'IDEA CENTER' OF MECHANIZED WAR . . . Page 249

SCIENTIFIC AMERICAN

JUNE • 1943

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Bamboo, a 435-Pound, Tomato-Throwing Gorilla . . . See page 246

Would you turn your back on a wounded Soldier?

You think you wouldn't...you don't mean to...

But unless you are giving every precious minute of your time...every ounce of strength that you can spare...towards helping win this war as a civilian, you are letting down those soldiers who are sacrificing lives to win it for you.

What you are asked to give up isn't much compared with what they're giving up. The extra work you undertake is small compared with the gigantic effort they are making. But to a wounded soldier, what you do can mean the difference between life and death.

You make the choice.

LOOK AROUND YOU! *Pick your war activity—and get into it! In your local Citizen Service Corps or Defense Council there is something for every man, woman and child to do. If no such groups exist in your community, help to organize them. Write to this magazine for free booklet, "You and the War," telling what you can do to help defeat the Axis. Find your job—and give it all you've got!*

EVERY CIVILIAN A FIGHTER

BAMBOO, weightier of Philadelphia's two fine, vigorous gorillas, has a fascinating habit of pitching bananas, tomatoes, and watermelons at some whose looks he doesn't happen to fancy, with such fine control that they learn to keep their distance. His kind of fun. The article on page 246 tells more about him.

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SCIENTIFIC AMERICAN

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NINETY-NINTH YEAR **ORSON D. MUNN, Editor**

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JUNE • 1943

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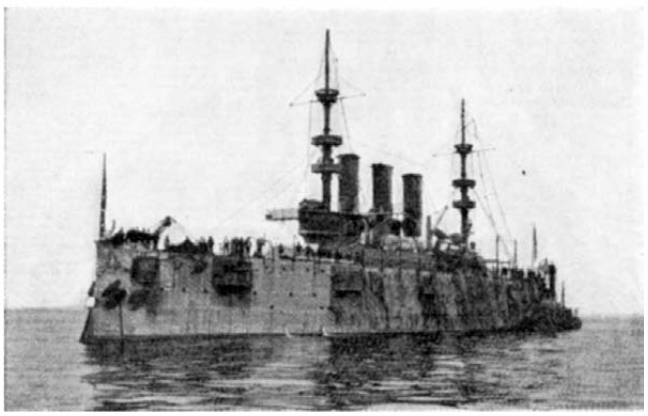
50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of June, 1893)

SUBMARINE BLASTING—"The most extensive submarine blasting operation ever undertaken for the improvement of a harbor was that for the removal of the rocks known as Hell Gate, which obstructed the passage between New York Harbor and Long Island Sound. The works for the final operation in removing the middle reef consisted of the excavation of 21,669 feet of galleries through the rock, of an average section of 10 feet square, and involving the removal of 80,232 yards of rock by blasting. The total quantity of roof and pillars remaining to be shattered by the final explosion to a depth of 30 feet amounted to 270,717 cubic yards. The number of cartridges placed in the holes was 42,500, containing 240,399 pounds of an explosive consisting of potassium chlorate and nitrobenzol and 42,331 pounds of dynamite."

CRUISER—"Never before in the history of our navy has the trial trip of a war vessel attracted such general attention as was excited by the final speed test of the new cruiser New York. . . The performance of the engines, boilers, and accessories was excellent. . . Not a journal heated unduly nor was any water



used on bearings except as a matter of precaution. . . Her ram bow and high freeboard are conspicuously noticeable as the vessel is seen at anchor, the 8 inch rifles she carries being 25 feet above water. . . She has also twelve four-inch rapid fire guns, eight rapid fire six pounders, four rapid fire one pounders, and four Gatling guns, besides six torpedo tubes, one in the bow, one in the stern, and two on each broadside."

INDUSTRIAL CHEMISTY—"Chemists turn scrap iron into ink, old bones into lucifer matches, the shavings of the blacksmith's shop into Prussian blue, fusel oil into oil of apples and pears, the drainings of cow houses into fashionable perfumery, beggars' rags into new pilot coats, cesspool filth into ammonia, and tar waste into aniline dyes and saccharine."

ENGINES—"The triple expansion engine for ships was first designed by Peter Ferguson (of Fleming & Ferguson, of Paisley), who fitted them on board ship in 1872. To the late Dr. Kirk, however, is due the general adoption of this class of engines, through the clearness with which he demonstrated their superior economy."

LIGHTSHIP WAS ANSWER—"The Lighthouse Board of the Treasury Department has not given up the project of erecting a lighthouse on the outer Diamond Shoal, off Cape Hatteras. The shifting sands of the ocean bottom at this point, combined with the frequency and the violence of storms and the difficulty of getting material to the ground, conspire to make the erection of a lighthouse there more difficult than any undertaking of the kind that has ever been attempted in the world before."

