danish port. The Florida boom saw her pressed into service hauling hotel and building supplies south from New York, and one voyage ended with her conversion into a floating hotel of 100 rooms. In a storm she capsized, sank, and for months partially blocked the Miami ship channel; then she was raised to become a floating aquarium. But her last voyage was up—and it was sailed in a sea of mud.

WHAT TO DO ABOUT DUST?

Industrial Dust Hazards . . . Little Known of Them . . . Foundation to Study Ways, Means of Combating . . . Medical, Legal, Engineering Aspects

By **JOHN F. McMAHON**
Executive Assistant, Air Hygiene Foundation

DUST might be roughly described as the "airy particles" arising from a world that is wearing away under the ceaseless erosion of nature and the onrush of restless man.

The physical world is, of course, composed of matter in many forms. Dust, in a broad sense, is simply the tiny remnants resulting from the breaking up of this matter. It is the product of that tireless process of wearing out which walks hand-in-hand with time and affects life, mountain tops, and all material things. Dust is one of the common denominators of the world and exists, potentially, in every solid object. Even man is made of dust, according to the Scriptures, and unto dust he ultimately returns.

Thus certain fine, powdery particles are a part of the natural order and might be called natural dusts, since they are independent of man. Examples of such forms of air pollution include withering dust storms searing the country side or miniature particles of plant and animal life afloat in the air.

Far more dangerous than these, however, are the man-made dusts generated in the industrial processes of our highly industrial era. Besides the "chimney sweeps" of incomplete combustion—smoke, ash, tar, and so on—there are the numberless industrial dusts. The use of abrasives to clean and polish metal, abrasive powder and abrasive soap making, foundry work, sand blasting, quarrying, tunnelling, mining, glass making, and pottery making are among the "dusty trades."

The stone cutter of old, hacking at hard rock with a pick or with hammer and chisel, had little to fear from dust. The modern stone cutter, thundering through brittle rock with power drills, stirs up smoke-like waves of dust. Unless properly protected, he may inhale harmful quantities of dangerous silica particles. Some of these drills are known among miners as "widow makers."

THE United States Public Health Service estimates that approximately 1,000,000 workmen are exposed to silica dust in America's mines and mills—a dust which, breathed in sufficient quantities and over a sufficient period of time, may cause silicosis and other disorders of the respiratory organs. The inhalation of dust may, under certain conditions, weaken man's resistance to tuberculosis, colds, bronchitis, pneumonia, and sinus troubles. Men working in dusty trades

suffer more from such ailments than men working elsewhere. "The evidence that excessive dustiness of any kind is harmful is beyond argument," according to Prof. Philip Drinker of the Harvard School of Public Health.

Of the estimated 1,000,000 workmen exposed to silica dust, approximately one half of this number is exposed to harmful concentrations. In addition to silica, there are numerous other dangerous dusts, such as lead dust or asbestos dust.

It was not until about two years ago that the general public in this country became acutely conscious of dust as an enemy to health and a cause of occupational disease. This realization followed the wide publicity given to silicosis cases in connection with a tunnelling project at Gauley Bridge, West Virginia.

But prior to this general awakening, with its accompanying panic and hysteria, a number of industrial leaders representing the steel, foundry, glass, ceramic, pottery, refractory, aluminum, coal, and metal mining industries began meeting and discussing ways and means of combating occupational diseases. An epidemic of ruinous lawsuits was sweeping the country. Many firms were forced out of business entirely. The

industrial areas about St. Louis and Rochester, New York, suffered severely. Insurance rates were mounting as a result of the many claims.

IN the face of these developments, industry, perplexed and often bewildered, knew not where to turn for help or guidance. Even noted physicians frequently disagreed as to the medical aspects of the problem. Engineers, attempting to devise equipment to dispose of dust, were hampered by this inability of medical men to say just what concentration of a given dust constituted a hazard to health, and just how low the concentration should be cut to make a reasonably safe working place.

Consequently a score of firms and trade organizations banded together and established the Air Hygiene Foundation of America, a non-profit, scientific organization created to conduct research on silicosis and kindred industrial diseases. The Foundation, in its search for the vital knowledge needed to combat these ills, is not only engaging in research itself but is attempting to collect into one central reservoir the fruits of experience and research which have accrued heterogeneously everywhere.

After getting underway early in 1936,



A dangerous concentration of silica dust at left, thrown off in a cloud by a pneumatic drill. On the right a new suction collector carries away all dust

the Foundation immediately launched a program of fact-finding searches in the three fields bearing upon the problem—medicine, engineering, and law.

The medical survey, for example, involved the evaluation of findings gleaned in a number of industries, in hospitals, and in research centers here and abroad. It concludes that on the basis of present knowledge, nine points are definitely known about silicosis. They are:

1. Silicosis results from the inhalation of dust containing free silica.
2. The time required for the development of silicosis varies from a few years to 20 or more, depending upon the concentration of silica particles in the air and the length of exposure.
3. Beginning silicosis is recognizable only by properly taken roentgen films (X rays) of the chest.
4. Associated with silicosis is a marked predisposition to tuberculosis.
5. Silicosis can be prevented by protecting the industrial worker from inhaling silica dust.
6. Concentrations to which dust must be reduced in order to be safe have not been absolutely determined.
7. Industrial dusts, containing silica, are frequently not all silica, being mixed with other materials. Some of these may alter the silica action on the body.
8. Asbestos, a silicate, is the only dust other than free silica which has been shown to cause lung fibrosis.
9. Simple—that is, uncomplicated—silicosis, as seen in the industries in this country, causes relatively little severe disability. It is its combination with other diseases which is serious.

The report of the preventive engineering survey warned engineers to center their attack on the smallest dust particles, pointing out that, in a general sense, the finer the dust the greater the potential danger.

The legal survey examined the statutes and court decisions of each of the 48 states in an effort to establish the exact status of the law in each state as regards

occupational disease due to air pollution. This review disclosed sharp conflicts between the laws of the various states respecting compensation for occupational disease. It noted, however, a growing liberal trend toward compensating workmen who contract industrial disease just as workmen injured in industrial accidents are compensated.

THE occupational disease question is so broad, with its social and economic implications, that many of the 44 state legislatures which met last year considered the problem.

Further, as pointed out in the Summary Report of the Economic, Legal, and Insurance Committee of the National Silicosis Conference, "increased costs for preventive or compensatory measures may have marked economic effects upon the relative position of competing industries or units." Obviously a manufacturer in a state with stringent regulations is placed at a disadvantage with a competitor in a state where few such regulations exist. This disadvantage promises to be temporary, however, and may be offset even now by the cost of damage suits.

Aside from the economic consideration is the even more important social or human factor. If a workman contracts an occupational affliction, his wife and his children suffer indirectly, as does the whole community. The United States Public Health Service has shown that the life expectancy of industrial workers is several years less than in the case of other workmen. Pneumonia rates are twice as high and tuberculosis rates are much higher for the industrial group, which roughly comprises some 15,000,000 persons employed in manufacturing and mining.

This situation further emphasizes the need of a coordinating and correlating research center dedicated to the development of sorely-needed information on the cause, cure, and prevention of air-borne occupational diseases. Possessed

with the findings of its inventory-like surveys, showing, roughly, what is known and what remains to be sought out, the Air Hygiene Foundation was able to lay out a practical program of scientific research into the fundamentals of industrial air pollution.

The research is to be carried on at institutions deemed best fitted for the particular task in mind. Some of these are the Saranac Laboratory, Saranac Lake, New York; University Hospital, University of Pennsylvania, Philadelphia; United States Bureau of Mines, Washington, D. C.; Harvard School of Public Health, Cambridge, Massachusetts; Singer Memorial Laboratory; and Mellon Institute, Pittsburgh.

This program, recently announced, seeks to answer many puzzling questions on the medical and engineering aspects of the subject. Some of these include:

- I. What is the mechanism by which silica acts upon the body? Is silica a poison or an irritant? Is the action of silica physical, as in cutting, or is it chemical?
- II. What is the relation between silicosis and tuberculosis?
- III. What is the effect of other substances upon the action of silica? (It is claimed that some dusts retard the action of silica, apparently diluting its effect, while others are said to speed up the silica action.)
- IV. Determination of hood design data for various dust-producing processes involved in the crushing, grinding, and general handling of rock.

Another problem calls for the development of a fool-proof technique of roentgenography (X ray). It appears that pre-employment medical examinations including a chest roentgenogram will be required of workmen to an ever increasing degree in the future. Thus a man may be hired or rejected on the basis of his X-ray film. Therefore, the best possible technique that can be evolved is the least with which employers can be satisfied.



Coal mines constitute another dust hazard and especially at points where machines undercut the coal seam by means of powerful cutting teeth on a flat arm. At the right, this operation is rendered dustless by a spray of water on the cutting arm

CHEMOTHERAPY AND PRONTOSIL

Uses and Abuses of the New Drug... Valuable, but to Be Used with Caution... Theory of Chemotherapy... Hope for Other Drugs in Research on Same Theory

By T. SWANN HARDING

SUPPOSE you were an officer of the law charged with the duty of arresting the Purple Gang. This gang is composed of individual units who may be likened to toxic agents or poisonous bacteria ready to make society ill. Their trail leads to a dance-hall full of people. But you are alone. The task of arresting these members of the Purple Gang, scattered as they are among many innocent people, seems hopeless.

Ah, but you have a magic revolver loaded with charmed bullets. These are like the famed silver bullets of savage witch doctors. You can aim the revolver, pull the trigger, and release several of them, and each will emerge, unerringly search out a gangster, and paralyze him temporarily. The bullets will not harm anyone else than members of the notorious Purple Gang.

Once the gangsters are paralyzed the rest is easy. You simply arrange to have them hauled off to jail while they are for the time impotent to do harm, and there you are. There also you have a fair example to illustrate what physicians who use chemotherapy with care and intelligence can often accomplish.

Prontosil, the official name of which is sulfanilamide, the substance about which there has been so much in the newspapers recently, is such a chemical charmed bullet. Doctors are now shooting it at the gangster germs that cause meningitis, childbed fever, pneumonia, gonorrhoea, pyelitis, but chiefly various infections caused by germs known as streptococci.

The substance does not kill disease germs. Instead, it prevents their growth and multiplication within the victim's (or host's, as the merry pathologists say) body. It paralyzes them in the dance hall. Then the body's own fighting forces get to work and conquer the infection.

NATURALLY, newspaper reports have often been sensational and exaggerated. For example, the drug was much publicized when used in the illness of the President's son. But readers were not told that only a few doses were given, that these availed nothing, and that surgery was resorted to.

The drug also has been abused. It is a powerful and dangerous agent. Publicity regarding its use in gonorrhoea has, unfortunately, led laymen to buy it at drug stores for self-medication. State and city ordinances should prohibit its sale except on prescription, and it cer-

tainly should never be used by laymen for self-medication. [An editorial on this drug appears on page 9.—*Ed.*]

Some uncritical doctors themselves have tended to discredit Prontosil by using it in all sorts of infections. Even dentists have used it promiscuously. One must always take stories of marvelous new remedies with a grain of salt. Nevertheless, there is a nugget of truth here that deserves a little careful exposition.

Chemically, this drug is a dark red dye called the hydro-chloride of 4'-sulfamido-2:4-diamino-azo-benzol. It was discovered by Domagk in Germany about 1935. He called it prontosil, a word that has since been adopted as a commercial trade name by one American firm. The correct official drug name is, as was said above, sulfanilamide.

But, in order to enable us to understand the manner in which this drug acts, we must briefly examine chemotherapy as a whole. While it is usually supposed that this form of therapy took its start with Paul Ehrlich, it started much earlier in folklore and primitive medicine. The Brazilian Indians of Pizarro's time actually practised chemotherapy empirically when they used cinchona, which contains quinine, as a specific against certain kinds of malaria, also ipecac, which contains emetine, in certain types of diarrhoea. In such cases a magic chemical bullet was fired at germs that caused certain diseases in the body, in order to destroy or combat them without injury to the body.

Chemotherapy is, then, the treatment of internal disease by the use of chemical substances which have a specific and immediate toxic effect upon the microorganisms that cause the disease, but which do not seriously poison the patient. (They may do him a little unintentional injury but it should not be great. For example, a substance called optochine, when used to treat certain types of pneumonia, caused serious though frequently only temporary blindness. That is something like the three-powder treatment for heart trouble invented by a movie "doctor." The first powder cured the heart trouble but un-

balanced the patient's mind; the second restored his sanity but blinded him; the third restored his eyesight but injured his heart. Chemotherapy has to avoid such contingencies as this.)

Scientifically, chemotherapy did get its start with Ehrlich. Facts standing alone—such as that quinine cured malaria—lack the usefulness and significance they have when organized into scientific hypotheses. Ehrlich's theories and hypotheses put facts to work in this field.

PAUL EHRLICH was a German Jew, born in Prussia in 1854. After he obtained his medical degree he devoted himself to pathology. He sought to learn the nature of diseases by examining the organs of the body, in order to determine the effects of various diseases upon them. Naturally, he used a microscope with which he observed very thin slices or sections of tissues from the various organs and even then, as now, they were stained with dyes. These dyes were used in order to make certain structures visible to the observer. This is because they are selective. That is, they stain only certain types of tissues or certain parts of cells or, as was soon found, only certain bacteria. Thus, certain bacteria are called "Gram-positive" because they will hold a certain purple dye when stained with it by the method of Gram, a Danish physician. But, with the growth of the German dye industry, many new synthetic agents became available with which Ehrlich could experiment.

In 1890, Ehrlich had returned from Egypt, whither he went to recuperate from tuberculosis, and entered the Institute for Infectious Diseases in Berlin, under Robert Koch who discovered the germ of tuberculosis. About this time there was much study of antitoxins which fought the poisons produced in the body by diseases such as diphtheria and lockjaw. The antitoxins were so called because they seemed to neutralize the poisons or toxins of disease and render them impotent to harm.

That gave Ehrlich the germ of an idea. Soon he had organized various facts into

his great theory of immunity. In the very simplest language this theory held that disease was basically chemical in nature and that chemicals might be set to fight chemicals. Since very recently the viruses causing certain diseases have been found to be chemical substances, non-living but autocatalytic proteins that can somehow manage to reproduce themselves in certain tissues, the theory assumes more importance now than ever.

Ehrlich reasoned that both animal or tissue cells and bacteria were composed of complex chemical substances. Such substances are formed of very large aggregations of molecules—maybe a hundred thousand or so. When they react with one another they do not pitch into the reaction wholeheartedly, as would simple substances like table salt and sulfuric acid but, instead, they react through certain of their suburban side chains or trailers of their molecules.

However, such reactions can cause a great change in the nature of the complex chemical substance. If it were poisonous, they could perhaps render it non-poisonous. The problem was one of finding the silver bullet that would hit the gangster target while harming no one else in the dance hall. In other words, the problem was one of getting some chemical that could be given to the sufferer from a disease which would detoxify and render harmless the agents causing the disease, but without injury to the victim.

YET, remember, the body tissues and the germs themselves that cause disease are probably a good deal alike. They both contain proteins. They are both, chemically speaking, complex substances. But, since the dyes would enter a mouse, for example, and unerringly pick out germs of a certain type, staining only these particular germs, why would it not be possible to hitch some other substance, deadly to the germs, right on to the dye and thus paralyze the germs? That was Ehrlich's idea.

At that time the dreaded African sleeping sickness (not the disease commonly called sleeping sickness in the United States) was attracting much attention. It was caused by a one-celled animal, the trypanosome, which was easy to find in the victim's blood. So Ehrlich went after that trypanosome, using about 500 different dyes combined in various ways with arsenic, antimony, and phosphorus. He was unsuccessful.

In 1905, however, he took up the study of an arsenic-containing drug called atoxyl, which was said to be non-poisonous. It was used in treating sleeping sickness, but it endangered the patient's eyes. He proceeded to make small changes in its composition and finally, in 1907, his 606th trial was successful. Salvarsan, since called 606, appeared.

Next, Ehrlich proceeded to a great

discovery by proceeding upon a totally erroneous theory. He supposed wrongly that the agent causing sleeping sickness was closely related to the one causing syphilis. Hence, if his 606 would cure one of these diseases it should cure the other. Actually it did, even though the organisms involved were not closely related, and the rest is history.

Salvarsan or 606 became the parent and grandparent of numerous other arsenicals. Tryparsamide was perfected at

AFTER the accompanying article had been written, and while it was being prepared for publication, the newspapers of the nation contained day-by-day accounts of many unfortunate deaths caused by an elixir of the sulfanilamide around which the article centers. While this in no way affects anything in the article, it calls for a clear explanation, and this will be found on page 9.—*The Editor.*

the Rockefeller Institute in the United States. Later mercurochrome-220 appeared, in which a dye was combined with metallic mercury, obviously based on Ehrlich's faith in the antiseptic powers of dye compounds.

Recently, the attack of chemotherapy has shifted to the field of the dangerous streptococci, which exist in many degrees of virulence and have long baffled medicine. These Gram-positive organisms occur in pairs or chains. Some of them can ripen cheese or sour milk; others cause scarlet fever, erysipelas, childbed fever, and blood poisoning in human beings, mastitis in cows and strangles in horses. They attack numerous tissues and are exceedingly difficult to destroy without injury to the victim. They are the micro-gangsters against which modern witch doctors now aim their silver bullets. Domagk of Germany first used the dark red dye, which he named prontosil, to combat hemolytic (red-blood-corpuscle-destroying) streptococci in mice, the germs being of human origin. In France other investigators claimed success with a similar dye. The drug from Germany was used in Great Britain in 38 cases of puerperal or childbed fever, all results being reported favorable.

Further studies tended to elaborate and confirm these results. In the United States prontosil has been used to combat the organisms causing scarlet fever, erysipelas, otitis media, tonsillitis, puerperal infection, chronic impetigo, pelvic peritonitis, and so on. More recently it is said to have been used successfully to combat the meningitis germs and those causing certain types of pneumonia. It is used both in tablet form orally and in liquid form by injection.

The Mellon Institute of Pittsburgh began work on pneumonia and streptococcal infections about 1926. In 1930 efforts were made to produce a quinine salt that would inhibit the growth of pneumococci but would not damage the patient's vision. A general survey was made of natural and synthetic cinchona derivatives, and those that foreshadowed success were tested. By June, 1937, more than 76 chemical preparations had been made, tested first on pneumococci in test tubes and then with infected white mice. Some 20,000 white mice unintentionally gave their lives to science. At present, one of the compounds called hydroxycupreines offers the greatest promise. Some 200 cases have been treated in human beings and several lives have been saved that would otherwise have been sacrificed to pneumonia. Several years more will be required for full testing. The compound must be produced in large-scale lots, and clinical trials must be conducted on a wide base.