STONE-CUTTING—"French ingenuity has contrived an improved stone-cutting saw of remarkable efficiency—a circular saw having its edge set with black diamonds in the same way as the straight blades; but as the strain on the diamond is all in one direction, the setting can be made much firmer."

ALWAYS ROOM—"We hear so much about the material progress of the age, our wonderful inventions and the great discoveries that are destined to be of untold benefit to man, that it is well sometimes to take a look through the big end of the field glass and see how little really has been accomplished in comparison with what remains to be done. For in truth we have but scratched the surface of the globe to a very small extent. The north temperate zone alone has begun to be developed, and it is only a beginning—the wastes of Siberia still lying practically uncultivated—while the south temperate zone and the tropics are scarcely touched, with their untold wealth of animal and vegetable products, besides the undoubted mineral resources which they contain. . . The lesson of it all is that there is always room for discovery and that we are nowhere near the exhaustion point of the earth's resources."

PRE-SPARKPLUG—"Ignition tubes for gas engines are now made of a composition consisting of kaolin, chalk, sand, and feldspar. These materials are ground up with water before being mixed, and the coarser particles are allowed to subside; the creamy fluids containing the finer particles in suspension are then mixed and allowed to settle. The paste deposited at the bottom is drained, kneaded, and stored for some months in a damp place. It is then moulded into the required shape, and dried by exposure to the air. The tubes are then packed in cylindrical cases of clay, and heated for fourteen days by the flame of a wood fire. Such tubes have lasted 546 days and showed no signs of wear, whereas a wrought iron tube is often destroyed in three days."

ROADS—"The centralization of power and its distribution by the trolley system have inaugurated a cheap and rapid transportation system for suburban and even rural districts. The country roads have been invaded by the trolley. . . Simultaneously the movement for good roads has mounted into a national issue. All over the country are heard the calls for better roads. . . The ideal road has been claimed to be a Telford or macadam strip with a trolley line on each side. This provides for those who wish to pay fare, while the farmer can transport his product by the old-fashioned way. It is a self-evident fact that horses must become accustomed to the trolley car . . . Already local steam roads have been seriously affected by the competition with trolley roads . . . The next generation will only be able to wonder how its ancestors continued to exist under the regime of slow horse cars."

WOOD PRESERVATIVE—"Naphthalene, which is a product of coal tar distillation, in appearance something like paraffin, has been found useful in England for the preservation of timber."

He can smile through it all

So let's keep a smile a-going back here, too.

Even though war is crowding the wires, telephone people still want to give you pleasant, friendly service. Materials for new telephone facilities are not to be had. But there's no shortage of patience and understanding.

Takes a lot of pulling together to do this and we appreciate the help from your end of the line.

BELL TELEPHONE SYSTEM

WAR CALLS COME FIRST

• Your continued help in making only vital calls to war-busy centers is more and more essential every day.

OUR *Point* OF VIEW

SMALL INDUSTRIES ALSO SHINE

THE IMPORTANT fact that individual initiative is far from dead in these United States is daily being more and more forcefully brought out by charily released information on the progress of war production. First to receive the Army-Navy "E" award among manufacturers were, of course, the larger industrial plants. They were more flexible in operation, had greater resources, could stand momentary losses; therefore, they could more readily convert to war needs. But soon came word that smaller plants were in line for the coveted pennant. They, too, were showing their mettle, were proving that not big business alone could do the things which had to be done to assure victory for the United Nations. And some of them were surprisingly small; at the time of writing, the "E" had just been presented to a six-man plant engaged in precision instrument production. This is not the lower limit of size, however. Records show that this plant is the third smallest manufacturing unit to be so recognized for efficiency in service.

That such small plants can do their share, and sometimes more than their share, in the war effort would be accepted as a matter of course if it had not become the fashion, in recent years, to think of American industry as composed of huge corporations with millions in resources at their backs, and with thousands of employees at their beck and call. Not to be forgotten, however, is that these large companies did not spring full-blown from nothing; they, also, had their small beginnings when there was only a tiny shop and the boss worked side by side with employees.

Thus the small plants that today are showing the stuff of which modern American industry is fabricated are but carrying along the traditions of the American way. From the days of metal-worker Paul Revere through the early struggles of Charles Goodyear and the first productions of Thomas Edison to the mighty industrial empires such as that started from scratch by Henry Ford, our nation's history is replete with records of the accomplishments of the "little man."

Now, with World War II setting new industrial production goals, these "little men" are once more proving that they have the guts to fight against odds, to gamble their futures on their faith in their own ability, to give themselves whole-heartedly to the cause that demands the best in every man.