THAT the drug will be abused, even by some over-enthusiastic physicians, goes without saying. Certainly no layman should for a moment think of trying to medicate himself with these compounds at present. *See your doctor* still holds good.

Prontosil was presented at the meeting of the American Medical Association in Atlantic City in June, 1937, as curative of the serious and troublesome urinary tract infection called pyelitis. Cases were reported as completely cleared up at Mayo Clinic by the use of this sulfanilamide.

The substance apparently checks the growth of all the round germs of the coccus family. It is the silver bullet charmed by the modern witch doctors and certain to seek them out and prevent the growth and multiplication of these germs. These developments all form further justification for Ehrlich's theory of chemotherapy. They likewise presage a great future for medical therapy. In time, medical research workers may be able to predict in advance, quite theoretically, the kind of complex chemical compound that should be able to seek out and overpower particular germs. Then the compound can be made and turned loose in the body of the germs' involuntary host to seek them out and destroy their power for evil without injury to their victim.

But we must remember that many remedies tend to rise in a blaze of glory and later to sink into disrepute. For a time they seem to be panaceas, magic waters of health, utopian cures for all ills. But more careful and discriminating study usually damps the fire of early enthusiasm. Medical therapy gains by slow, patient accretions of knowledge. It never leaps to universal success at one bound.



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN

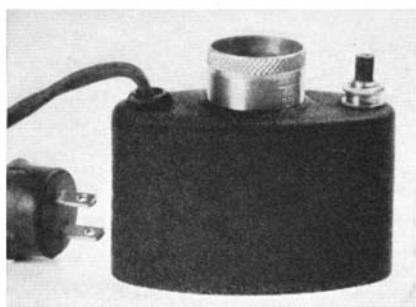
In charge, Daniel Guggenheim School
of Aeronautics, New York University

D. H. KILLEFFER
Chemical Engineer

ADJUSTABLE ELECTRICAL MAGNIFIER

AN innumerable variety of inspection jobs may be performed with unusual ease with a new illuminated magnifier just placed on the market by Lincoln Optics, of Chicago. It is different from others now available in that the lenses are adjustable.

This magnifier is in the form of a metal cup in the top of which the lenses are



Small objects are illuminated and magnified in this compact device

mounted in a barrel which screws in or out as may be necessary for focusing. A tiny electric lamp under this "hood" illuminates the inspected object without glare, electricity being supplied from the 110-volt lighting circuit. The manufacturer states that the lenses are of optical glass, precision ground so that distortion is prevented.

This device is designed for close observation of pictures, films, textiles, maps, identification marks, bank notes and checks, postage stamps, and many other things requiring close examination by business or professional people.

PROGRESS AND PEACE

IN the hurry and bustle of modern living and working, few stop to think of progress as a product of peace, or to realize that the future of civilization is fully dependent upon renouncing war as an instrument of national policy—as soon as is humanly possible. It is the aim of the Hopper Peace Foundation, under the direction of W. Earl Hopper at Oglethorpe University, to emphasize this important fact. The scientific section, known as the Hall of Science and Industry, has as its main objective the fur-

thering of the cause of peace and amity among nations by a true interpretation of the word "civilization." In this respect it differs from, goes a step further than, most such institutions. Many nations of the world have already contributed to the Hall exhibits which they believe most clearly personify the national cultures. Industrialists and manufacturers of many kinds of products have also added their contributions. The Foundation asks that any who may be interested in lending their aid write for further details.

NOISE

SOUND engineers are now putting an end to kitchen clatter. Monel sinks are sound-deadened, the entire under-body being coated with a special compound which sound-proofs all surfaces.

ALCOHOLS FROM SUGAR

LONG a mainstay of inorganic industry, electricity has now invaded the organic field with important results. The reduction of sugars to corresponding alcohols is not a new reaction, having long been accomplished with alkali metals in ethyl alcohol solutions, but now it is being carried out on commercial quantities of sugars by electrolytic means.

Crystalline dextrose, itself a relatively new commercial product, supplies the sugars for reduction. From this very pure raw material, dissolved in pure distilled water with the addition of salts to impart conductivity, direct reduction in the cathode compartments of electrolytic cells produces hexahydric alcohols.

The two hexahydric alcohols thus made are finding uses of growing importance. Mannitol is nitrated to a valuable explosive. Sorbitol has two principal values. As a moistening and softening agent it is used

where its very strong humectant properties are significant. In this field it competes to some extent with glycerol, but at a higher price justified by its greater efficiency as a softening agent. Textile problems are solved and the soft glue rolls used to spread printing ink on type are improved through the use of sorbitol. Sorbitol is also valuable as an intermediate in synthesis. Most important of its derivatives at present is ascorbic acid (vitamin C), made on an increasing scale. The fields of use for hexahydric alcohols are just being explored, since they have been commercially available for only a short time.—D. H. K.

POLARIZED LIGHT INSPECTION INSTRUMENT

POLARIZED light, about which so much has been written in recent months, has been given a new job—that of providing improved visual perception of colors, surface markings, weave, and so on, of various materials. Its particular value is in its elimination of glare and highlights so that true colors and true detail are made more clearly visible.

The Marks Polarized Colomat, the device



Polarized light shows true colors

that has been developed for such inspection and analysis, consists essentially of a case containing a suitable white light source and an optical system containing a Marks polarizing plate. Both the light and the binocular eyepieces are directed toward a partially enclosed large area through the sides of which the material to be examined may be inserted. This is shown in the accompanying illustration, the letter "A" indicating the space for the material.

There are many places in which this device may be used in both the laboratory and in the production line. With it one can inspect and match the color of textiles, prints, enameled articles; detect flaws, fine markings, strains and double refraction of materials; or examine textiles, fibers, powders, minerals, and metals.

**"MECHANICAL MOLE"
BUILDS RIDGE**

A SIMPLE machine for building contour ridges on hillside pastures without destroying any sod—and at the same time leaving very little sodded earth exposed—has been devised by Soil Conservation Service engineers in co-operation with engineers of Iowa State College.

Although farmers like the idea of the furrow-ridge because it conserves a rainfall on sloping pastures and reduces loss of soil, lime, and fertilizers by surface runoff, they have objected to the sod destroyed when the furrow is made with an ordinary plow.

The engineers call their furrowing machine a "mechanical mole" because it works mostly underground. A conventional rolling coultter makes a vertical cut about eight inches deep. A modified plow bottom, much like the old breaking plow of the prairies, lifts a sod strip eight inches thick on the downhill side of the coultter cut—but does not break the strip at the outer edge nor turn it over.

At the same time a plow bottom lifts a four-inch thick sod strip in a similar manner on the uphill side. A low, scraper-shaped plow, following directly behind this uphill plow, pushes about four inches of dirt into the eight-inch furrow under the downhill sod strip. All three plows and the coultter are attached to the same beam.

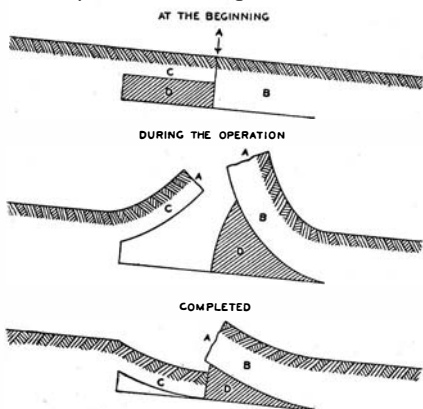
As the machine moves along, the four-inch uphill sod strip falls into place—but about four inches lower than before. The eight-inch downhill sod strip also falls into place—but four inches higher than before. The result is a vertical eight-inch wall or ridge; that is, a furrow about eight inches



Photo by Robert Yarnall Richie

Correct lighting and a wide-angle lens made this photograph possible

deep. This wall is the only soil left exposed to erosion by wind and rain—because the outer edges of the sod strips are not broken—and it soon becomes grass-covered. Height of the ridge may be varied by cutting the sod strips at different thicknesses. Heavy rollers following behind the "mole"



How the mechanical mole works: *A*, vertical cut made by rolling coultter. *B*, sod strip on downhill side. *C*, sod strip on uphill side. *D*, soil thrown under downhill sod strip. See also the two photographs below

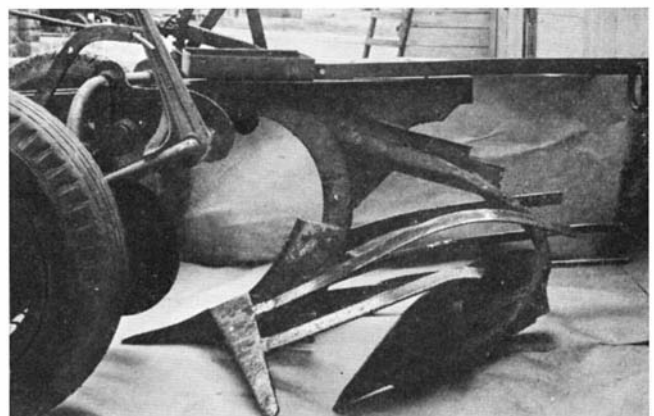
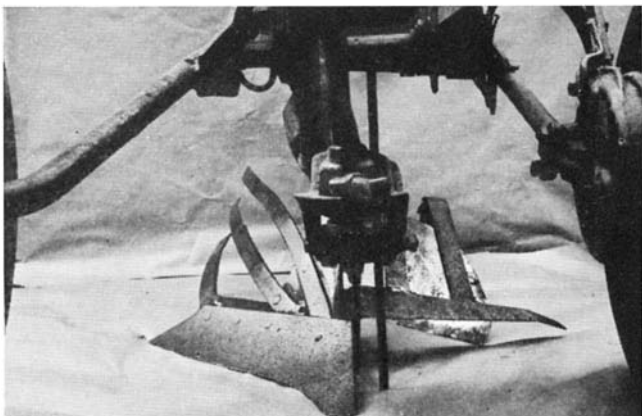
pack the sod strips firmly into place and leave the ridge uniform in height. The power needed to pull the mole varies with soil and slope, but apparently a track type tractor with about 20 drawbar horsepower is best suited.

The first work with the furrowing machine was done on slopes up to 10 percent. The furrows were on level contour lines spaced about 15 to 20 feet, with a vertical interval of about 1.2 feet. Some of the later work was on slopes as steep as 18 percent.

Widespread interest in the "mechanical mole" indicates that other machines of this kind may soon be developed. The "mole's" inventors are attempting to perfect a similar device which can be simply assembled from parts of ordinary farming equipment.

**PHOTOGRAPHY ON A
GRAND SCALE**

THE professional photographer of today frequently encounters situations that call for the proper execution of many and varied steps in order to produce the desired results. An assignment recently given to Robert Yarnall Richie, several of whose photographs have appeared on the front cover



Two views of the contour furrowing machine, showing plowshare with three lifters, and sod cutter with two lifters

of this magazine, required the production of a series of pictures that would tell the story of a great banking institution, the National City Bank of New York. One of the photographs desired, and one which called for the exercise of a considerable amount of ingenuity, was of the main room of the bank, which might be said to be the nerve center of the institution. The room, designed by McKim, Mead, and White, is 188 feet long, 125 feet wide, and 72 feet high. The photographer's job was to include as much as possible of the large room, showing officers, cashiers, tellers, guards, and customers. Thus there must be made a photograph that would show the great size of the room but which must include intricate detail, fine contrast in lights and shadows, and dramatic action. To achieve this result it was necessary to use 40 flash reflectors and 10 Photo-flood units. The equipment set-up included cameras with wide-angle lenses, three of them being used, both to check error and offer a variety of composition. A telephone was installed on a specially constructed camera platform, and was connected through the main switchboard to all parts of the great room, so that proper instructions could be given to the 50 persons who were posed in various parts of the set-up. Five hours of hard work were required in the placement of lights and models before the actual taking of the picture.

Although the small size of our reproduction on the preceding page does not do full justice to the large original, the observing reader will fully appreciate the problems involved.

SORTS SPUDS AUTOMATICALLY

FACED with the task of sorting by hand 15,000 bushels of potatoes into market grades every fall, a young Ohio farmer boy decided it was time someone gave serious thought to ways and means of simplifying this long and tedious job. After considerable experimenting, he conceived the idea of using a series of mechanical fingers made of bristles and mounted on pairs of disks. Each pair was set farther apart so that when the potatoes moved over the assembly they were automatically separated according to size.

If there were any skeptics among the people who came to view this machine, they went away convinced and the word soon



Rubber fingers sort spuds

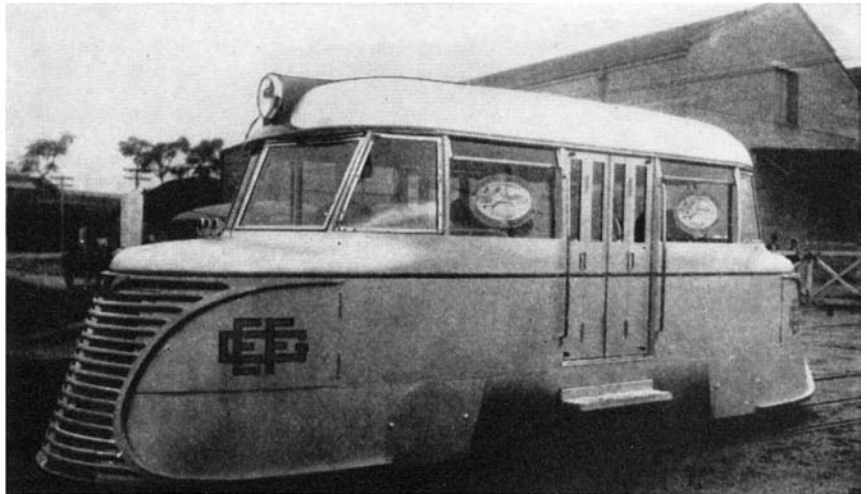
spread about this new time- and labor-saving device. News of it reached a large farm machinery maker who sent its designing engineers to investigate. They, too, were convinced of its merits and arrangements were made with the youthful inventor to manufacture this potato grader for general use.

The manufacturer discovered, however, that while the mechanical fingers made of bristles worked satisfactorily for a time, they wore out and broke off quickly. The problem was submitted to The B. F. Goodrich Company, whose engineers soon developed for this machine fingers of a special wear-resisting rubber which not only graded the potatoes perfectly without injury, but cleaned them as well.

Scores of these new potato grading machines have been placed in service with highly satisfactory results. Operation is quite simple. Cleaning and grading is entirely automatic. The only manual labor required during the grading process is the removal by hand of those potatoes injured during digging and storage.

RAILROAD INSPECTION IN COMFORT

STREAMLINED inspection cars like that shown in one of our illustrations are a familiar sight on many of the South Ameri-



South American railroad inspectors ride in comfort in this rail car

can railroad networks. It was built by Grassi & Cia., São Paulo, Brazil, for the Estrada de Ferro de Goyaz of Brazil.

Stretcher-levelled, cold-rolled steel sheets, 20 and 22 gage, manufactured by The American Rolling Mill Company, were used for all sheet metal parts on the car. It is powered by two automobile engines, placed fore and aft.

Officials of the line make frequent inspection tours in speed and comfort. The interior is furnished with six large armchairs.

LIGHT FREIGHT TRAILER

APPLICATION of a self-aligning third wheel to the conventional two-wheel trailer chassis has led to the development of

TRANSPORTATION SECTION

TIRES

IN 1910, an automobile tire costing 50 dollars produced 5000 miles; in 1936, a tire costing 15 dollars gave 20,000 miles—the estimated annual savings to American motorists due to research, 3,002,580,000 dollars.

a commercial trailer or freight conveyer in which the entire load is carried by the trailer and none of it is thrown on the drawbar. The conveyer comprises a 16-foot van mounted on a steel chassis with carrying capacity of two tons. Because it is light in weight, it can be towed by a light delivery truck to supply a larger freight-carrying capacity than would be provided by the truck alone and yet obviate the necessity of maintaining heavy trucking equipment when the number of large loads is too small to warrant the investment.

A NEW PROCESS IN RAIL MANUFACTURE

RELAXATION, a recognized aid to human longevity, is now being utilized in the finishing of the inanimate railroad

rail to give it longer life through increased resistance to the rigors of service in supporting the faster trains of today. This relaxation is brought about in the steel rail by the new "Brunorizing" process of the Carnegie-Illinois Steel Corporation, subsidiary of the United States Steel Corporation.

Like a tennis player, who, failing to relax, finds defeat staring him in the face, because his muscles grow tense, a rail may squander its strength by harboring tenseness in the form of dual internal stresses, one working against another. At the worst, these stresses can possibly cause microscopic internal discontinuities which one might call the "charley horses" of rails.

Relaxation in a rail is conducive to longer life because it delays fatigue, which may



ALEXANDER HAMILTON INSTITUTE

Announces

A NEW PLAN OF EXECUTIVE TRAINING

FOR sixteen months the Institute Staff has been working to prepare for this announcement. The results of its work make this one of the most important, perhaps *the* most important, announcement ever made by the Institute.

Important to whom?

Not to the *average* man, because he probably hasn't any more than a vague notion of what is going on in the world of business and doesn't care much about it either.

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

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

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

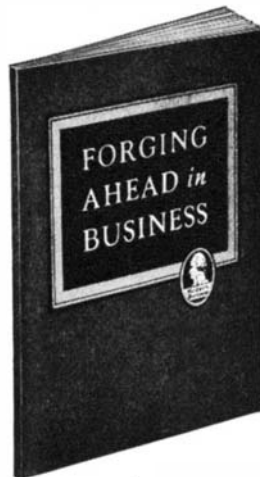
The Alexander Hamilton Institute is ready to prepare you for the test of ability and training which lies ahead. In each new business cycle during the past twenty-seven years, the Institute has developed and remodeled its Course and Service to meet the special needs of the day. Thousands of men have trained for executive responsibility and financial independence under the Institute's guidance.

Now again, the Institute, keeping abreast of American business developments, offers a **NEW PLAN** for executives and for those *who will be* executives—a plan built to meet the new conditions and to fit more exactly your personal requirements for growth and progress.

For Men Who Set No Limit on Their Futures This Free Book Tells a Vital Story

IN this new plan of executive business training, the Institute offers you the ideas, experience, and judgment of the most successful business men in America, formulated and organized to put at your command the proved principles and methods of modern business.

Among the dozens of American industrial leaders who have helped to build the Institute's Course and Service are Alfred P. Sloan, President, General Motors Corp.; J. C. Penney, Chairman, J. C. Penney Co.; C. M. Chester, Chairman, General Foods Corp.; M. H. Aylesworth, Chairman of the Board, Radio-Keith-Orpheum; Clifton Slusser, Vice-President and Factory Manager, Goodyear Tire & Rubber Company; J. S. Tritle, Vice-President, Westinghouse Electric and Manufacturing Company; Hubert T. Parson, Director, F. W. Woolworth Co.; Frederick W. Pickard, Vice-President, E. I. du Pont de Nemours & Co., Inc.; Putnam D. McMillan, Vice-President and Director, General Mills, Inc.; Paul M. Mazur, General Partner, Lehman Brothers, New York Bankers; Thomas J. Watson, President, International Business



Machines Corp.; David Sarnoff, President, Radio Corporation of America.

If you agree that daily access to the methods and judgment of such men will guide and inspire you, if you can appreciate the priceless opportunity of sharing their viewpoints and learning from their experience, then you will read "Forging Ahead in Business" with eagerness and profit. The new edition of this famous book carries a message of vital importance to you. The coupon will bring your free copy.

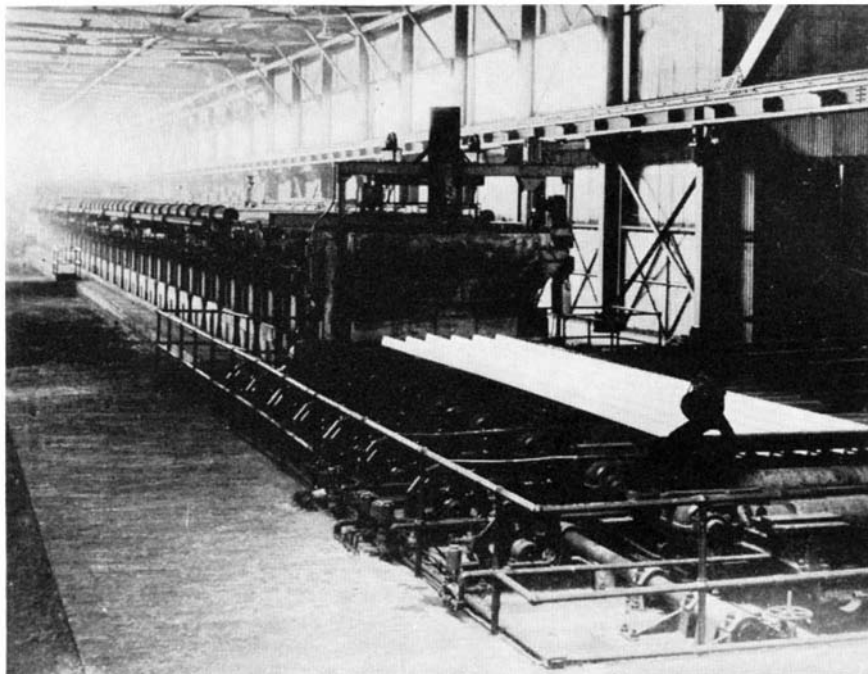
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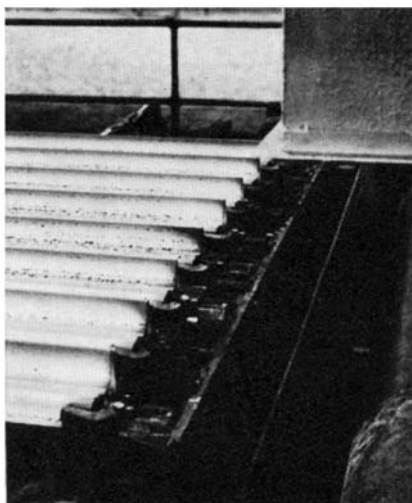
Above: A charge of rails emerging from the Brunorizing furnace where they have been subjected to a controlled thermal treatment. *Below:* The rail ends are given a Brinell hardness of 350 to 402 by means of a blast of compressed air

ultimately result in a transverse fissure in the rail. In the "relaxed" rail the internal stresses are minimized so that a vastly smaller proportion of the total rail strength is accounted for by fruitless "pulling and pushing" within the rail and a high proportion of the strength is available to resist the fatigue of repeated loads under the wheels which exert veritable blows at the high train velocities. The specific degree of the reheating applied in "Brunorizing" relaxes the rail much as a rubdown and hot bath relaxes the athlete. But Brunorizing accomplishes even more.

A rail must be shaped from the great block of fine steel by rolling at a high temperature. At this temperature the steel is composed of many minute crystal grains held together with a tenacity even greater than the cohesion within the grains themselves. During cooling, a rail or any piece of steel must be cooler in the external outlying zones than in the interior. Furthermore, steel, like the mercury in a thermometer, expands with increasing temperature and contracts at lower temperature. Thus the difference in temperature in a cooling rail tends to produce different lengths and dimensions in accord with the distribution of temperature.

Now the strength of a rail prevents any such situation, but so strong are these tendencies that high stress is set-up in prevailing against them and the attendant dimensional differences. These stresses reach a maximum when the rail has cooled well along toward ordinary natural temperatures. Brunner's method halts the cooling and stress building before it becomes serious and then the reheating equalizes the temperature again, wipes out the stresses, and starting from this new temperature some 300 or 400 degrees lower than the initial temperature the cooling never again builds them up to high values.

An equally important point relates to the size of the grain referred to above. The reheating establishes grains which are perhaps 20 to 50 times as small as the minute grains



formed just after rolling, fine as they were! It happens that finer grains build up smaller stresses and dissipate those stresses more easily.

CAR DESIGN AND SAFETY

IN a paper presented before the Society of Automotive Engineers, Mr. J. H. Hunt of General Motors discussed the important factors in the relation of car design and safety. The paper is too extensive to abstract here, but Mr. Hunt called attention to some governing conditions and features needing research, which may well be discussed.

Most car users do not realize that the design adopted must be a compromise between opposing conditions that affect safety. For example, lowering the center of gravity of the machine and lowering the top to reduce wind resistance contribute to safety under certain conditions, but the driver's eye has been lowered and the field of view in the immediate vicinity of the vehicle has been lessened. The designers think there has been a net gain but many drivers complain about the visibility, and the problem of deciding just what is the proper balance be-

tween such opposing factors is not easy to solve in the lack of pertinent accident data. It is to be hoped that in more investigations of highway accidents an attempt will be made to get the answers to such questions as this as well as to find the culprit upon whom the responsibility for the accident can be placed.

Headlights, horsepower, and steering gear ratios are other elements of design for which conflicting desiderates must be balanced.

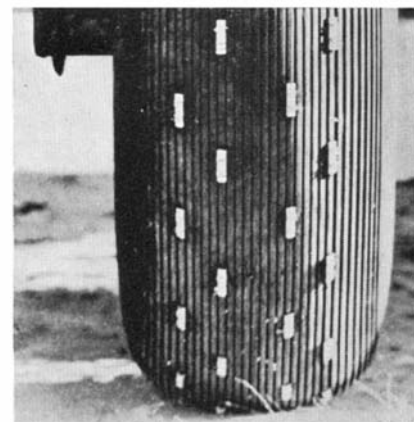
Although so-called safety glass is required by law in many states, according to Mr. Hunt, some surgeons claim that the percentage of fatal skull fractures is increased and that in severe collisions the damage done by its fine splinters is on the average worse than that done by the larger pieces of plate glass. Some fact finding is needed.

Mr. Hunt discusses the relation to design of fatigue factors such as ventilation, noise, vibration, eye strain, adjustability of the driver's seat, ease of control, and monotony, concluding with the following statement concerning the status of knowledge in this field:

"The problem (fatigue factors) is primarily one for the psychologist and the physiologist. The engineer can only remove or reduce sources of fatigue after information about fatigue sources has been supplied. We do not seem to have enough information about the effect of various combinations of annoyances upon people, even if some data are available as to the effect of simple disturbances, such as certain sounds and vibrations. Furthermore, the sensitivity of different individuals varies tremendously. A person who takes satisfaction in a smoothly operating mechanism may be greatly irritated by uneven running of the engine, while another person may be greatly distressed by a sustained engine noise, which would not disturb the mechanically minded person because this noise would seem to him quite in order. In the absence of scientifically proved data as to sources of trouble, we can only use common sense in attacking this problem, and are not justified in claiming too much for the results. We are justified in believing that the overall effects of the engineers' efforts in the last few years have been toward improvement."—R. W. Crum.

NON-SKID CLEATS FOR AIRPLANE TIRES

SHARPENING the claws of the nation's fighting war-birds, the United States Army Air Corps has been experimenting at several of its air fields with steel cleats imbedded in the multi-ribbed tread of the



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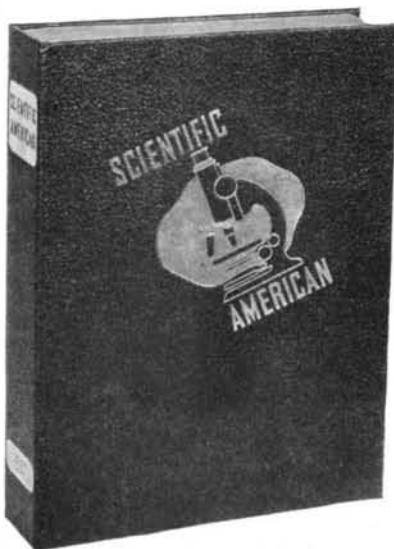
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General streamline airplane tires with which many of the Air Corps' fighting planes are shod.

While the flexible rubber vanes of the squeegee tread on the low-pressure streamline tires provide maximum traction and adhesion to wet or dry runway surfaces, Air Corps engineers believed they might increase the clinging power of the tires on smooth ice if sharp steel cleats were imbedded in the tires so that they would bite into the smooth ice sometimes encountered in mid-winter landings. No tires have yet been devised which will provide sure traction on or adhesion to sheet ice, either on airplanes or on motor-cars.

DOTS ON TIRES INDICATE BALANCE

BY means of a system of dots placed on the sides of automobile tires, near the rim, manufacturers indicate how well the tires are balanced, and at what point with respect to the casing the inner tube valve should be placed when a tire is mounted. These dots, which may be square, round, triangular, single or in pairs, are red, and invariably are placed at the point on the casing where the inner tube valve should go.

There is no universal system of tire marking to indicate balance. Some tire manufacturers select their best balanced tires and mark them for front-wheel use, where balance is highly important. Tires that do not come quite to the front-wheel standard with respect to weight distribution are marked for rear-wheel use. Other manufacturers make no distinction, but produce tires that reach one definite standard of balance. Tires can be marked for front and rear wheel service only when they are shipped to automobile manufacturers as original equipment, with tubes in place in the casings and partly inflated. The complete unit—casing and tube—is balanced so that, when used on wheels that have themselves been balanced, the result is an almost perfectly running wheel assembly. Tires sold directly to motor-car owners are balanced, but, because there is no way of knowing the kind of inner tube that will be used with them, they are marked only for position of the valve stem.

GOOD ROADS MAKE BAD WATER

INCREASED use of tar on roads throughout the country is causing the water supplies of hundreds of cities to take on objectionable tastes and odors, reports the American Institute of Sanitation. Road tar contains small amounts of phenolic chemicals which are leached out by the rain and carried along to the lakes, rivers, and reservoirs from which cities obtain their water supplies.

The chemicals washed out from tarred roads by the rain are usually present in very small amounts and ordinarily are unnoticeable to the taste. But when the water is chlorinated the phenolic substances are turned into pungent compounds having a pronounced medicinal taste. Just a few drops of the phenolic leachings from tarred roads will render a million gallons of water undrinkable after chlorination. Since a majority of cities chlorinate their water to remove harmful bacteria, and since thousands of miles of roads in this country are

being tarred each year, the problem of medicinal tastes developing in water supplies is very common. Chlorination also emphasizes the various other disflavors in water caused by algae, industrial wastes, and so on.

Fortunately it is now possible to remove the objectionable tastes and odors in public water supplies that arise from tarred roads and other causes, says the institute. Scientists have perfected a purifier, activated carbon, which takes out such disflavors in water. Its action is mechanical, attracting and holding the undesirable tastes and odors. It does not dissolve in the water and adds nothing to it. More than 1000 cities in the United States are now using activated carbon to keep their water sparkling, sweet, and palatable, and the use of the substance is extending to Europe. The cost of safeguarding the palatability of a city's water supply is very small, amounting to only about three cents per capita per year.

(End of Transportation Section)

NERVE TRANSMISSION BOTH ELECTRICAL AND CHEMICAL

HOW the various portions of the body communicate with one another through the nerves, how the brain tells the finger to move or a pricked finger tells its plight to the brain—this problem is a major one in physiology. There are two general theories as to the method of communication or transmission in living material—electrical and chemical.

In recent years physiologists have accepted pretty generally the view that transmission along a nerve fiber is in the main an electrical phenomenon. Local currents within the fiber from the excited to the unexcited portion provide for the transmission of that state of excitation which we call a nerve impulse. But the transmission of a state of activity from one nerve fiber to another, as happens in the brain when any of our sense organs are stimulated, or from a nerve fiber to a muscle fiber, as happens when we make a voluntary movement, means the transmission of an excitation from one cell to another.

There is much discussion as to whether the passage over the junction point between the two cells is an electrical or a chemical process. There is much evidence to show that the transition is effected by chemical transmitters, such as acetyl choline, in the case of our voluntary and involuntary movements. According to this view, every movement we make is accompanied by the production of minute amounts of acetyl choline at the ends of the nerve fibers, and it is through this chemical agent that the muscle is set into action.

Other physiologists have held that the nerve impulse when it reaches the junction point is transmitted electrically to the muscle fiber.—Copyright, *Science Service*.

SELF-EXTINGUISHING COMBUSTION

A KIND of combustion, flameless but otherwise like a fire, tends to extinguish itself as its temperature rises. In the search for a cheap method of making valuable chemical compounds for use in industry by oxidizing cheap raw materials with oxygen from the air (which costs noth-



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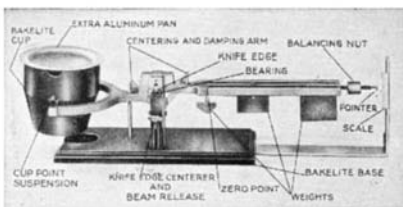
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ing), the reaction between acetaldehyde and air to form acetic acid in the presence of a catalyst has been found to go slower as the temperature rises.

Normally, when organic materials are oxidized (that is, burned) in air, the products are carbon dioxide and water, and the hotter the fire gets the faster it burns. The reason for this is that oxygen more readily combines with carbon and hydrogen as the temperature goes up. However, when a mixture of the vapors of acetaldehyde and air is passed over a heated catalyst, acetic acid is formed directly. This conversion takes place more rapidly as the temperature goes up until it reaches the range of 145 to 160 degrees, Centigrade. After passing that temperature, the rate at which acetic acid is formed drops. The catalyst used is a silica aerogel containing a small fraction of 1 percent of platinum oxide. The explanation of this slowing down of reaction, offered by Foster and Keyes of the University of Illinois, who have investigated it, is that at the optimum temperature, contact between air, catalyst, and acetaldehyde is best and that above this temperature the contact between the three essentials to the reaction is less intimate.—D. H. K.

INJURY

HIGH-SCHOOL chemistry books and courses should be revised to increase instruction on how to prevent and treat injuries of a chemical nature, according to Dr. J. O. Frank, head of the Department of Chemistry of the Wisconsin State Teachers College.

MODELING SHEET RESEMBLES LEATHER

A NEW material which looks and feels like leather and which may be tooled in beautiful designs has just been announced by the Arts and Crafts Division of the Burgess Battery Company. This interesting new art material, Cellocraft, is easy to work and requires little skill or effort. Worked according to directions, it gives results resembling those obtained with the finest Russian tooling calf.

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colors—chrome and brown. After tooling, it may be colored with water colors, wax crayon, oil, dyes, stain, or wood finish, and then varnished or lacquered.

The process of tooling is quite simple. First, a design is traced with a stylus in the front side of the sheet. Then the back is carefully dampened and the stylus is used to press the design through from the back while the work is held in the hands.

UTILIZING OAT HULLS

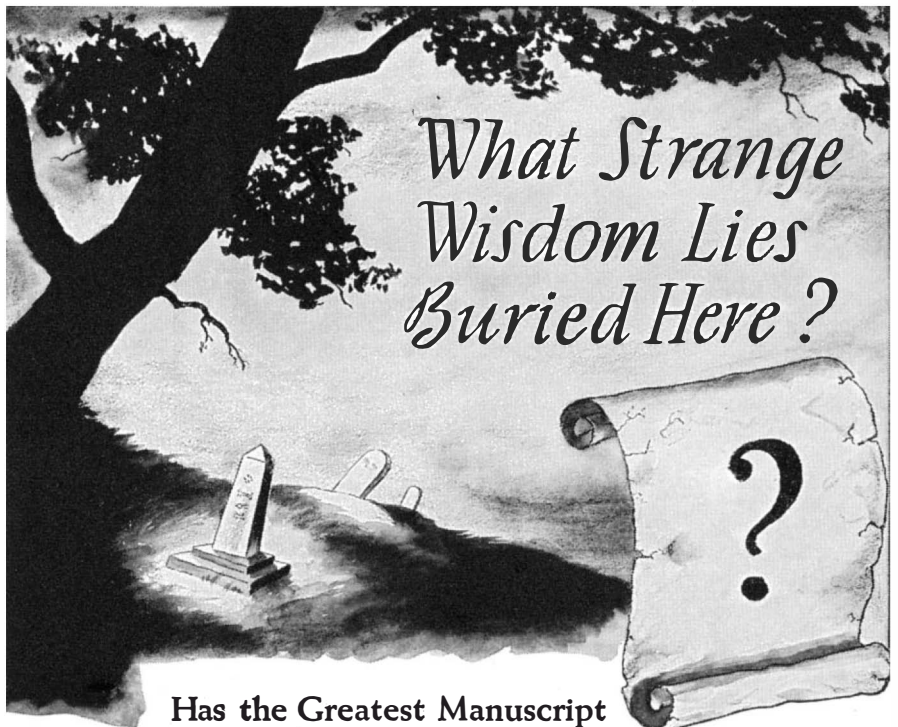
BY treating oat hulls with dilute acids, a solution containing sugars is produced. Recent investigations have shown that when this product of oat hulls is added to corn mash, a good yield of butyl alcohol, acetone, and ethyl alcohol can be obtained by fermentation. Oat hulls have been studied as typical of farm wastes containing cellulose. The preparation from them of valuable solvents like butyl alcohol and acetone indicates a possible method of utilizing agricultural wastes to produce industrial raw materials.—D. H. K.