To the small manufacturers as well as the large who have earned the "E" award, our heartiest congratulations. To those who have not as yet reached that peak of perfection goes our faith that they will never let down until the pennant flies above their plants. American industry is in this fight with both fists and both feet. With the shining examples that have been set so far, failure is unthinkable.—*A.P.P.*

ENGINEERING RESEARCH IN UNIVERSITIES

A RECENT plea that industry finance university research in the fields of engineering, uttered by Prof. James Kip Finch of the School of Engineering, Columbia University, brings new attention to one of the aspects of college operations that is all too often forgotten. In the laboratories of these institutions is conducted invaluable research in many fundamentals of science that sometimes comes to public attention in the form of new industrial processes or products. Often, however, the endowment system under which most of this work is carried on is not sufficient to make the greatest possible use of the facilities available.

Thus, states Professor Finch, "the university must turn to industry for the increased support necessary not alone for the maintenance of fundamental research but to make possible that expansion of research activities which will be essential to the maintenance of both industrial as well as educational leadership in the post-war world. . . . While the situation differs in the several branches of engineering it is clear that industry must rely upon our engineering schools not only to train the personnel required in industrial research, but for all possible aid in conducting such research.

"The great bulk of development research," continues Professor Finch, "the search aimed at the development of new or the improvement of older manufacturing methods, at improved quality or lower manufacturing costs, will probably be undertaken by industry. But fundamental research usually has not such immediately practical aims. It is true that some of the knowledge that it uncovers often leads to new and patentable products or methods, but much of it is directed toward the clarification and extension of existing theory, and the reduction to a science of hitherto empirical techniques. While development research may thus become increasingly an industrial activity, it seems clear that our engineering college laboratories will continue to share the field of fundamental research with industry."

This makes good sense. Even though the research worker in industry may be as unhampered as possible in his exploration of the unknown, there is always a certain amount of restraint engendered by the knowledge that his work is closely linked with industrial needs. Never can he be completely freed from this feeling. In the cloistered laboratories of the university, however, there is less feeling of immediate need, of the necessity for turning up something of practical industrial value that can be put at once into production or other use.

It would seem to us, then, that the plea of Professor Finch is one that should not go unheeded. Properly administered and with adequate safe-guards against exploitation, such co-operative research should have tremendous value to all concerned. Industries that do not, or cannot for one reason or another, maintain their own pure-science research facilities have here an offered opportunity to participate in a branch of work that will be of great value to them in the future and that at the same time will aid in developing our over-all knowledge of the fundamentals. Organizations now doing such work in their own laboratories can benefit by similar co-operation either through an expansion of existing programs or by turning over their fundamental research to a corps of university specialists and concentrating their own resources on applied research.

No matter how the details are worked out, the suggestion has great merit and will warrant the fullest investigation and study by all industry.—*O.D.M.*

OF MANY TONGUES

MEMORY of school-boy aversions to the study of foreign languages comes clearly to mind when reading of the present educational work which the government is conducting with groups of men who are destined to take over administrative work in many fields when the war is won and the reconstruction period sets in.

Thinking along the same general lines, but apart from the immediate aims of these governmental "schools," those school-boy aversions must by now be sad history for many men. When the war is over and the peace is being won, industries of all kinds will be reaching for foreign markets. There will be a crying need in many fields for technically trained workers who also have a mastery of languages, preferably several. Only those who are equipped with the proper background will find themselves in a position to take advantage of the positions then available.

This self-evident fact makes us urge that fathers guide the thinking of their sons along these lines, that upper high-school and college students take this part of the future into consideration before shying away from languages classes.—*A.D.R., IV.*

Personalities in Science

MAJOR EDWIN HOWARD ARMSTRONG

IN THE field of radio, the name of Major Edwin Howard Armstrong is second only to that of Marconi. Recently the Edison Medal was presented by the American Institute of Electrical Engineers to Major Armstrong "for distinguished contributions to the art of electric communication, notably the regenerative circuit, the superheterodyne, and frequency modulation." With characteristic modesty, Major Armstrong accepted the Medal with the following words:

"The continuous good fortune that has followed me, providing second chances at inventions when the first chance was missed and tossed away, has been all that a man could hope for and more than he has any right to expect."

Internationally known for inventions which created modern radio and particularly for the invention of wideband frequency modulation, Armstrong is Professor of Electrical Engineering at Columbia University, and likes best the title, "a former pupil of Pupin." Thirty years ago, when Armstrong finished his engineering studies at Columbia, he became the protege of Michael Pupin, Edison Medal winner in 1920.

Armstrong was born in New York City December 18, 1890. While a sophomore at Columbia he became interested in the operating properties of the audion detector, or radio tube. Experimentation at his home in Yonkers, New York, led to his invention of the feedback or regenerative circuit, which increased the sensitivity of the audion hundreds of times as a detector of radio signals. For the first time, useful, solid transoceanic and transcontinental radio signals could be received. The initial Armstrong invention also produced for the first time continuous high-frequency oscillations by means of a thermionic tube.