A DUSTY DISCOURSE

ANNOUNCEMENT of another possible solution of the silicosis problem (see article on page 26 of this issue) has been made in a medical report by scientists and physicians at the University of Toronto, who suggest that tiny traces of aluminum dust added to the silica-filled air breathed by workers may eventually stay the ravages of silicosis. These investigators were able to prevent silicosis in the case of rabbits that breathed silica-filled air containing a trace of aluminum powder, while rabbits that breathed the silica dust alone contracted silicosis. From this work, it has been concluded that the presence of the aluminum in the dangerous dust inhibits the rapid solution and concentration of the silicious material, thereby preventing degeneration of the lung cells and the production of fibrous tissue.

Other research workers, reporting in the *American Mineralogist*, intimate that dusts like powdered coal, iron oxide, and alkaline earth carbonates also have a protective ac-

(Please turn to page 44)



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OF all the things optical described in the book "Amateur Telescope Making—Advanced," published last February and now owned by just under 2000 amateurs, the Richest-Field Telescope or "RFT" has perhaps attracted the most attention. This is a short-focus, wide-field reflector of high light-gathering power, that is simply held in the arms and used for exploring the starry reaches of the galaxy. It is designed to reveal at one view of striking splendor



Figure 1: Myers and his RFT

the greatest number of stars possibly visible at one time. A thoughtful person cannot help but feel deeply impressed when he thus sees with his own eyes what an inconceivably vast and magnificent thing our universe is. S. L. Walkden, father of the scientifically designed RFT and author of the RFT chapter in ATMA, was right when he said that it made the awed beholder almost wish he were alone with his telescope.

Figure 1 shows J. E. Myers, 1519 Olin Ave., Omaha, Neb., holding a 5 $\frac{1}{4}$ " $f/4$ RFT. Figure 2 is a photograph of Frank Wickenburg, Theosophical Headquarters, Point Loma, Calif., with a 5", $f/4$ RFT which gives a full 2° field. "It is packed full of thrills," he says, "and at a recent meeting of our club in San Diego it stole the show." Figure 3 is a 4", $f/3.4$ RFT made by George R. Harrington, Jr., 4031 Vernon Road, Drexel Hill, Pa. He writes: "It astonishes me what this scope picks up—I'll give Mr. Walkden a vote of thanks." Figure 4 is from Willard R. Harer, 311 Rodman Ave., Jenkintown, Pa., who says, "The results with it are highly gratifying, giving me the most beautiful sights I've ever seen with a telescope. It surpassed my expectations."

The remainder of the account is by Mr. Walkden, and the reader will discover that the chapter in ATMA merely scratched the surface of this subject. Whenever the abbreviation RRFT is used, this means "richest, richest-field telescope," a sort of

superlative superlative, if this is possible.

ADOPTING the accessible data it becomes evident that, if the observer uses an 11th-magnitude RFT, perhaps of about 2 $\frac{3}{4}$ " aperture, he may obtain the most star-crowded average field of view with respect to the zone of the Milky Way all round the sky; on which account such an RFT had better be distinguished as the general-purpose RRFT, and, though small, be regarded as the most important instrument (Figure 5).

"Suppose, then, that instrument is directed upon an average star-cloud at average distance of about 3000 light-years, upon which cloud the RFT is acting as the proper RRFT because of just revealing that critical star, here of the 11th magnitude, at which the stars of the cloud stop increasing in numbers faster than they grow fainter (ATMA, pages 631-633). Now let the aperture be made x times greater. Of course the aperture area is x^2 times greater, and so it can reveal the critical star if x^2 times as faint. That will occur if the whole star-cloud and its critical star is placed x times farther away. Any doubt as to whether the critical star remains the same individual star may be easily dispelled, on realizing that distance fades all the stars similarly, without altering the relative brightness of one star compared with another. (Each cloud is supposed to have only a moderate depth, compared with its distance.)

"Now the ability just to reveal the critical star exactly defines the RRFT condition, and so it comes about that an RFT of any aperture 2 $\frac{3}{4}$ x inches can become a special-region RRFT on our finding for it a star-cloud at distance 3000 x light-years. Since 3000 $x \div 2\frac{3}{4}x$ is practically 1000, we may say that every RFT can become a special-region RRFT for a star-cloud distant about 1000 light-years per inch of aperture. The rate of proportionality, 1000 light-years per inch of aperture, will be further justified, later, on the basis of what the critical star really is.

"Then there is the question of the numbers of stars in the fields of view. As in the third line of page 637, ATMA, the rule for the number of stars seen in the field of a standard RFT is

$$N=102.6 \times \Delta/a^2$$

(The final term of this equation was misprinted in ATMA with $\Delta m/a$. The 102.6 is the square degrees area of the actual field of view of a standard 1" RFT of 40° apparent field diameter; so the 102.6/ a^2 is the square degrees area of the actual field of a standard RFT of " a " aperture. Finally, of course, the multiplication by Δ at once finds N which for the general-purpose, 2 $\frac{3}{4}$ " RFT becomes

$$N=102.6 \times 25.4/2.75^2=345 \text{ stars,}$$

as stated on page 636, ATMA.

"When, now, the star-cloud is pushed x times farther away, and is followed up by the x times larger aperture, so that the aperture becomes 2 $\frac{3}{4}$ x inches and the star-

density becomes, by a natural perspective effect, 25.4 x^2 , then

$$N=102.6 \times 25.4 \times x^2 / (2.75 \times x)^2 \\ =102.6 \times 25.4 / 2.75^2=345 \text{ stars,}$$

precisely as at first, aperture and distance having had no effect whatever.

"Yet it is the case that the larger sizes of instruments do offer opportunities for showing much more star-crowded fields of view, and there are reasons for this being so. If, while looking at an average cloud at the average distance, we turned to another cloud at the same distance, and found it gave a field of view b times more crowded, we should have to conclude this second cloud had b times the Δ of the first, in fact a star-density of 25.4 b . But, looking at the cloud even with the naked eye, we should notice it also had b times the surface brightness or shine of the first cloud, because there would be b times as many stars per square degree to help the surface brightness or shine. Thus b , the brightness or shine compared with the average, becomes an exact measure of the Δ of the cloud for a view at the average distance. The shine of the cloud is not affected by distance, for while at x times the distance the stars are all faded x^2 times there are, to compensate, x^2 times as many stars per square degree acting to make the shine. Accordingly, a brightness or shine of a cloud b times the average tells us the cloud has a star-density, at



Figure 2: Wickenburg and RFT

average distance, of 25.4 b , so that if the cloud is actually at x times the average distance then, by the rule,

$$N=102.6 \times 25.4b \times x^2 / (2.75x)^2=345b \text{ stars.}$$

"This all becomes very simple; it enjoin looking at the star-clouds which are distant as many thousand light-years as there are inches in the RFT aperture used, and then preferring the brightest of these clouds.

"But the problem is to know the distances. What can usually be done is to judge on the basis of results or experience. The nearer clouds, such as the Cygnus clouds,

are recognizable by soon resolving into stars on a darkening background, even with quite small RFT apertures: but the farther and farther clouds want larger and larger RFT apertures, before a decidedly stellar field replaces the powdery appearance and there is a substantial darkening of the milky luminous background.

“(Note: So far as the star-clouds contain the Eddingtonian kind of stellar mixture to



Figure 3: Harrington and RFT

be referred to later on, the following method can estimate by calculation, and closely enough, the RRFT aperture required for a simple spot of cloud. First, look at the cloud through a refracting test telescope of T'' aperture, of low power though not necessarily as low as an RFT, and count the stars in the field of view. Then cut down the aperture to 60 percent of the full diameter, by a cardboard stop, and again count the stars, and find the quotient, Q , of the first number of stars divided by the second. The RRFT aperture needed is then simply about $Q^3 \times T/25$ inches diameter, so long as Q is kept within the limits of 5 and 2 by the use of a suitable size of test aperture, T'' . A 3" will be found to test up to 15" aperture, a 4" up to 20" aperture, and so on in proportion. The quotient Q is always about $\sqrt[3]{25}$, or 2.9, when the telescope in use is already the proper RRFT; and so far as the cloud is distant 1000 light-years per inch of RRFT aperture the method also estimates the distance of the star-cloud. The reflector RRFT has generally to be of about 50 percent larger aperture, and it may show about 25 percent smaller number of stars. The method is based on our knowing how far we are from the peak of a known arched curve, as soon as the slope near where we are now has been made to reveal itself.)

“However, it is clear why the larger apertures can show more crowded fields. A small 2" RFT acting as an RRFT performs upon star-clouds distant only about 2000 light-years, and such clouds are few to select from and not particularly bright ones. Perhaps 300 stars may be expected. But a 20" RFT acting as an RRFT performs upon clouds distant about 20,000 light-years, where there are a hundred times as many to select from (chiefly a surface matter, depending quite on the square of the distance), and several really very bright specimens. Where $b = 6$, $N = 345 \times 6$, and

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about 2000 stars may be expected in the field of view.

“(Note: Since the actual field of a special-region RRFT is $11.43/a$ degrees in diameter, and 1° at 1000 light-years is 17.5 light-years, and since the distance at which the instrument operates is about 1000a light-years, the actual field of view is, very curiously, always about $(17.5/1000) \times 1000a \times 11.43/a$, or 200 light-years diameter in the proper star-cloud. A tube of 100 light-years radius and of D light-years depth is of volume $\pi \times 100^2 \times D$, cubic light-years, which is the volume of the field in the star-cloud. If S is the number of stars per million cubic light-years of the cloud (down to the critical star), then the number of stars in the field is the volume $\times S \div 1,000,000$, and that is to say that $N = 0.0314 \times D \times S$. This alternative formula for N is of little more use than again to advise finding deep and congested clouds to operate on with the proper apertures—the clouds distant and bright, like those about 30,000 light-years away near the hub of the galaxy and needing apertures of about 30" for their RRFT's. The special-region RRFT for a particular star-cloud is, by the way, very agreeably more sharply defined than is the general-purpose RRFT designed for the whole round of the Milky Way, for reasons of a kind not very hard to perceive.)

“Practical Applications: In the application of what has been explained, a 1" RFT could be a special-region RRFT if the nearest clouds in Cygnus were at half their

several times explained. It shows about 350 stars per average view. The 6" RFT, as the special-region RRFT for the 6000 light-year, nearer clouds of Scorpio, is able to select brighter clouds, and 600 or 700 stars per view may be expected (probably paralleled by the special-region, rich-field observations described by Mr. Tombaugh on page 640, ATMA).

“The 12" and larger are special-region instruments for the big clouds near the hub of our galaxy, in Scorpio and Sagittarius, and have much bright material from which to select. Fields quite as rich as 1000 or 2000 stars may be found in places, and appear very magnificent. A 100" RFT, which should be the proper special-region RRFT for the Greater Magellanic Cloud, which is very bright in places, may be expected to produce superbly magnificent fields of view of surpassing grandeur, containing thousands, perhaps nearly 10,000 stars, with several, perhaps, as bright-looking as Sirius, and one or two, perhaps, as bright-looking as Venus or even brighter—much brighter if a naked-eye foreground star can be caught in the view.

“The Real Critical Star: Turning to the sublime meaning of these views, few users of the RFT's as regional RRFT's are likely ever to forget that these marshalled hosts of heaven, delicately colored like sparkling jewels, from red to blue, and drifting across like snow at every move of the telescope, are really the magnificent suns of our universe. Estimates have been made of the relative numbers of stars of different sun-powers in an average sample of the stellar mixture that seems to prevail everywhere in space. One estimate is in Vol. 21, page 320, of the 14th or latest edition of the *Encyclopædia Britannica* (Sir Arthur Eddington's article on Stars). For every 200,000 stars of the same power as our own sun, there are said to be 42,000 ten times as powerful, 3300 one-hundred times as powerful, 90 one thousand times as powerful, and one ten thousand times as powerful, and of course there are vaster multitudes less powerful than our sun, all of which, strangely enough, we shall not have to regard. The important thing is that, when these figures are examined by means of a curve on squared paper (a curve of the numbers of stars, 1, 91, 3391, 45,391, and 245,391 against the sun-powers, 10,000, 1000, 100, 10, and 1; preferably done on double logarithmic paper or by plotting logs both ways on plain squared paper, carefully noticing the point of 45° slope), it is found to be at about sun-power 15 that the stars stop increasing in number faster than they grow fainter. Of course, this tells us what our critical star really is at close quarters. It is really a sun of about 15 times the power of our own splendid sun, and other disclosures easily ensue. Since the special-region size of RRFT is determined by just perceiving the critical star and none fainter, it astonishingly follows that these gloriously rich fields are made up of stars all more than 15 times as powerful as our sun. Indeed, if all the stars less powerful than that were blotted out of existence the fields might look still finer, gaining by contrast with a darker background between the lucid countable stars. Other facts emerging are that the average power of those stars in the field of view must be about 27 times the power of our sun, and out of every 350 stars in the fields there is one likely to be



Figure 4: Harer and his RFT

distance of 2000 light-years, to bring their critical star within the grasp of so small an aperture. But, used upon those clouds as they are, there may be seen about 200 stars in the field of view, and though not very bright the view is recommended as quite cheerful for so tiny an instrument. A 2" can really start being a special-region RRFT upon those clouds of Cygnus, exhibiting bright and charming views of about 300 stars. The important 3" RFT is a special-region RRFT for the further clouds of Cygnus, as well as being the general-purpose RRFT for the whole Milky Way, as

over 1000 times as powerful as our sun. Of course there are stray stars between us and the star-cloud, and some of these within one quarter of the distance of the cloud—the square root of 15 is about 4—may be no more powerful than our sun, but they are only a casual few, and not in the cloud.

“Our own sun, we know, looks like a 10th-magnitude star at 326 light-years distance. Therefore, it would look 2.512 times

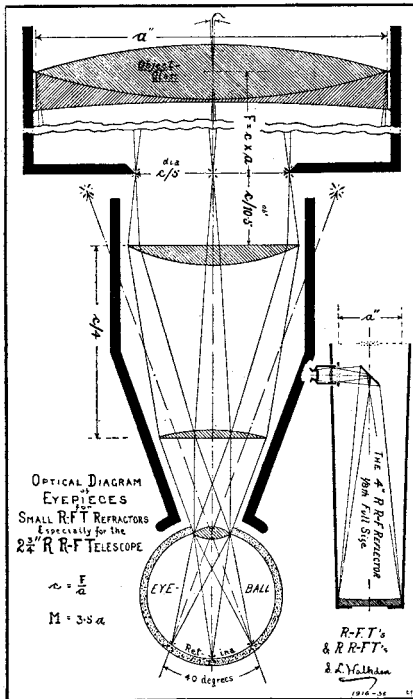


Figure 5: Walkden's diagram of a general-purpose RRFT (to clip and insert at page 636, ATMA). Angle marked by little arrow at top is $11.43/a$ degrees. This indicates the actual diameter of the visible field

brighter and of the 9th magnitude at $326/\sqrt{2.512}$, or 206 light-years distance. So the critical star of 15 sun-power would also look like a 9th magnitude star—which is supposed just perceivable with 1" of aperture—at $206 \times \sqrt{15}$, or 797 light-years distance. This—with some disrespect for exactness of the data or respect for better eyesights—is going to be rounded off to about 1000 light-years for each inch of aperture. And so we find confirmed the rule, easy to remember and already used in the earlier part, that an RFT proves to be an RRFT, for star-clouds distant about 1000 light-years per inch of aperture.

“There is, accordingly, good reason for an observer having not only the little general-purpose RRFT, but another of as large an aperture as he finds possible, this second one for use on to-be-discovered special regions of the Milky Way and giving views magnificent according to the aperture. The observer need not first ascertain the cloud distances—small star magnitudes and the powderiness of the fields can suggest the distances—he only needs to discover and exult in the brightest and richest spots, which he knows are findable here and there.

“The Special-Object RRFT: The possessor of an RFT soon notices the vivid views it gives of some objects which are not definitely star-clouds. Since a standard RFT has an actual field of about $11.43/a$ degrees in diameter (see footnote, page 633), it always

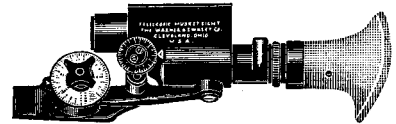
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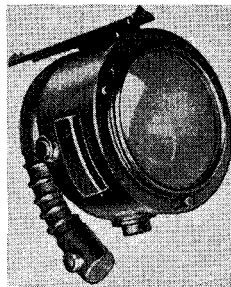


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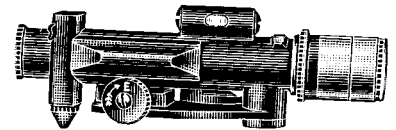
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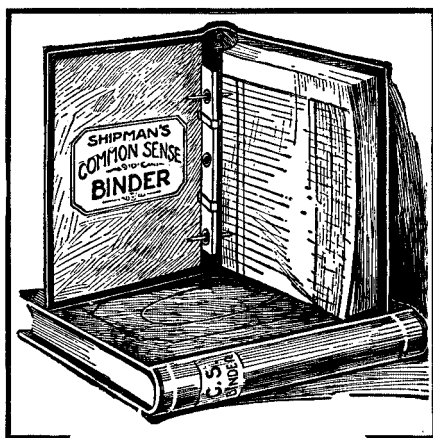
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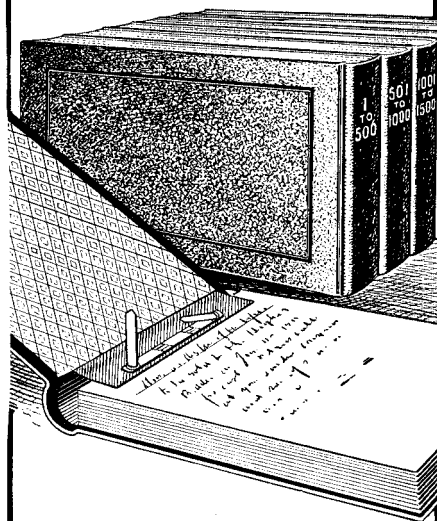
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performs splendidly on objects which look their best in fields of about 12/a degrees diameter, or, with reasonable latitude, in fields from about 18/a to 8/a degrees diameter. In this way a 2", with field of about 6° diameter, may be found to be a *special-object* RRFT for viewing the bright groupings in the prominent constellations of Orion, Taurus, Cygnus and many others. A 4" is still more delightful in the same way, and for viewing the Hyades and Pleiades and open clusters, and especially for most beautifully viewing the Andromeda Nebula as a complete whole. A 12" gives most dazzling (perhaps too dazzling) views of the moon, three-quarters filling the field when a power of 5 per inch of aperture is used; the bright light contracts the eye's pupil to about 1/5th inch. A 24", of field about half a degree, takes its place for viewing most brilliantly the globular clusters, especially the great Hercules Cluster; but it also gives a remarkable view of the whole spread of Jupiter and his satellites, the latter looking like first-magnitude stars. It is as well in these instruments to have spare eyepieces of about ¾, 2, and 3 times the strict richest magnifying power, to help some objects to occupy the apparent field in the best possible manner, since a separate RFT for each of the many sizes of objects is rather out of the question.

"The Spiral-Nebulae RRFT: Just as the 4" RFT is found to be about the best size for observing the Andromeda Nebula as a whole, so also would the 8", 12", 16", etc., RFT's be the best sizes for observing the same nebula if it went away to 2, 3, 4, etc., times its present distance of about 1,000,000 light-years, for of course, the nebula would shrink to ½, ⅓, ¼, etc., of its present apparent size, by such recessions. Evidently an RFT suits the observation of such spiral nebulae at a distance of about 1,000,000 light-years for each four inches of its aperture. The number of nebulae so observable, each in its entirety and nicely filling the field, must, of course, be roughly proportional to the square of the distance, and that means to the square of the aperture. The great 200" therefore, if completed as a *visual* RFT, would show a few thousand nebulae, just as the one in Andromeda appears so beautifully in the field of a 4" RFT. For the tens of thousands of such nebulae much nearer, the 200" is too large to show more of each one than a small patch, which, however, in the case of the Andromeda itself, may be richly filled with 1000 or more of stars, each one at least 400 times as powerful as our sun, and these seen against the irresolvable luminous haze of all the rest."

THIS ends Mr. Walkden's contribution on the RRFTs for various special uses, and the reader will have observed that, just as the common or garden variety of RFT enhanced the view many times, compared with a conventional telescope, so the special-purpose RRFTs, used on their appropriate objects, enhance even this a goodly number of times. Every amateur has had the experience of showing the stars to non-astronomical persons and slyly noting their disappointment at not seeing something quite striking; they go away thinking their telescope-making friend "isn't so much, after all." If, however, they are shown some RRFT views, they may go away vastly impressed.

THE SCIENTIFIC AMERICAN DIGEST

(Continued from page 39)

tion and assist the lungs in their elimination of dust so that no permanent damage occurs.

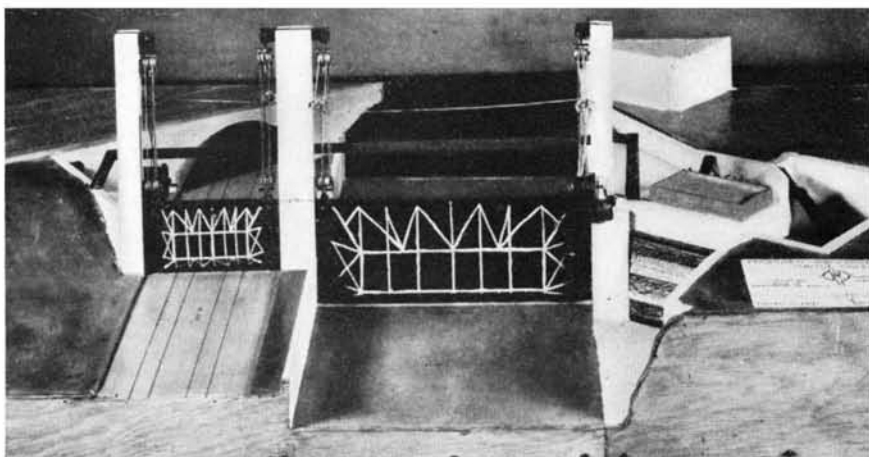
Silicosis is known by a wide variety of names, such as "miner's consumption," "potter's asthma," or "grinder's rot," according to the occupation in which it is caused, but in all cases it is a disease due to the inhalation of silica dust. It is characterized anatomically by generalized fibrotic changes, and clinically by shortness of breath, decreased chest expansion, lessened capacity for work, increased susceptibility to tuberculosis, and by characteristic X-ray findings. While possibly not the worst American health hazard, silicosis will continue to be dangerous as long as there are unprotected workers in dusty occupations.

Industrial engineering research has played an important part in detecting silicosis hazards, and special equipment and methods have been devised to indicate the amount, size, and kind of dust particles found in industrial situations. The Greenburg-Smith impinger, which has been used for determining the total number of dust particles in large volumes of air, functions by causing the dust-laden air to bubble through water and impinge upon a moist plate which wets the dust particles and keeps them in suspension. Portions of the liquid are then examined microscopically with the use of a specially ruled dust-counting cell, which gives an indication of the number and size distribution of the dust particles present. Typical of a more recent development is the Bausch & Lomb dust counter, which unites in a single mechanism the pump for impinging the dust samples upon a moist plate and a semi-dark field microscope for viewing the dust particles when they are obtained. Instruments of this sort have the advantages of speed and compactness, although they sample much smaller quantities of air.

A still more recent development is found in the Dustoscope, an instrument for the estimation of dust in air, which was developed by J. B. Ficklen and L. L. Goolden, chemical engineers, of the Travelers Insurance Company. This instrument has the advantage that neither microscope nor laboratory apparatus is necessary, and a layman can make satisfactory estimates for control of plant dust. Further methods for determining dust hazards have been developed by workers at the Aetna and the Liberty Mutual Insurance Companies who have worked on the determination of the chemical composition of very small dust particles by observing their optical characteristics with the polarizing microscope.

Among the best known methods for the prevention of silicosis are segregation of dust-producing operations, dust control, ventilation, protective devices, good housekeeping, and medical supervision, including periodical X-ray examinations of the chest.

At a recent Department of Labor conference on silicosis, it was agreed that there should be coverage for silicosis in the compensation acts of all the states, and it was further recommended that the federal legislation provide more adequate appropriations



Above: A model of the huge gates that will hold out the backwater of the Monongahela River. Below: Arrow on model points to the dam that will soon isolate Turtle Creek

to government agencies for the study of the medical, engineering, economic, legal, and insurance phases of the silicosis problem. Research projects suggested to aid industry in its conquest of the disease include a study of the relationship between silicosis and tuberculosis, the effects of other substances upon the action of silica in the body, a study of the mechanism by which silica exerts its injurious effects, and research in the technique of X-ray photography—*Industrial Bulletin* of Arthur D. Little, Inc.

SWEETS, STARCHES, AND COLDS

YOU may have fewer colds this winter if you cut down on sugars and starches in your daily diet, it appears from a report made by Frederick Hoelzel of the University of Chicago to the scientific journal, *Science*.

Observations by himself and various other investigators show that colds are fewer on such a diet and Mr. Hoelzel believes it is because the diet reduces the amount of fluid in the body tissues and this in turn reduces susceptibility to nose and throat infections.

If you think of applying this theory, it would be advisable to have the diet prescribed in detail by a physician so as not to run the danger of becoming ill from a badly balanced or deficient diet.—*Science Service*.

DAM HOLDS OUT BACKWATER

THE first major flood prevention project to reach the construction stage in the Pittsburgh district will protect the Turtle Creek valley in which lies the huge works of the Westinghouse Electric and Manufacturing Company and other major industries.

In the future when high water from the Monongahela River threatens the valley, two huge gates will be lowered, forming a barrier against rising waters and the normal flow of Turtle Creek will be continued by means of powerful pumps. The project will cost 500,000 dollars.

Installation of the gates will be made near the viaduct where the main tracks of the Pennsylvania Railroad cross Braddock Avenue and the creek just below the main works of the Westinghouse Electric and Manufacturing Company. One of the steel gates, 80 feet long by 30 feet high, will form a dam in Turtle Creek; the other, 40 feet long and 20 feet high will close the



street. When not in use the gates will be held approximately 20 feet above the street level to accommodate traffic.

The three pumps to be installed will have a combined capacity of 7500 cubic feet a second or more than 3,300,000 gallons a minute, when pumping against a low difference in height between the level of the creek and the level of water beyond the gates; and a capacity of 5000 cubic feet per second when pumping against a difference of 10 feet in the two levels.

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 (Please turn to page 52)

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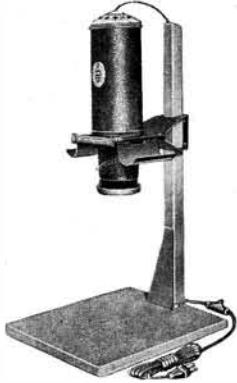
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PICTURES AT NIGHT

THE fascination of pictures made at night has currently become associated chiefly with the miniature camera and fast lenses, candid shots and snapshots of street scenes, and so on. However, night pictures were made before the miniature came upon the scene simply by setting the camera firmly on a tripod and giving a time exposure. And when it comes to that, the best night pictures are made that way even today, with time exposures and often with the lens diaphragm stopped down. Nor is it especially necessary, unless one is making a snapshot (where this is possible with the fastest panchromatic emulsions today available or where some movement in the



"Winter Night"



"By Moonlight"

subject demands it), to employ ultra fast film. Film of average speed is quite suitable; you simply allow a little more exposure.

Since the type of subject we have in mind will stand a small stop and a time exposure, the stopping down of the lens diaphragm is equivalent to reducing the speed of the lens. That makes the so-called cheap, "slow" lens in many cases the equal of the faster lenses when stopped down. So you fellows who have been entertaining an inferiority complex because you cannot at present afford to purchase one of those shiny, new fast-lens cameras may rest secure that, given an even break, such as small-stop night photography permits, you can turn out work every whit as good as that produced by the much more expensive cam-

era equipped with a high speed lens, whose high speed—that is, the largest diaphragm opening of which the lens is capable—is for the time being in temporary suspension, being as slow a lens when stopped down to F:6.3, for example, as a regular F:6.3 lens which has no larger opening.

While the picture "By Moonlight" was made at the full opening of an F:3.5 lens, a faster film emulsion would have permitted the use of a slower lens or smaller stop. The exposure, too, had to be relatively short because of the movement of the moon. The exposure, incidentally, was 30 seconds since this, as you may recall from a piece appear-



"Across the Courtyard"



“The City at Night”

ing in this department some months back, is the maximum permissible time exposure for “stopping” the moon. Clouds usually proceed too rapidly to be stopped at 30 seconds, but the slight fuzziness noticeable helps rather than mars the effect.

“Winter Night” is another miniature camera shot made at F:8 and an exposure of several minutes. The picture was made through an open window on the opposite side of the street and called for frequent capping of the lens as the headlights of automobiles streaked across the scene.

“Across the Courtyard” and “The City at Night” were exposed on 9 by 12-cm film, the first calling for an exposure of 12 minutes, the second requiring 15 minutes. “Across the Courtyard” was made with a telephoto lens that reached out across a space more than half a city block long to get an impression of domesticity in a city “cliff” dwelling. Notice how small, intimate details have been picked up by the lens, stopped down to F:8. The camera was set askew on the tripod to get the effect shown, since the ordinary vertical viewpoint seemed to possess no special attraction. The reader will please be charitable enough to overlook, if he happens to notice it, the fact that the legs of the lady in the room at the top seemed to go double during the exposure. It is just one of those things that can’t be helped when human beings are included in such a long exposure as 12 minutes; besides, we were photographing windows, not a lady’s legs.

“The City at Night” was shot from the back part of the house. A lens of normal focal length was used and the diaphragm stop was set at F:8. Since the window through which the shot was made was of the casement type, obstructing the view at the sides, it was necessary to set one leg of the tripod on the outside window ledge. Such dodges as this will frequently have to be used by the amateur who attempts night photography, where unforeseen obstacles beset the path and ingenuity has to be exercised to overcome them.

The illustrations here shown indicate to

some extent the type of material it is possible to shoot at night with even the cheapest cameras and call attention once again to the fact that night photography is still, as it always will be, within the means of other photographers than the high-speed clan.

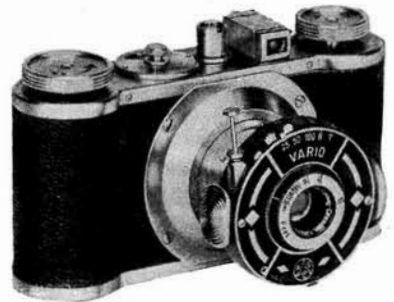
FOTOFOLIO FILES

Replacing the ornate, heavy album of yesterday is the Fotofolio idea of today, a new method of filing negatives and prints. An adaptation of the business method of keeping card index records on overlapping cards held by hinges, the Fotofolio albums will take 25 prints to the page and, in some of the styles, negatives of the prints as well. Thus, print and negative are kept together for ready availability. The albums are designed in book form and finished in cloth, “neo-leather,” and full leather. Gold lettering is furnished on brown, green, red or black. The Fotofolios are available in various styles, taking negatives from 35 mm up to the larger size amateur snapshots.

INTERNATIONAL SALON OF PHOTOGRAPHY

SOME indication of the mortality rate of a great salon will be gained from an examination of the results of the judging of the Oval Table Society’s International Salon of Photography, recently held in New York City. However, though many fell by the wayside, those who succeeded in getting hung may truly be said to have “arrived,” for the judging was most critical and the standards very high. Prints were received from all over the world; there was a total of 3155 prints in both pictorial and technical sections, of which 2968 were pictorial and 187 were technical. Only 443 prints, or about 15 percent of the pictorial total, made the grade, while the technical prints fared better with 125 accepted out of a total of 187 submitted, the percentage in the latter case being 67. Successful exhibitors in the pictorial section totaled 291 out of 775 entrants, a percentage of 38 and those success-

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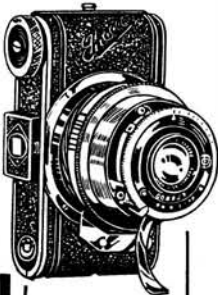
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ful in the technical section were 74 out of a total of 136, a percentage of 55.

An interesting sidelight on the salon is the announcement of how the various countries fared as to the number of successful exhibitors representing the several countries. In the pictorial section the United States exhibitors led with 240 prints from 150 exhibitors, this being 54 percent of the total exhibited, while Great Britain came second with 126 prints (28 percent of the accepted total) from 84 exhibitors. Japan, Austria, Belgium, Sweden, Poland, and France came next in the number of successful exhibitors, the individual totals of the several countries being in the order named. The balance were scattered over many countries. In the technical section, the United States led with 72 prints, followed by 53 from England.

A special apparatus was constructed to assure proper and expeditious judging of the great number of prints submitted. The entire total was passed quickly before the jury in a sort of "preview" to determine the general quality of the submitted prints, after which the final vote was taken more slowly and with full and critical consideration of the quality of the individual prints as they were placed before the jury.

This device, which is an electrical indicator registering the accepting or rejecting vote of the individual judges at the teller's station, together with a triangular revolving easel for placing the print in position for judging, is being made available by the directorate of the Oval Table Society for the use of other photographic salons desiring to make use of these facilities. Requests for the use of this apparatus should be addressed to the Oval Table Society, 10 West 33rd Street, New York City.

**AND NOW THE MINIATURE
FLASH BULB**

WITH the Wabash Photolamp Corporation's announcement of a new midsize flash bulb, of which a half dozen can be carried in an overcoat pocket, bulk is no longer a problem for the wayfaring flash shooter. The new bulb is called Superflash No. 1 and is the latest addition to the now widely used fluffed hydronalium wire-filled Superflash bulbs, Superflash No. 2 (the standard size) and Superflash No. 3, which



Three of the new miniature flash bulbs make a comfortable handful

BOOKS

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Amateur Photographers

NEW WAYS IN PHOTOGRAPHY, by Jacob Deschin. Eminently practical from every point of view, this new book contains nothing of theory and nothing that the advanced amateur photographer will not find valuable in one way or another. It covers the whole range of amateur photography, discussing such things as trick photography, photomurals, retouching, infra-red, and a number of other subdivisions that will not be found elsewhere in as clear and concise a manner. \$2.90.

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

THE FUNDAMENTALS OF PHOTOGRAPHY, by C. E. K. Mees. Not only tells how to take and finish pictures but gives a solid foundation of the principles of photography. \$1.10.

CAMERA LENSES, by Arthur W. Lockett. *Explains simply and clearly, yet with scientific accuracy, all the underlying principles of lenses.* \$1.10.

CHAMPLIN ON FINE GRAIN, by Harry Champin. A complete hand-book on the entire subject of fine grain, including formulas and how to compound and use them. \$1.90.

PRACTICAL AMATEUR PHOTOGRAPHY, by William S. Davis. *Deals with the whole subject from the origin and growth of photography to the latest types and uses of cameras.* 264 pages, illustrated. \$1.20.

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

PHOTOGRAPHIC ENLARGING, by Franklin I. Jordan, F. R. P. S. *One of the most interesting and authentic books on enlarging. Its 224 pages cover every phase of the subject and 75 illustrations, many of them salon-winners, show the value of correct technique.* \$3.70.

PICTORIAL LIGHTING, by William Mortensen. Complete control of lighting is an absolute "must" for successful photography. This book tells clearly how to obtain such control. \$2.15.

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BOOKS

gives three times the illumination of No. 2 and is intended for large areas.

Tests made with Superflash No. 1 indicate that this bulb affords sufficient lumen output to make possible synchronized exposures on fast panchromatic emulsions at stop F:8, shutter speed 1/200th second, and distances up to 10 feet. Another welcome feature of the new midget bulb is that the glass is thicker than in other flash bulbs, an obviously imperative safeguard against bursting under the intense heat generated in such a small enclosure. Some idea of the size of the bulb may be gained from the fact that three cover the area of an open hand.