These giant strides in radio started 18 years of litigation costing millions of dollars. The U. S. Supreme Court ruled against Armstrong. Disagreement with the verdict of this tribunal was expressed by the Franklin Institute, the American Institute of Electrical Engineers, and the Institute of Radio Enginers in awarding their highest honors and medals to Professor Armstrong.

The advent of 1917 found Armstrong in France as an army captain, later as a Major, with the United States Signal Corps, in charge of the technical end of Aircraft and Intelligence Radio. While serving in France he perfected his second invention, the superheterodyne circuit, magnifying the weak signals on the short waves thousands of times. This receiving system was greatly superior to any development up to that time, and is still used today in almost all types of radio receivers.

Armstrong's development of the superregenerative circuit, disclosed in 1922, was his third great invention. The superregenerative was the means of increasing the sensitivity of the regenerative some thousands of times above that normally obtained by means of simple regeneration, and made possible exploring and developing the short-wave channels, notably for two-way police and military communication systems.

Armstrong secured patents for his wideband frequency modulation invention, his fourth outstanding contribution to radio and to the world, in 1933. Through "FM," static was conquered, ultra-high-fidelity broadcasting was made practical, and there was opened the heretofore restricted territory of United States radio to the development of more stations and more networks.

Among the honors accorded Major Armstrong are the Doctor of Science Degree from Columbia in 1929 and from Muhlenberg College in 1941; the Medal of Honor of the Institute of Radio Engineers in 1917; the Egleston Medal of Columbia University, 1939; the Holley Medal of the American Society of Mechanical Engineers, 1940; the Franklin Medal of the Franklin Institute, 1941; and the John Scott Medal awarded by the Board of Directors of the City Trusts, City of Philadelphia, 1942. The French government made him a Chevalier de la Legion d'honneur in 1919, and he received one of the 19 national awards of "Modern Pioneer" by the National Association of Manufacturers in 1940.

Major Armstrong may be found at almost any hour of the day in his office or in his laboratory in the Philosophy Building at Columbia. He is neither difficult to find nor hard to see. Rejecting any attributes of genius, Major Armstrong attributes his success in no small measure to "luck, plus a tremendous amount of hard work." His large, well-knit frame bespeaks the outdoor man rather than the laboratory worker. Armstrong's energies these days are now devoted almost entirely to aiding in the war effort—"just like everybody else," in his own words.

99TH YEAR SCIENTIFIC AMERICAN JUNE 1943

GORILLA ROUND-UP

Concerning Each of the Sixteen Living Gorillas in these United States

ROGER CONANT
Curator, Philadelphia Zoological Garden

AMERICA didn't become gorilla conscious until a circus bought a specimen called Buddy, rechristened him Gargantua the Great, and ballyhooed him all over the country. Thanks to circus publicity and the fact that, until recently, he was the only portable gorilla in captivity, Gargantua is better known than all other gorillas put together. His popularity is a real tribute to his press agents, for there are no less than 16 gorillas in the United States.

Despite his wide notoriety, Gargantua is not the largest gorilla in captivity, nor the oldest, nor the one which has lived longest outside of the African jungles. Animals now residing in American zoos are the holders of all these records.

Ngagi, who lives in the San Diego Zoo, tips the scales at the incredible weight of 635 pounds, the greatest ever officially recorded for any gorilla. Ngagi, Cincinnati's Susie, and Philadelphia's Bamboo, each estimated to be 17 years of age, all are tied for the honor of being the oldest individuals in captivity. Bamboo also holds the record for longevity; on August fifth, this summer, he will have survived 16 years of civilization.

Gorillas are found only in Africa and two subspecies are recognized, each confined to its own special area. One, the Coast Gorilla, inhabits the hot, tropical rain forest along the Gulf of Guinea, and the other, the Mountain Gorilla, lives 600 miles away in the mountains of the easternmost part of the Belgian Congo.

Between the two beasts, coastal and mountain, there is little to choose. Each attains the same size and the technical distinctions for telling them apart consist chiefly of comparative measurements and anatomical features, points which can be determined with accuracy only after the animal is dead. In general, though, the mountain gorilla has longer, heavier hair and is more showy and desirable for exhibition. When accurate information is available on just where an individual was captured, one can class a specimen immediately, but coastal gorillas also inhabit mountains in certain parts of their range. This leads to confusion and probably more than one so-called mountain gorilla actually belongs to the other race.

Determining sex in gorillas is almost as difficult as attempting to classify a specimen of doubtful origin. Males and females look much alike and more than one lamentable mistake has been made. Martin and Osa Johnson sold a pair of gorillas to the San Diego Zoo in 1931; now both are known to have been males. Massa was delivered to the Philadelphia Zoo as a female, but "she" turned out to be "he." When the circus acquired M'Toto as a mate for Gargantua, the skeptics began shaking their heads, but it is now generally agreed that this animal is a female.

THE anthropoids have a propensity for contracting human diseases and doubtless this weakness, plus faulty dietetics, contributed most to the early lack of success in keeping them at zoos. In any event, every gorilla transported from its native habitat died in short order—that is, until recently. Nowadays more is known about keeping them alive and healthy, and there are now no less than 13 of the great beasts in American zoos, plus the two in the circus and one in private hands.

Ngagi, the 635-pound champion, is the undisputed leader when it comes to size. He lives in the San Diego Zoo and stands five feet, eight inches high in his unstockinged feet. Although well-proportioned, he has the appearance of an obese gentleman who dotes on cake and ice cream and who gets most of his exercise pushing himself away from the table. Briefly and unreservedly, he is immense.

Ngagi and the late Mbongo were captured as youngsters by the Martin Johnsons and both definitely have been identified as mountain gorillas. They were playing together when found and were constant companions until March, 1942, when Mbongo succumbed to San Joaquin disease after a brief illness. They slept and ate their meals in separate quarters but they played and wrestled together every day, although, in keeping with their great weight and dignity, they were not so active and playful in recent years as they used to be. Ngagi is now living alone, but the young female gorilla, Kenya, recently acquired by the San Diego Zoo, someday will be his mate.

Like all gorillas, Ngagi is a vegetarian, consuming 30 pounds of fruit and vegetables daily. Special visitors to the San Diego Zoo are taken behind the scenes at bed time when the big fellow receives his evening meal and is locked in his sleeping quarters for the night. Close mesh wire makes it impossible for him to reach out, but it gives visitors a real thrill, none-the-less, to stand inches away from the monstrous animal. With fingers as big around as a woman's wrist, he daintily removes every speck or blemish from his food. He lies down or rests on his elbows while eating and the entire process is one of enjoyment, accompanied by much smacking of lips. Carrots, potatoes, and apples he peels with his teeth carefully and with little waste; the rinds of citrus fruits also are discarded. He prefers his bananas green and bitter; sour grapefruit bothers him not in the least.

AN INGENIOUS method of weighing the gorillas was adopted years ago and it is still possible to obtain accurate weights at regular intervals by following the same procedure. A panel, cut in the bottom of the door adjacent to the sleeping quarters, admits the platform of an ordinary warehouse scale. By offering Ngagi food, he can be induced to step upon the platform to be weighed.

Chicago has the distinction of exhibiting twice as many gorillas as any other city. A fine big male, named Bushman, lives in the Lincoln Park Zoo, and the Chicago Zoological Park, in suburban Brookfield, boasts a male and two females, Sultan, Suzette, and Miss Congo.

Bushman is a burly brute. Like all other gorillas in captivity, he came into human hands as a youngster. Today, standing six feet in height and weighing 473 pounds, he little resembles the tiny mite whom native women nursed when he was captured in the jungles of the French Cameroons.

Upon his arrival in Chicago in 1930, Bushman was very friendly, and the keepers delighted in taking him for romps on the lawn. In their spare time they taught