Jack Price, writing in *Editor & Publisher*, calls attention to the fact that the short height of the new bulb requires a smaller reflector and voices the opinion that "no doubt the manufacturers of synchronizers will be quick to make reflectors to fit this bulb as the demand will require this additional change." He refers, of course, to the fact that, in order to operate at full efficiency, the wire filled portion of the bulb must be set at the center of the reflector.

While the midget flash bulb was still in production and not yet on the market at the time of this writing, it will be available by the time this announcement appears. Just in time, too, for parties, street shots, all kinds of indoor picture-taking—and a dozen lights for a dozen shots comfortably carried in the two pockets of an overcoat.

ZEISS IKON EXHIBITION

IF you own a Zeiss Ikon camera, here's your chance to show off what you have done with it during the past year. The Fourth Annual Zeiss Ikon Exhibition will be held the latter part of January in New York City, after which it will make a tour of the United States. The closing date is December 31, so you'll have to step on it if you think you have something that looks good. All entries should be marked: "For Annual Zeiss Ikon Exhibition," and addressed to Zeiss Ikon Company, 485 Fifth Avenue, New York City.

"As before," the announcement says, "there is no restriction as to subject matter, and it is our desire to show the various ways in which photographers are applying Zeiss Ikon cameras in pictorial, commercial, industrial, theatrical, press, color, candid, scientific, and medical photography, as well as the many other uses and applications of photography in American life and industry. Color pictures, whether in the form of prints or transparencies, halftone or photolithographer's proofs, will be exhibited with full credit to all concerned in the making of such pictures. While only a limited number of transparencies can be exhibited, provision will be furnished for showing these to their best advantage."

"Finished prints measuring from 8 by 10 to 11 by 14, or larger (all preferably unmounted), test prints, or negatives may be submitted for consideration; transparencies may be mounted or unmounted; and color prints or proofs should be unmounted so as to facilitate mounting under matte and protective transparent surface."

"FRAMING" THE DISTANT VIEW

A TELEPHOTO lens is not always the best one for recording the distant landscape, for in some instances it is preferable to include part of the foreground—"framing" of the distant scene through the use of trees, a hilltop or a road so arranged in the camera finder or ground glass that this foreground material is made to enclose or "frame" the view in the manner indicated in the accompanying illustrations. This is not only a practical device but, we submit, is interesting pictorially. The pictures shown are not the best examples of the idea we have in mind, but they serve to make the idea clear.

In pictorial arrangements of this kind, the foreground will often be in shadow, and that is really best in order to achieve depth and reality. If the shadows are too deep for straight enlargement of the entire negative, it will be necessary to do some dodging in



Framing the distant view—A

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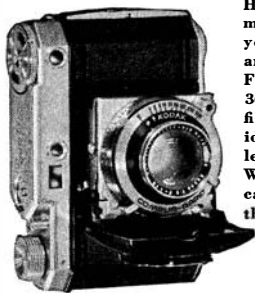
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order to permit a greater exposure time for the distant view than for the foreground. This was the procedure adopted in the case of Distant View—B, in which the horizontal foreground detail as well as the tree at the right were "held back" during part of the total exposure.

A picket fence, a bench on a hill, a human figure, will often be useful in this connection and in many cases much more effective and striking than a tree or hilltop. Whatever you may wish to adopt to bring about the "framing" discussed, we believe this to be a valuable aid to the photographer seeking ways and means of photographing distant views, yet retaining an impression of the viewpoint whence it is seen.

RECORD SPEED FILMS

THE highest speed yet attained in film emulsions is claimed for three new films by the sponsors, Agfa Anso Corporation. Two of the films are intended for the use of the gentlemen of the press, though there is nothing to stop the rest of us from trying them out, and the third is furnished in 35-mm, 36-exposure spools for miniature cameras. The press films, Superpan Press and Super Plenachrome, are claimed to have a speed of from three to four times greater than present "super" types of photographic film, while the 35-mm film, called Agfa Ultra-Speed Panchromatic, has about the same speed.

"This amazing gain in film sensitivity," the company points out, "will mean an advantage of 1½ to 2 full lens stops to the photographer, or a permissible shutter speed that is three to four times as fast as that previously necessary. . . . Press photographers will find this extra speed extremely valuable in their work, for in some instances ordinary Mazda light or normal room illumination will be sufficient for pictures."

These new films and particularly the 35-mm film will be useful in stage photography, candid camera work and under other conditions of relatively low illumination or where speed is called for.

The 35-mm film is available in a new type of 36-exposure daylight-loading cartridge for the Leica and similar cameras and in a 36-exposure daylight loading spool for the Contax and similar cameras.

The company claims that the film speed was attained without sacrificing such other desirable characteristics as keeping quality, clarity, proper gradation, and color sensitivity. Superpan Press is slightly faster than Super Plenachrome Press, particularly in artificial light. Both films are available in standard sizes.

In addition to the 36-exposure roll, the Ultra-Speed Panchromatic may also be obtained in 27½-foot and 55-foot containers of film notched and tongued for easy division and darkroom loading in 36-exposure lengths, and in 100-foot lengths of unnotched film.

A new development in connection with the introduction of Ultra-Speed may be the answer to the long-standing criticism of the 35-mm film roll that it takes too long to expose the full roll of 36 pictures and won't somebody please do something about it. Agfa announces that the new film as well as three other Agfa 35-mm films are obtainable in 15-exposure darkroom loading lengths. The films are wrapped in black paper and sealed in aluminum containers and are furnished with tabs which provide easy loading in the darkroom onto the spool of the camera magazine. A 5½-inch tongue on the other end of the film simplifies loading into the camera. Besides Ultra-Speed, the films in which these new darkroom loadings are available include Superpan, a supersensitive panchromatic material; Finopan, a fine grain panchromatic film, and Infra-Red, a film for special effects such as night scenes in sunlight.

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DuPont Superior .	64	27	40	25
Eastman Super X	64	27	40	25
Eastman S. S. Pan.	40	25	24	23
Panatomic	40	25	24	23
Finopan	32	24	20	22
Parpan	32	24	20	22

These ratings refer to bright sunlight. Before 9 A.M. or after 4 P.M. or on cloudy, smoky, hazy days, the Mazda readings are recommended.

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"Alone"

its distance and therefore smallness, because it is practically the only point relieving the monotony of sky and clouds and water. Moreover, because it is so small the vastness of sky and water is dramatically portrayed.

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The expanded details of this calculation are: First, formation of partial products.

A D M I T T A N C E	POTENTIAL			
		+2.8	+h 12.8	+i 12.1
+77*	+215.6*	+h 985.6*	+i 1931.7*	-j 608.3*
+h 48*	+h 134.4*	+614.4*	+j 580.8*	-i 379.2*
-i 4*	-i 11.2*	-j 51.2*	+48.4*	-h 31.6*
-j 54*	+j 151.2*	+i 691.2	-h 653.4*	+426.6*

*divided by 725

Second, summation of partial products.
 $(+215.6+614.4+48.4+426.6) / 725 = 1.8$
 $h(+985.6+134.4-31.6-653.4) / 725 = h0.6$
 $i(+931.7-379.2-11.2+691.2) / 725 = i 1.7$
 $j(-608.3+580.8-51.2+151.2) / 725 = j 0.1$

Third, grand total.
 $1.8+h 0.6+i 1.7+j 0.1$

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THE SCIENTIFIC AMERICAN DIGEST

(Continued from page 45)

“Calicel,” is cooled at between 10 and 40 times its original volume.

Calicel, the announcement from the Celotex laboratories indicates, is expected to find wide use in noise correction for the monumental type of structure—railroad terminals, churches, theaters, school auditoriums, and the like—where stone is essential for maintaining the decorative and architectural scheme.

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PERSONAL IMPRESSIONS OF THE ELMIRA MEET

SPACE will not permit us to give a full account of the Elmira glider meet which, moreover, was fully reported in the press in the matter of records, mishaps, prizes, and so on. But perhaps from the point of view of those interested in the glider art the personal impressions of Earl R. Southee, one of the best informed men on gliding in the United States, will be of greater interest.

This is what Mr. Southee told us, in brief: In design, performance, construction, and finish American gliders are now ahead of the German gliders. A great many of the American gliders are entirely home-made. Young Americans have not lost Yankee ingenuity and resourcefulness and can achieve much in small shops of the home-equipped variety. Finally, Mr. Southee was greatly impressed by the fact that Messrs. Paul and

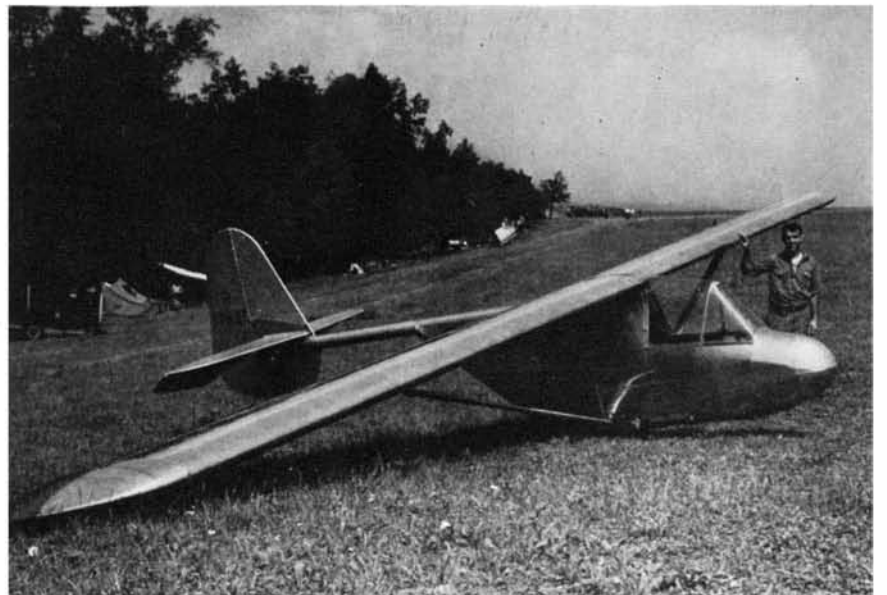
Ernst Schweitzer, operators of a Peekskill garage, managed to produce an aluminum glider which embodies every refinement of metal construction known to the art, including stressed skin, flush type rivets, and so on. Our heartiest congratulations to these skilled and determined amateur builders. They have done well in particular to disprove the fallacy of the statement that metal construction cannot be applied to gliders.

The Schweitzer model received third place in the Eaton design competition, and was second in the long utility flight. Of the utility type, the Schweitzer glider has a span of 38 feet 4 inches and weighs only 290 pounds empty. The wings are of monospar construction with metal covered torsion leading edge and fabric covered rear section. The wings weigh three-quarters of a pound per square foot. The front of the fuselage is monocoque, and the rear a steel-supported tubular tail boom.

The glider may be entered easily and the pilot enjoys unimpeded vision. There are landing wheels but it will be noticed how little aerodynamic projection they offer. The cabin is entirely enclosed in transparent plastic material, finely worked out in the design. We enjoy seeing originality and departure from German ideas in this art, although we have the utmost respect for what the Germans have done in this field.—
A. K.

NEWSPAPERS TO HELP SEAPLANE LANDINGS

LANDING on “glassy” water, so calm as to be without a ripple, is a most difficult feat for a seaplane pilot, because he cannot tell the distance of the water within 10 and sometimes within 50 feet. The difficulty is all the greater when the shore-line or horizon is obscured by fog or haze and there is nothing by which to judge height above the water. One way to meet the situation is to “stall” the machine; that is, to raise the nose to an angle well above the horizon and to let the machine land roughly and more or less at hazard. But this is not a reasonable way to land if long life is expected of the hull bottom, which strikes the water with considerable impact pressure.



The Schweitzer glider described above



Two views of the Mercury, upper component of the Mayo composite seaplane



The *News Letter* of the Aero Insurance Underwriters gives a useful suggestion. The seaplane pilot should come down to a low altitude and throw out a handful of newspapers. The newspapers floating on the water allow him to judge height. Another dodge is to throw stones and land by observing the ripples. Seaplane piloting calls for many such wrinkles in seamanship and airmanship.—A. K.

THE MAYO COMPOSITE SEAPLANE

FOR achieving transatlantic flight on a commercial basis, and securing pay load in spite of the huge amount of fuel that has to be carried, there have been proposed or tried the floating islands or aerodromes; flight in the stratosphere; stops at the Bermudas and the Azores; use of the shortest over-sea route between Newfoundland and Foynes Bay in Ireland; catapulting float seaplanes from the deck of a steamship; and the composite seaplane.

The idea of the composite seaplane is due to Major R. H. Mayo of the Imperial Airways, a man of great ability. A very large flying boat is to carry aloft a moderately large seaplane. Since the seaplane is to be launched or released from the flying boat when a considerable altitude has been at-

tained, it should be perfectly safe to overload the seaplane much more than would be the case if it were launched from a catapult since there might be "stalling" after the catapulting. The idea is simple in principle and success of operation is assured, but the construction of the composite aircraft has necessitated the most careful and complex engineering.

The "lower component" of the composite seaplane is a four-engine flying boat similar to the Short Empire boats, with a span of 114 feet and with a total take-off power of nearly 4000 horsepower. It calls for no special comment, except that it is a finely built, modern aircraft thoroughly capable of regular independent operation.

The lower component carries on top of its wing a strongly built tower, on which the "upper component" is firmly mounted. One of the principal problems which had to be overcome in connection with the design of the dual aircraft was the mechanism for interlocking the two planes during the take-off and release. The design evolved has been subjected to exhaustive tests and there is not the slightest doubt that the mechanism will function adequately.

The upper component has been termed the Mercury and is a twin float seaplane, with four engines with a maximum output of 1360 horsepower at 13,000 feet altitude. The engines are of a type not known to

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American practice, being 16-cylinder air-cooled engines of H form built by Napier. The span of the Mercury is only 73 feet and it has the moderate gross weight of only 20,000 pounds. What is extraordinary is that, thanks to the extremely heavy loading (made possible by launching at altitude) of 32 1/2 pounds per square foot of wing area, a fuel load of nearly 10,000 pounds will be combined with full passenger comfort, a mail load of 1000 pounds and a range of 3500 miles at a cruising speed of 170 miles per hour. This should be sufficient range to make the north Atlantic crossing even with a continuous head wind averaging as much as 60 miles an hour.

During the climb prior to release, the lower component will be as lightly loaded as possible and both sets of four engines will be co-operating, so that enormous power reserve will give a very rapid climb to the desired altitude.

Some contrary arguments have been made: That it is easier and cheaper to operate a catapult from a surface vessel; that passengers will not like being launched in any fashion; that the next size in flying boats will meet the challenge of non-stop Atlantic operation. Nevertheless, the plan remains very interesting and plausible.—A. K.

HAIR WIRE

COPPER wire about the size of the human hair and totalling 3,016,000,000 feet was required for constructing the coils of electric clocks in 1937 by the Telechron Company. This footage, if stretched out, would encircle the globe 23.2 times.

NEW YORK VERSUS BALTIMORE

THERE is constant rivalry between New York City and Baltimore as to which will be the terminal of the transatlantic airways. During the summer and early fall, Pan American Airways has been operating from its temporary base at Port Washington, Long Island, some 25 miles from New York City. For the winter months Pan American is moving to the milder climate of Baltimore. Because the city of Baltimore has

been so co-operative and far-sighted there has been a good chance hitherto that the terminal would be permanently located in the more southern city. But New York City is now meeting the challenge by an enormous extension of both the land and water facilities of the North Beach Airport, at a cost of 12,762,000 dollars. The extension will be completed well ahead of the World's Fair, and the Sunrise Highway will connect North Beach with Triborough Bridge, with only a ten-minute drive from bridge to airport.

The plans call for a final area of 429 acres or four times the size of the present airport. There will be two administration buildings, one for land planes and one for seaplanes. The land plane building will be placed at the center of a semi-circular row of two-plane hangars; it will be fireproof, 304 feet long by 77 feet wide, with a semi-circular pavilion 175 feet in diameter on the side facing the field. A covered platform will run around this pavilion and extend out upon the roof of rectangular wings. A semi-circular public concourse, 80 feet in diameter, is to occupy the center of the building, lighted through glass-brick upper walls.

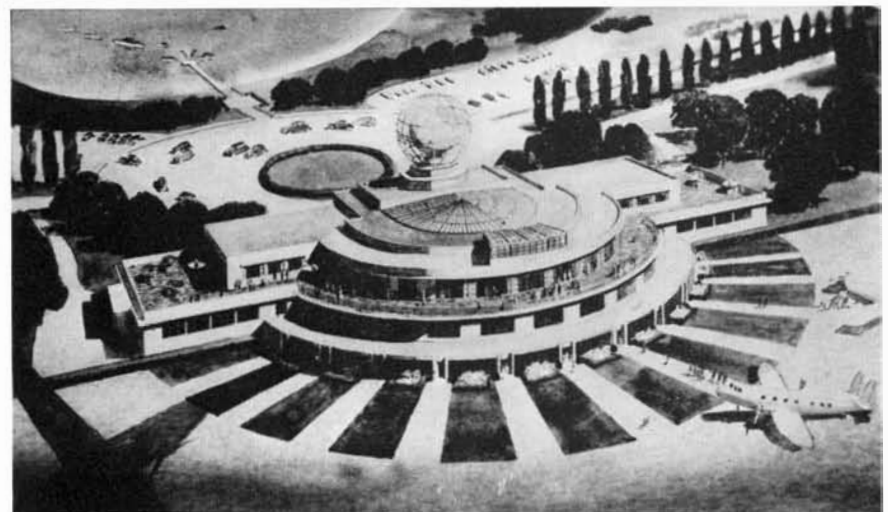
The circular seaplane building adjoins the four-plane seaplane hangars forming four sides of a hexagon. The runways will be built with an asphalt or tar surface until the filled-in ground has settled, when they will be resurfaced with concrete. An airplane taxi runway will make possible quick and easy transfer between transoceanic and transcontinental planes. A covered ramp will connect the landing dock with the central concourse of the seaplane building.

The project is sound in its engineering and aircraft features, and gives promise of being highly satisfying to the eye.—A. K.