Reprinted from *Fauna*, published by the Zoological Society of Philadelphia

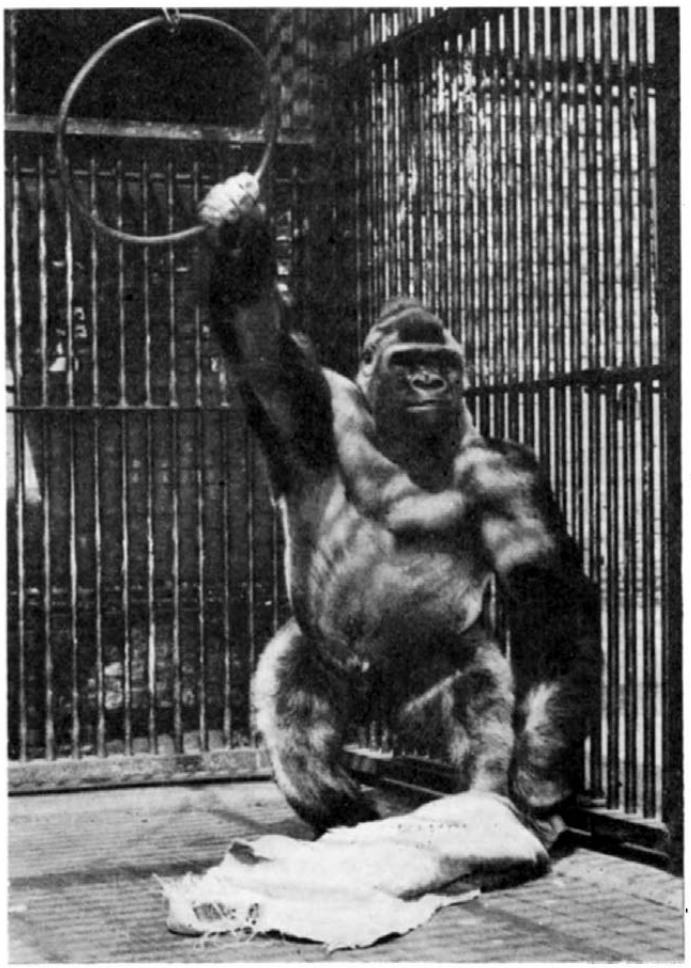
him to wrestle and to play football. Wrestling came naturally to him, and it didn't take long for him to master the arts of tackling and running with the ball. Had he exhibited anything approaching human intelligence, he might have been in demand for the teams of "dear old Siwash," but unfortunately his brawn grew faster than his brain power. In due time, figuratively speaking, he was putting the keepers' shoulders to the ground far more often than the other way around. One day he caught an attendant off guard. Employing his best wrestling technique, Bushman threw the fellow to the ground with such force that it was indeed lucky he landed on his shoulders rather than on his head. The gorilla stayed in his cage after that and he has not been out of it since, except in 1939, when he was transferred to new and stronger quarters. One of the features of his new home is a huge steel chair on which he sits occasionally. When he does, his weight registers on a dial visible to the public.

Sultan, Suzette, and Miss Congo, the other Chicago gorillas, all are youngsters. They live together in a big cage and, like children, they enjoy playing. A favorite pastime is to jump off a see-saw and let their partner get bumped. The play device they enjoy most is a tub set up under a shower bath, which they operate themselves by pulling a chain. They play pickaback, but Sultan is always the passenger for he is by far the smallest of the trio. The two females, both nine years of age, weigh about 220 pounds each, while he is only seven and weighs about half as much. Miss Congo is the ruler of the roost and she used to give Sultan a drubbing every time they were together. Suzette, with better mother instinct, takes Sultan's part and at the present time, things are progressing amicably.

Cincinnati claims the only educated gorilla in captivity. Surely, Susie's accomplishments merit acclaim, for she sits at a table and eats her meals with her keeper, rings a bell for service, and shows a remarkable aptitude for handling a fork or a spoon. Despite her age and size—she is 17 and weighs 400 pounds—she is remarkably tame and her keeper enters her cage regularly. Because of her docility she is the only living gorilla for which accurate dimensions are available. According to recent measurements, she is five feet tall and her reach, with arms outstretched, is 85 inches from fingertip to fingertip. Her neck measurement is 25 inches, chest 56, waist 64, right arm (around the biceps) 19½, wrist 13, calf 15½, hand (across the knuckles) 7½, foot (heel to toe) 10½. She certainly is no contender for the title of Miss America.

Susie is a coast gorilla and was exported from the Congo to Germany in 1927. Subsequently she was exhibited in Hamburg and Paris. Her trip to America in 1929 was the most unusual ever accorded to any gorilla. Her passage was booked, for $1000, aboard the *Graf Zeppelin,* and she was one of the passengers on the big ship's maiden crossing.

Each of the two gorillas in the Philadelphia Zoo, Bamboo (see front cover photograph) and Massa, has quite an interesting history. Bamboo's point of origin, as is the case with most animals secured from dealers, is rather vague. He had three owners before reaching Philadelphia and most of his early history was lost in the process of changing hands. Quite definitely, he is a coast gorilla.



Philadelphia Zoo's 375-pound Massa, a show-off

Upon his arrival, Bamboo weighed only 11 pounds and he fitted snugly inside the suitcase which served as his traveling compartment. With him, in another suitcase, was a young chimpanzee named Lizzie, who was his playmate for many years and whose constant antics kept him physically fit and on his toes. Since he was the first gorilla to live in America for any length of time, Bamboo attracted wide attention and there is a complete record of his early years and growth.

Eventually, he far outgrew Lizzie and, tiring of her play, he put her in her place. In time it became necessary to remove her, and for awhile Bamboo lived alone and liked it—to judge from all the interest he took in his neighbors. Then, just after Christmas in 1935, Massa arrived. After a period of introduction, which lasted several months and during which the two big animals were permitted first to touch fingers, then hands and arms, they were allowed to enter the same cage together. Massa, although smaller than Bamboo, took the lead at once and for a few days he was king of the cage. Finally Bamboo gave him a clip across the head and orders were issued to separate the two permanently.

Bamboo has an amusing, although unpleasant habit. He delights in throwing things and, after years of practice, he has developed an underhand pitch with marvelous speed and control. Usually he confines himself to throwing handfuls of gravel but occasionally he tosses a banana or a tomato, with disastrous results. A wire fence around his cage helps to protect visitors, but news-photographers, who must go inside the barrier and for whom he appears to entertain a special dislike, are out of luck unless they are adept at dodging. On his last birthday he scored a record by splashing five of them with a single, well-aimed watermelon.

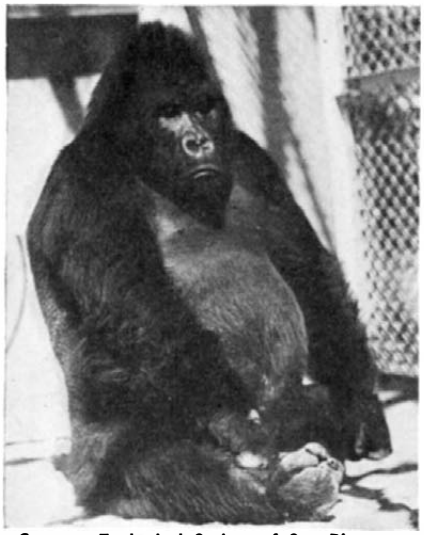
At present Bamboo weighs about 435 pounds, which represents very little change in the past few years. He may now have reached his limit but, judging from the rapid way in which he gains weight if his rations are increased, it is believed that 50 pounds could be added to his bulk in short order, if he were allowed to eat his fill. In the interest of maintaining him in the best of health, such an experiment will not be tried. Bamboo probably preserves more of the dimensions of a wild gorilla than do his more corpulent contemporaries in other zoos—and in the circus.

Massa was raised in a private home in company with Gargantua. As a youth he had the run of the house during daylight hours and great was the mischief into which he managed to get. He delighted in removing the pictures from the walls and enjoyed helping his mistress, Mrs. Gertrude Lintz, of Brooklyn, in scrubbing the floors. It was while engaged in just such an activity that a serious accident occurred. While handling the mop, Mrs. Lintz slipped and accidently struck Massa in the leg. He turned on her and bit her severely. Not long afterward he was offered to the Philadelphia Zoo.

Massa is an inveterate chest thumper. He delights in standing erect for a few moments, meanwhile beating a lively tattoo on his chest with his partly clenched fists. He is a show-off and amuses the

crowds of visitors by dashing around his cage with a flat-footed shuffle. Ripping burlap bags is one of his pastimes. Another is to seize the gymnasium ring mounted on a chain and slam it against the cage bars.

Both Massa and Bamboo have learned to eat meat and they enjoy the fair fraction of a pound of raw hamburg or cooked



Courtesy Zoological Society of San Diego
Mbongo of San Diego Zoo weighed 618 pounds before he recently died

liver which they receive almost daily. Other gorillas also like meat occasionally but, in the main, all are vegetarians.

Massa's exact point of origin is unknown, as is the case with most of the other gorillas, and while he is supposed to be of the mountain type, some doubt has been cast upon this. Perhaps his identity will not be determined with accuracy until after his death, when detailed measurements can be made.

DESPITE predictions that the war would cut off all importations of rare animals, zoo history was made in August, 1941, when no less than eight gorillas arrived in the United States, all at one time. The prime reason for the sudden influx was the relaxation of strict regulations which have, for many years, prevented the mass exportation of the rarer African animals. The newcomers were snapped up like hot cakes and five of them survived. Kenya, of the San Diego Zoo, is one of them; Oka and Makoko, of the Bronx Zoo, and Phil and Mattie, of the St. Louis Zoo, are the others. All are thriving, and already they are taking their places as foremost zoo citizens.

One gorilla, Du-du, imported late in 1942, still is in private hands. Were it not for the fact that several of her eight predecessors did not live, Du-du probably would now be living in a zoo or circus. The uncertainty of war conditions and the possibility that gasoline rationing may decrease attendance, and thus lessen income, have made zoo officials a bit chary about acquiring another expensive specimen. Du-du is an infant, as great apes go, being only three years of age, but the chances are that before many months have passed she, too, will be on public exhibition somewhere in a zoo or circus.

Both of the two remaining gorillas in the United States belong to "The Greatest Show on Earth." Care, comfort, and publicity have been lavished upon them and there are few persons who do not know at least something about them. They travel in air-conditioned cages and are sonorously and extravagantly billed as "Mr. and Mrs. Gargantua," and, without a doubt, are the greatest attraction in the entire Ringling Circus. Both were raised in the lap of luxury.