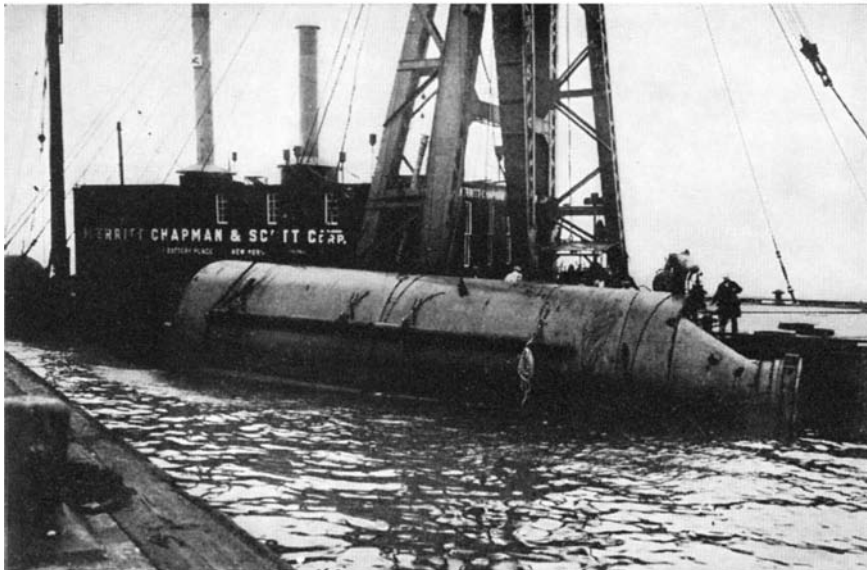
IS AVIATION PAYING ITS WAY?

AVIATION has now become a great industry and the above question is of considerable interest, but like many questions in economic science, it cannot be answered definitely. Perhaps our readers would like to know some of the conflicting factors of the situation.

Total airplane sales for 1937 amounted to something like 115,000,000 dollars; the "big eight" manufacturing companies (Douglas, Boeing, Curtiss Wright, Consolidated, Unit-



One of the administration buildings to be built at North Beach



One of the coking drums that was shipped to the middle west on its own "bottom"

ed, Glen Martin, North American Aviation, and Lockheed) did business ranging from half a million to 31 million dollars each, and have developed a highly profitable export trade. But the margin of profit is only 9 percent, leaving little reserve for leaner years and less successful designs. A tremendous handicap for our manufacturers of military and naval aircraft lies in the long elapsed time between the building of a successful experimental model and the final production orders. Naturally, the Army and Navy have to make sure by long service tests that the ships are just right, but in the meantime the expense of a "waiting" and partially idle plant are overwhelming. Low-powered airplanes of the Aeronca and Taylor Cub type, for example, are a bright spot in the industry, and about 2000 of these small machines were delivered in 1937.

On the transport side of the industry there is rapid and steady growth, with several of the major airlines doing an annual business of more than ten million dollars. So great are the expenses, however, over and above the simple elements of fuel, oil, and pilot's pay, depreciation of equipment, communication, aids to navigation, and innumerable other items, that the margin of profit is less than 1 percent, and the border line between profit and loss is woefully thin.

Since 1927 the country has invested in public financing of the aviation industry some 120,000,000 dollars. Total profits for 1937 will be about 10,000,000 dollars. Then there is a large amount of capital which was invested before 1927, and important sums have gone into the industry privately, so that the real return on invested capital is rather slim.

We will leave conclusions to our readers.—A. K.

ON ITS OWN "BOTTOM"

ONE of the strangest freight shipments ever made in the United States recently completed its long journey from The M. W. Kellogg Company's plant in Jersey City, New Jersey, to Whiting, Indiana. It consisted of four coking drums, the dimensions of which prohibited shipment by rail, steamer, or barge. Careful check-up of bridge clearances, channel depths, and so on,

proved the feasibility of launching the drums into New York Bay at Jersey City and towing them to Whiting by way of the Hudson River, the New York State Barge Canal, up Lake Erie to Detroit and on through Lake Huron into Lake Michigan to Whiting.

As each drum was 60 feet long and 16 feet in diameter, and weighed 175,000 pounds, it was necessary to load them on special flat cars at the Kellogg Plant for transfer to New York Bay, where they were lowered into the water. The immense diameter of the drums not only necessitated the entire suspension of all other railroad traffic while they were in transit from plant to dock, but it was also necessary to build special tracks within the plant and to cut special doors in the walls to permit their egress.

The dimensions of each of these four drums are: Length 60 feet; weight 175,000 pounds; content 8900 cubic feet; wall thickness 1 1/16 inches.

SIGNS

A NEW night highway sign uses rhodium plating for its letters which shine when automobile headlights strike them. Rhodium is used because of its qualities of high reflectivity and non-corrosion.

SNAKES USED IN MEDICINE

SERPENTS twain wretched the staff of Aesculapius, classic patron of medicine; a brazen serpent upraised in the desert healed the stricken Israelites who only looked on it.

How deeply entwined with medical lore everywhere and in all times is the subtle snake, Clifford H. Pope bears witness in his new book, "Snakes Alive."

We are used to hearing, in a superior sort of way, about the weird ingredients of native Chinese drug-messes, and so are not surprised to learn that the Chinese pharmacopeia includes snake "slough, skin, bile, flesh, fat and oil, head, eyeballs, eggs, and bones." Yet "snake oil" is still a widely sold commodity in these Enlightened States of America—and it is usually faked at that!

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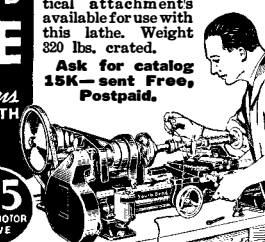
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Federal seizure and condemnation of "rattlesnake oil liniment" that contained "little, if any, snake oil" is a matter of recent record. And in France a "treacle" of snake-ingredients survived as an official remedy as late as 1884.

Two hundred years ago, a favorite English remedy for scurvy was "viper bread," which contained powdered viper's flesh and sarsaparilla, while for inducing a sweat physicians recommended "compound tincture of vipers" which was declared very successful in the Great Plague of London in 1665.

In 1685 Madame de Sévigné, one of the most cultured of Frenchwomen, recommended vipers in one of her famous letters:

"They temper, purify, and refresh the blood. But real flesh must be used, not the powder. Ask M. de Boissy to send you ten dozen vipers. . . . Take a couple every morning, cut off the heads, have them skinned and chopped up and stuffed in a chicken. Do this for a month, and then blame your brother if M. de Grignan does not become as well as we could wish him to be."

QUARTZ "PIPES"

HOMES of the future may be illuminated by a network of transparent quartz rods which transmit the light from a single bulb, suggests a scientist. The quartz rods would act as pipes, the light "flowing" through them as does water through an iron pipe.

IDLE LAND MAY YIELD A PROFIT IN TIMBER

ONE of many examples of idle land which has been made to yield good returns by planting it to trees—and letting the trees grow into money—is in the files of the United States Forest Service.

A New England farmer owned a three-acre sidehill pasture that was practically worthless. He set out 1400 seedling white pines on the hillside. Twenty years later the farmer died, and among his assets was this small tract of young pine. Much to her surprise, his widow was offered 300 dollars for the tract and sold it. About 15 years later a lumber company paid 1000 dollars for it.

MAKING WATER WET

DESPITE its universal reputation for wetness, water can be improved in this respect by the addition of what are called wetting agents. The applications of these materials which reduce the surface tension of water range all the way from fire extinguishing liquids, soaps, adhesives, insecticides and dust prevention to lead pencils and shampoos.

Many chemical reactions useful in industry are performed more easily, according to P. E. Hattinger in a recent article in *Chemical Industries*, by the addition of wetting agents to improve the contact between a water solution and an oily material. The effectiveness of fire extinguishers depends upon securing intimate contact between water and the combustible material. This is improved by the addition of a wetting

agent. Adhesives stick tighter and spread more evenly if a small amount of wetting agent is included in their composition. This may be included in the dry material or added to the solution.

Wetting agents are necessary in practically all agricultural insecticide and fungicide mixtures. By securing a complete wetting of the plant by the poison the effectiveness of the treatment is greatly improved. Indeed, some of the wetting agents used (lauryl rhodanate, for instance) are of themselves poisonous. Similarly, when the problem is to remove the insecticide from the fruit after it has served its purpose, wetting agents again make the task easier.

Dust explosions in mines are minimized by the addition of small amounts of wetting agents to the water used to spray down the dust. Patents have recently been granted to a German lead pencil manufacturer covering the inclusion of a wetting agent in the pencil leads to improve their properties. Numerous shampoos avoid the use of soap by including a wetting agent which leaves no residue on the hair.

Among the most important of the modern synthetic wetting agents are alcohols made from the acids of fats and their sulfuric acid derivatives as well as a number of sulfuric acid derivatives of coal tar and petroleum products.—D. H. K.

TINY BALL BEARINGS, SIZE OF PIN HEAD

TINY, precision ball bearings are now being manufactured in Switzerland, reports *Science Service*. In overall size, including the ball race, they are no longer than the head of a pin. They can be substituted for jewel and plain bearings in all forms of clockwork, motors, delicate machines, and sensitive measuring apparatus.

They are particularly useful for aviation instruments because they can withstand shock and vibration better than jewel bearings. Tests on the reduction of friction obtained have been made for comparison with jewel and plain bearings. The ball bearings have an extremely low coefficient of friction so that only approximately the same force is required for starting as for running.

The smallest ball bearings now available (1.5 millimeter diameter) have three balls and the larger ones have eight. It is claimed they operate satisfactorily up to 10,000 revolutions a minute. Only 15 percent as much oil is needed for lubrication as is required for plain bearings, so that they do not need lubrication for years in a small unit. The machined accuracy of the bearing is plus or minus 1/10,000 of an inch.

UNPASTEURIZED MILK STILL CONSUMED BY MORE THAN HALF OF UNITED STATES

MORE than one half of the 123,000,000 people in the United States are still consuming potentially dangerous raw, or unpasteurized, market milk even though the public health importance of milk pasteurization has long been established. Dr. James A. Tobey, prominent New York health expert, recently told the annual convention of the International Association of Milk Dealers. Only about 47 percent of the fluid

milk produced in this country is pasteurized.

"In 1936 there were 42 epidemics of milk-borne diseases in the United States, involving 1547 cases of preventable diseases, and 28 unnecessary deaths, as reported by the United States Public Health Service," said Dr. Tobey. "In every instance these unfortunate outbreaks of typhoid fever, septic sore throat, scarlet fever, and other communicable diseases were caused by infected raw milk of low grades. The only gratifying feature about these epidemics is the fact that the number is less than the country's average for the past 10 years, indicating a gradual improvement in the small town and rural milk supplies in which most of these outbreaks occur.

"Although the organized medical profession, as represented by the American Medical Association, strongly advocates pasteurization, many individual physicians do not seem to realize the significance of this necessary process. In some parts of the country, education of the professional man in this respect is as much needed as is education of the presumably more ignorant layman.

"The opinion was once prevalent, and is not yet wholly dispelled, that pasteurization is merely a corrective for an impure milk supply. Today that idea is a delusion, for pasteurization is not, and is not intended to be, a substitute for sanitation in milk production. The process renders a clean milk safe and helps to guarantee its purity, but it does not in any way obviate the necessity for an original milk supply of high quality.

"Another common delusion has been the erroneous idea that pasteurization exerts an adverse effect upon the nutritive properties of milk. Actually, however, milk that has been pasteurized by modern methods is virtually equivalent in food value to raw milk."

ELECTRIC EELS

ELECTROPHORUS electricus, the electric eel, can produce up to 500 volts. A baby eel only eight inches long can produce a voltage equal to that used for electric lights in the home, while one a yard long can produce the higher voltage mentioned above.

"IN THE FULL OF THE MOON"

RURAL folklore the country over declares that moonlight has some sort of effect on crop growth. Whether it is stimulating or depressing depends on the local variation of the superstition. Certainly the actual effect—if there is any—must be small, but plant physiologists have not been absolutely sure that it might not exist. When all the factors that influence plant growth are considered, it becomes very difficult to assign any values to this one factor.

Some elements of the problem have just been attacked in experiments with the effects of polarized light on plants conducted in the Division of Radiation and Organisms of the Smithsonian Institution. The results are reported in a paper prepared by Dr. Earl S. Johnston.

Moonlight is "polarized sunlight" reflected from the surface of the earth's satellite. That is about the only qualitative difference between moonbeams and sunbeams that science can easily put its fingers upon.

Dr. Johnston experimented with oat seedlings, measuring the quantitative effects of the two forms of light on two fundamental phenomena of plant life. One was phototropism, the tendency of a plant to bend toward a source of illumination. Thus, a sunflower "follows the sun."

This behavior is explained by the finding that growth is slightly inhibited on the illuminated side. The tip of the plant bends in the direction of least growth. Thus a measure of the amount of phototropism induced becomes a rather delicate measure of the growth-inhibiting effect of different wave bands and intensities of light.

The other was carbon-dioxide assimilation. The basic phenomenon of plant growth is the capacity for taking carbon dioxide out of the atmosphere and making use of it, through the fundamental process of photosynthesis, in the formation of carbohydrates (sugars and starch), which are the food substance of the plant itself, as well as the basis of all life.

A plant's carbon-dioxide assimilation capacity has been found to vary quite markedly according to intensity, wavelength, and time of illumination.

If a difference could be found in either of these processes dependent on the polarization of light, some basis might be established for the supposed lunar influence found in folklore.

Dr. Johnston used polarized and non-polarized light in carefully balanced amounts from one electric lamp and tried to "balance" their effects. He found no difference whatsoever, he reports, within the limits of experimental error. If there is any difference it must be sought in relation to some other factor in plant growth, or to some quality in moonlight other than polarization.

ALLOY RADIUM BOMBS

TO avoid danger from the radiations of radium, it has been customary to keep this element in heavy lead bombs which confine the radiations. Recently a new alloy, half again as heavy as lead, has been formed of tungsten, nickel, and copper, which is more efficient than lead for this purpose and thus permits smaller bombs to be used safely. The new alloy has a tensile strength higher than that of mild steel, resists corrosion, and takes a high polish. Other uses for it are in balancing crank shafts of racing cars, gyroscopes, and other rapidly rotating parts.—D. H. K.

HEART DISEASE STRIKES DOCTORS TWICE AS OFTEN

HEART disease is much commoner among doctors than bankers or any other occupational group. The reason is to be found in the heavy strain under which the doctor or surgeon constantly labors, explains Dr. Harry L. Smith of the Mayo Clinic.

What is a crisis for the banker or the business man is more or less a routine for the doctor. The physician's and, especially, the surgeon's daily responsibilities are near-

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ly as intense as those of the banker when there is a run on his bank. This is Dr. Smith's explanation of the fact that physicians suffer so much more frequently from coronary sclerosis than do persons in other occupations. In fact, this type of heart disorder is sometimes called the "disease of doctors."

Recently Dr. Smith made a comparative study of the incidence of coronary sclerosis among physicians, bankers, lawyers, clergymen, laborers and farmers who came to the Mayo Clinic. About 300 men in each of these occupations were examined; their average age was approximately the same. Coronary sclerosis occurs among doctors twice as frequently as in any other occupation, his study showed. It occurs four times as often as it does among laborers and farmers and about twice as often among bankers, lawyers, and clergymen as among laborers and farmers.

Stress, strain, and worry are called predisposing causes of this disease, which figures hardly at all among the manual laborers and is highest among those who do mental work.

In partial explanation of his findings, which are reported in the *Journal of the American Medical Association*, Dr. Smith declares: "A physician's schooling is long and intensive compared with that of the average banker and business man. A doctor has used up a great deal of nervous energy by the time he has finished school. The nature of his work is much more strenuous, for oftentimes the responsibility of life itself is on his hands. A physician's routine work, which includes ordinary obstetric cases with complications, broken legs, severe cardiac diseases, scarlet fever and diphtheria among children, and pneumonia among the aged, and the responsibility of the surgeons, which is probably greatest of all, is actually or nearly as intense as that of the banker when there is a run on his bank."—*Science Service*.

ABRASION-TESTING OF SURFACES

HOW long will the finish on a product withstand wear and abuse? How does a competitive product check with the claims of the salesman and with the material one manufacturer is now using? These and other questions of a similar nature are vital in the determination of what paint, lacquer, or metal plating should be used in finishing a product. They may be answered by abrasion testing the surface with the Taber Abraser which has been developed by the Taber Instrument Company.

As shown in an accompanying illustration, the Taber Abraser is a light, compact instrument. It gives a numerical wear rating to the tested specimen in terms of "wear cycles." The mechanism consists mainly of a power driven specimen holder, a reset counter, two ball-bearing pivoted pendulum arms, on which are mounted wheels made of a special resilient abrasive composition. The wheels are offset relative to the center of the specimen holder, resulting in a unique criss-cross abrading action as one wheel rubs from the inside of the wear pattern outward and the opposite wheel from the outside inward. This rubbing action is comparable to the wear materials receive under actual service conditions. The motor drives



To test abrasive resistance

the specimen through approximately 50 wear cycles per minute and ordinary materials have a range of 100 to 2000 wear cycles (2 to 40 minute test), depending on their durability. The life of the abrasive wheels averages better than 50 tests, depending, of course, on the type and durability of the materials tested.

The toughness and adhesion test assembly with standardized tungsten carbide tipped cutting tool determines the dig resistance, toughness, and adhesion of enamel finishes. The special contour blade removes the enamel coating down to the metal specimen plate under a loading indicated on the scale beam. Toughness or dig resistance is rated by the load required to drive the tool completely through the coating. Poor adhesion is indicated when the enamel chips away from the specimen plate as the sharp edge of the tool shaves through the coating. The continuity of the shaving peeled off is also an indication of the elasticity of the enamel finish.

HEAT TREATED PHOSPHATE FERTILIZER

THE rate of cooling of heat-treated phosphate rock after its fluorine content has been removed by calcining with steam affects the availability of its plant food content. If treated phosphate rock is cooled quickly the proportion of its phosphoric acid content available to plants may be above 90 percent, whereas if it is cooled slowly its phosphate content may largely return to an insoluble form which plants cannot use.—*D. H. K.*

HIGH TEMPERATURE ELECTRIC FURNACE ELEMENT

AN electric furnace element capable of operating at 3000 degrees, Fahrenheit, was recently exhibited under operating conditions in Pittsburgh. The element has been developed by Dr. Paul Schwarzkopf, a famous pioneer in powder metallurgy, in his laboratories at Reutte, Austria. The makers claim that such elements, after operating 4400 hours at a temperature of 3000 degrees, Fahrenheit, have shown no evidence of deterioration. As a result of tests made in Europe, the element appears to be resistant to hydrogen, oxygen, hydrocarbon, and sulfur and its combinations. The element holds

out much promise of being used in air, neutral, reducing and oxidizing atmospheres, in vacuum, or even in sulfurous atmospheres. It should, therefore, be suitable for use in glass and ceramic furnaces, as well as in the metal industry.

If the element has all the characteristics claimed for it, it will open a much larger field for the use of industrial furnaces and might in time even be used in the electric kitchen stove, where it would give the electric stove the quick cooking characteristics of the gas stove. The present tests, however, will be confined entirely to the use of the new element in industrial furnaces. The elements now in use in electric furnaces can not reach higher temperatures than about 2400 degrees, Fahrenheit, and have certain disadvantages which the new element does not seem to have.

DEEP WELLS REPLACE RAIN DANCE

THE rhythmic clank of the drilling rig is successfully displacing the tomtom of the rain dance as a means of getting irrigation water for the sun-cursed desert lands at Acoma Pueblo, New Mexico, reports the Department of Interior.

Ancient legends, telling of a fertile land watered by springs, in the present site of the desert farms of the Pueblos, gave the engineers a hint of possible underground water. Early failure by the drillers seemed to disprove the ideas, but on the advice of the older Indians, engineers drilled a well 1500 feet deep, in a site chosen by the tribesmen.

Seven hundred gallons a minute of pure, soft water gushed forth to prove that the Indians were right in their advice. After this preliminary success, more than 180 wells were drilled to a depth averaging 500 feet.

With a co-operation strangely in contrast

to the wars of only a few generations ago, Indians are doing much of the work on drilling these wells, and by agreement with the Indian Service, they will bear the cost of maintaining the wells and ditches and operating the pumps.

These wells will soon usher in a new era in Indian agriculture, lifting it from sub-marginal in character to profitable, and making Acoma Village self-supporting again, as it was in the distant past before the coming of the white man. Water, to the Indians of the arid southwest, is as important as the "black gold" petroleum of the oil fields; it spells, in fact, life itself.—*Science Service.*

STEEL PRODUCTION

THE United States continues to lead the world in steel production. Figures published in *Steel Facts* show that our production more than triples the second country on the list, and for the first six months of 1937 was 41.9 percent of world production. The tabulation follows:

Country	Year 1936	% of 1st 6 Mos. 1937 Total
United States	47,768	41.9
Germany	18,856	13.5
Russia	16,083	12.3
Great Britain	11,785	9.1
France	6,595	5.5
Japan	4,945	4.1
Belgium	3,125	2.6
Italy	2,291	1.5
Luxembourg	1,950	1.9
Czechoslovakia	1,535	1.6
Poland	1,123	0.9
Canada	1,078	1.0
Sweden	964	0.8
Estimated Other	3,902	3.3
Estimated Total	122,000	100.0

CURRENT BULLETIN BRIEFS

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

MICROSCOPE EQUIPMENT FOR THE AMATEUR is a 20-page pocket size booklet which describes and illustrates not only microscopes and such equipment as lamps and micro projectors, but also gives some details regarding microscopy as a personal hobby. Prices are quoted on the microscopes and equipment. *Write for Bulletin 138A, Scientific American, 24 West 40th Street, New York City.—3 cents.*

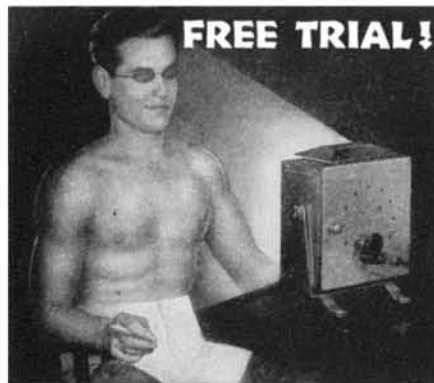
DIRECTORY OF MATERIALS tells where to buy iron, steel, and non-ferrous alloys, plastics, and other nonmetallic materials as utilized in the design of machinery of all types and sizes. It lists 336 trade-named materials embodying 654 different alloys. Nonmetallic materials show 113 trade-named types with 18 individual grades. *Machine Design, Penton Building, Cleveland, Ohio.—25 cents.*

MODERN PLASTICS, Handbook and Catalog Number, Volume 15, Number 2, contains a comprehensive series of articles on various types of plastics, together with advertising that is equally as interesting as the text.

The section on product development covers the automotive, aviation, and electrical fields. 342 pages, profusely illustrated. *Breskin & Charlton Publishing Corporation, 425 Fourth Avenue, New York City.—\$2.00.*

REFRIGERATION, a textbook for home study, is a multigraphed booklet that illustrates and describes the operation of the various types of modern refrigerators and gives hints regarding the correction of troubles that may be encountered. This is an ideal booklet for those who are sufficiently mechanically-minded to want to know something about the operation and repair of household refrigeration equipment. *Write for Bulletin 138B, Scientific American, 24 West 40th Street, New York City.—50 cents.*

PERTINENT QUESTIONS AND ANSWERS CONCERNING DUSTS is especially concerned with those dusts that contain free silica and cause the disease of the lungs known as "silicosis." The text is in question-and-an-



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SMITHSONIAN INSTITUTION ANNUAL REPORT for 1936 is a book containing 23 outstanding scientific articles reprinted from different sources and bearing on astronomy, northern lights, radioactivity, low temperatures, evolution, gorillas, bats, birds, aerial photography, petroglyphs, and other general scientific subjects. *Superintendent of Documents, Washington, D. C.—\$1.50.*

AMERICAN BEER AND ALE, A Handbook of Facts and Figures, gives the answers to many questions about beer and ale which could not otherwise be found without considerable research. The chapter headings give the scope of the book; Definitions, History and Development, Raw Materials, Processes of Production, Health and Moderation, Production and Consumption, Taxes and Allocation, and Brewery Employment. *United Brewers Industrial Foundation, 21 East 40th Street, New York City.—Gratis.*

THE MICROSCOPE is an attractive new journal of microscopy and photomicrography, published monthly and suitable for the serious amateur. *Arthur Barron, Ltd., 20 Took's Court, Cursitor Street, London, E. C. 4, England.—12 shillings yearly.*

CLEAR RECEPTION is a folder which deals specifically with the suppression of background noise in radio receivers. It tells how such noises reach the receiver and how they may be stopped either at the set itself or at the noise source. *Write for Bulletin 138D, Scientific American, 24 West 40th Street, New York City.—3 cents.*

OIL BURNERS FOR HOME HEATING discusses the various types of burners now on the market and particularly the question of obsolescence. Almost any questions that oil burner buyers may ask regarding burners and their efficiency are discussed. Circular 406 of the Bureau of Agriculture, *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

GARDEX "SOIL-FLOW" TOOLS is a new catalog that will turn your thoughts toward next spring's gardening operations. It describes and illustrates a line of gardening tools that are new in conception. The use

of these tools is claimed not only to be easier on the gardener, but to produce better results with less work. *Gardex, Inc., Michigan City, Indiana.—Gratis.*

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THE RAILWAY HANDBOOK, 1937-1938, compiled under the direction of the Editor of *The Railway Gazette*, is a collection of data regarding the railroads throughout the world. It gives the history of many of the more prominent lines and shows tables of figures on railway mileage, electrification, longest railway tunnels, speed records, Diesel equipment, and so on. *The Railway Publishing Company, Ltd., 33 Tothill Street, Westminster, London, S. W. 1, England.—Two shillings and sixpence.*

CONDOR COMPENSATED BELTS is a new illustrated four-page bulletin describing the reasons for compensating rubber belts and giving the principle on which they are designed. Engineering data essential to the proper selection, application, and supervision of belts is also included. *The Manhattan Rubber Mfg. Division, Passaic, New Jersey.—Gratis.*

ALUMINUM PAINT, ITS USES AND APPLICATION, is of particular interest to the managements of various types of plants and factories, inasmuch as it deals largely with the use of aluminum paints not only to protect plant walls, water tanks, structural steel and so on, but also to increase the light-reflecting ability of walls and hence the general lighting of an interior. Home owners will also find much of value, as a portion of the booklet is devoted to uses of aluminum paint as a priming coat on wooden surfaces such as the exterior of buildings. *Write for Bulletin 138F, Scientific American, 24 West 40th Street, New York City.—3 cents.*

RCA RESEARCH AND DEVELOPMENT is a running story of the work that is being done by the Radio Corporation of America in the development of the art of communication. *Radio Corporation of America, 30 Rockefeller Plaza, New York City.—Gratis.*

LEGAL HIGH-LIGHTS

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

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

New York Bar
Editor, Scientific American

STRICT CONSTRUCTION

NORMALLY the monopoly granted by a patent is not restricted by the exact language of the claims, and the claims are construed so as to cover equivalent structures. Thus where a claim of a patent specifies that certain elements are fastened together by means of a screw, under normal conditions a pin or a rivet is considered to be the equivalent of the screw. A different situation arises, however, where, during the prosecution of a patent application, a patentee avoids a rejection of the claim by inserting an express limitation in the claim. The limitation which is thus inserted in order to obtain the allowance of the claim is considered to be essential and cannot be disregarded after the patent has been issued. To disregard the limitation would be to confer upon the patentee a monopoly which the Patent Office had expressly rejected.

In a recent case before the Circuit Court of Appeals for the Tenth Circuit, involving infringement of a patent on apparatus used in the pumping of deep wells, the Court found that the claims of the patent were not infringed because the alleged infringing device omitted an element which had been inserted in the claims in order to secure their allowance. In this connection the Court stated:

"Where an applicant is compelled by rejection of his application to narrow his claims by the introduction of a new element in order to secure the patent, he is bound by the narrowed claims and cannot subsequently to the issuance of the patent broaden them by dropping the element which he is thus required to include."

INTERCHANGEABLE

IN the absence of limitations of the type referred to under "Strict Construction," a liberal interpretation is given to a patent and a patentee is not restricted to the apparatus disclosed in the patent. This is exemplified by a recent suit for patent infringement involving electric clocks operated on public lighting circuits. In a clock of this character any failure in the electric current causes the clock to stop, and when the current is resumed the clock again begins to operate, with the result that the time indicated is often inaccurate. The patent in suit relates to an indicator which operates upon the failure of the electric current. The indicator shown in the patent in suit consists of a pendulum normally held out of sight by means of a solenoid. The pendulum and solenoid are so arranged that when the current fails the pendulum swings into view due to the attraction of gravity, thereby giv-

ing visible notice that the time displayed by the clock is not accurate.

In the suit under consideration the defendant also employed an indicator operating upon the failure of the electric current. Instead of depending upon the attraction of gravity to cause the indicator to shift into view, however, the defendant employed a spring. It was contended by the defendant that since he employed a spring instead of depending upon the attraction of gravity his clock did not infringe the patent. The Court rejected this contention, however, and held the defendant's clock to be an infringement of the patent, and in this connection stated:

"The force of gravity and a spring, when they accomplish the same result in substantially the same way, have long been regarded as typical equivalents. Indeed, the interchangeable use of weights and springs is the stock illustration for equivalents."

WITHOUT PRECISION

PATENT law is not an exact science and it is often difficult to answer questions relating to this subject with mathematical precision.

The rules of law relating to patents appear on the surface to be relatively simple and understandable. The principal difficulty arises in determining which rule to apply to a given state of facts. This difficulty frequently arises in connection with the question of whether a new combination of old elements is a patentable invention.

In a recent *Federal Reporter* appear two decisions of different United States Circuit Courts of Appeals which contain statements that appear to be in conflict. One decision states:

"Combining old devices into a new design does not amount to a new invention. Putting the lint flue under the ginhouse floor involves only mechanical judgment. The conclusion we reach is that the patent is void for want of invention."

In this case the Court appears to say that a combination of old elements does not amount to invention.

In the second case the Court had the following to say:

"It is true that Tily selected the essential elements of his combination, such as the dies for cupping or corrugating the material, and tags to be pinned, the guide slots through the dies as a pathway for the pin, and a rudimentary pin driver from the prior art, but if the result was novel and useful it was not unpatentable."

In the second case the Court held that a combination of old elements was a patentable invention.

Actually there is no conflict between the

two cases. The general rule is that a combination of old elements does not amount to invention where the elements operate in their usual and expected way to produce the expected results. A patentable invention does arise, however, from a new combination of old elements where the elements acting in co-operation with each other produce an unexpected, new, or improved result. In the first of the two cases referred to above the Court was of the opinion that the elements did not produce, in combination, an unexpected, new, or improved result, and accordingly the patent was held to be invalid.

In the latter case the Court was of the opinion that an unexpected, new, or improved result did flow from the new combination of old elements and the patent was held valid.

PRIVATE CODE

A CABLE or telegraphic code may be protected by copyright according to a recent decision of a United States Circuit Court of Appeals.

The plaintiff in the suit had prepared a cable and telegraphic code which he had published in book form and copyrighted in 1912. The plaintiff had originated some of the phrases in his code and others he had selected from previous codes and then compiled them in alphabetical arrangement. The Court held that the copyright was valid both as to the portions compiled from previous codes and as to the portions originated by the plaintiff. In this connection the Court stated:

"Both the phrases, so far as they were his, and the arrangement were proper subjects of copyright."

The defendant published a similar code and the Court found that portions of the defendant's code had been copied from the plaintiff's copyrighted code. The defendant was adjudged to have infringed plaintiff's copyright and plaintiff was awarded statutory damages of 5000 dollars and also counsel fees of 2750 dollars.

This case illustrates an interesting aspect of our copyright law; namely, that a court has the power to award counsel fees to the prevailing party.

OCTANE RATING

THE term "Hi-Octane" has been refused registration as a trademark for gasoline on the grounds that it is descriptive of a type of gasoline.

A prominent distributor of gasoline applied for trade-mark registration on the term "Hi-Octane" and after it was refused by the Patent Office an appeal was taken to the Court of Customs and Patent Appeals. This Court sustained the Patent Office, pointing out that the prefix "hi" means *high* and that, accordingly, the term was equivalent to *high octane*. By reference to a number of technical and trade journals the Court showed that high octane was used in designating a type of gasoline, and that accordingly it was purely descriptive. For this reason the Court held the mark was not registrable.

It is interesting to note that in the course of its decision the Court referred to the *Scientific American* for August, 1932, which contained an article on octane rating of gasoline. It was partially on the basis of this article that the registration was refused.

Books SELECTED BY THE EDITORS

THE ADVANCING FRONT OF SCIENCE

By *George W. Gray*

A LITTLE army of only 100,000 men, in a world of 2,000,000,000, or one human being in 20,000, is the army of scientists who are advancing like a forest fire across the No-man's-land of ignorance and darkness and rapidly changing the face of the world we live in. So



George W. Gray

rapid is the advance and so varied the terrain that but few, even among the army of scientists themselves, can survey or even comprehend the whole scene. Mr. Gray, the author, is one of a mere handful of writers who are not professional scientists but who have the breadth and depth of insight into all the fields of science to report intelligently the great panoramic advance. Because of past performances in which all sensationalism and overstatement have been avoided, he has the entrée to all the laboratories and scientific institutions, also the full confidence of the scientists to the extent that they personally co-operate with him in seeing that his interpretations are not mere passable approximations of truth.

This latest book of his is strictly a reporter's job; he sweeps the whole horizon of science from astronomy and physics and chemistry to biology and its branches. He avoids mere retelling of encyclopedic facts and concentrates on what is news, and it is truly remarkable how much news he has embodied in this book. In any field it answers with a wealth of description the question, "What are the scientists doing now?" No wonder it is a Scientific Book Club selection; it deserves to be; and, in fact, if it does not turn out to be the whole year's best scientific book this reviewer will invite its author to luncheon and eat a copy of it without salt or sauce.—\$3.20 postpaid.—*A. G. I.*

THE MODEL RAILROADER CYCLOPEDIA (1937)

Edited by *A. C. Kalmbach*

A FIRST quick glance through this volume is enough to make one realize what it is about the hobby of model railroad building that fascinates so many thousands of people. Here we have many pictures of the puffing giants of the rails and a great many simplified

drawings for the use of those who wish to make miniature models of some of the latest designs. Steam engines, freight and passenger cars, electric locomotives, and electric trolley cars are shown in these drawings. In addition, there are construction diagrams for gate towers, tool supply houses and all the appurtenant equipment to make a complete model railroad. Cloth cover \$2.15 postpaid; paper cover \$1.65 postpaid.—*F. D. M.*

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By *A. L. Dyke*

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CHINA AT WORK

By *Rudolf P. Hommel*

AN author who obviously knows his mechanics describes in detail and at considerable length (366 large pages, 535 photographs taken on the spot by himself) all the tools and implements such as have been used by the Chinese people for thousands of years—their shop tools, tools for procuring food, making clothing, building, and for enabling transport, all in vast detail and variety. The effect of reading this splendid book is as though a man thoroughly familiar with China took the reader on a shop

tour of the interior and showed him the plain people at work at all their trades. Some of the tools are decidedly surprising and, from some of them, Occidentals might obtain valuable pointers. The Chinese do not like to be photographed, an objection they extend even to their tools, and thus the feat of getting these intimate photographs was remarkable; they even object to the measurement of their tools, and so the author had secret marks on a cane used slyly for that purpose. This reviewer spent many fascinated hours over this book.—\$5.25 postpaid.—*A. G. I.*

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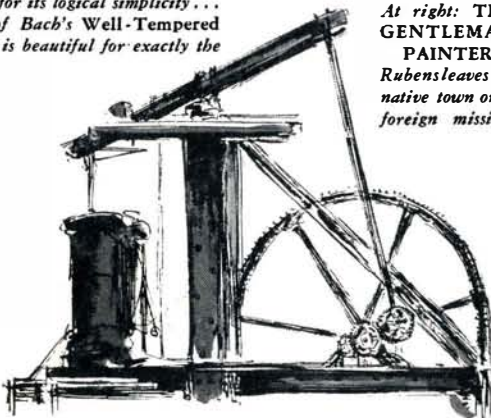
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