Gargantua, who started life as Buddy, lived in Brooklyn with Mrs. Lintz and Massa. On shipboard en route to America, he suffered severe acid burns on his face and chest, resulting in scars which help a great deal in his billing by the circus as "The World's Most Terrifying Creature." Several times he has managed to lay hands upon circus employees, never with fatal results, but his cage has been rebuilt to prevent future accidents. He is a big fellow and, while competent judges won't admit that he weighs as much as is claimed for him—well in excess of 500 pounds—he is a splendid specimen and, like most circus animals, in the pink of condition. Getting him to do his keeper's bidding is well-nigh impossible, but he still can be jockeyed into a small compartment at the end of his cage by showing him a snake. Like many other primates, he has a distinct dislike for serpents and he gets as far away from them as possible.

Mrs. Gargantua, nee M'Toto, is a wife in name only. As yet she has not been near her intended spouse, except to look at him through the bars of her cage and throw back the garbage which he tosses at her. The circus people say that it will be a year before they will risk allowing the two together.

M'TOTO is the most roly-poly gorilla imaginable. She is as broad as she is long and could give the circus fat lady a run for her money. Accustomed to being waited upon since infancy, she will accept only such foods as she chooses. These are cooked especially for her and her menu includes a long list of custards and purees. She was raised by Mrs. E. Kenneth Hoyt, who took her to Cuba when a child specialist in Paris advised a more equable climate for the then young gorilla. M'Toto had the run of the Hoyt estate for a time, and Mrs. Hoyt and the keeper can do almost anything with her.

And that completes the roster. Every one of the 16 is a champion in its own right, at least in the eyes of its owners. Each appears to be in the best of health and destined to live for years to come.

Everyone hopes that they will, for the time may come, and not too far distant, when gorillas may be a thing of the past. Already they are rare and the relaxation of the laws protecting them, resulting from the present chaotic conditions, has permitted raids upon their numbers which would not have been tolerated under normal circumstances. Several years ago most of the European nations with colonies in the Dark Continent agreed to prohibit the exportation of many rare African animals, including the gorilla.

Possibly within the next few decades the only gorillas remaining alive will be the few which survive in zoos. More than one spectacular mammal has succumbed to the inexorable advance of "civilization."

NAME	Sex	Weight	Year of Arrival	Estimated Age
BAMBOO Philadelphia Zoo	Male	435	1927	17
BUSHMAN Lincoln Park Zoo	Male	515	1930	15
DU-DU Private Owner	Female	37	1942	3
GARGANTUA Circus	Male	550	1937	13
KENYA San Diego Zoo	Female	150	1941	8
MAKOKO New York Zoological Park	Male	64	1941	5
MASSA Philadelphia Zoo	Male	375	1935	13
MATTIE St. Louis Zoological Park	Female	140	1941	6
MISS CONGO Chicago Zoological Park	Female	220	1936	9
M'TOTO Circus	Female	400	1941	12
NGAGI San Diego Zoo	Male	635	1931	17
OKA New York Zoological Park	Female	48	1941	3
PHIL St. Louis Zoological Park	Male	50	1941	4
SULTAN Chicago Zoological Park	Male	120	1937	7
SUSIE Cincinnati Zoo	Female	400	1931	17
SUZETTE Chicago Zoological Park	Female	220	1936	9

The 16 living gorillas in the United States

Where War Surprises Are Born

New Weapons and Standardized Maintenance Methods Are Developed at a Center in the United States

MERRILL FOLSOM

Now that the M7, the surprise weapon that first sent Marshal Rommel reeling on the African front, has seen the smoke of battle and is no longer held secret from the enemy, the evolution of this now famous tank killer and fortress blaster can be related.

It is an evolution sired by the changing demands of modern battle and nurtured by American manufacturing ingenuity; it is typical of the life stories of many new weapons, still clothed in military secrecy, that are flowing from our factories to armies of all the Allies.

When Rommel caught British forces by surprise on the Libyan desert in the Autumn of 1941 by suddenly using 88-mm. cannon to shatter tanks and blast vital gun-emplacements, the news was flashed by U. S. observers to Army G-2 headquarters in Washington. The Nazi cannon were not self-propelled, but their firepower was so superior that the elephantine battle-wagons of the British often were left a shambles or sent scurrying for cover.

Having long been aware that keeping a jump ahead of the Nazis in the development of better armaments was like playing leapfrog, Army engineers here were already working on a new weapon which consisted of the powerful 105-mm. howitzer mounted on the highly mobile M3 medium tank chassis.

The contrivance resulting from this marriage became known as the M7, a self-propelled weapon never before equalled in the world. It was capable of shattering objectives at distances of seven miles and then speeding at more than 35 miles an hour to new places of vantage before dive bombers could locate it and shower missiles from the sky.

The M7 appealed to officers of the Army Ground Forces and Ordnance Department as the ideal answer to the Rommel 88's, so it was labeled a "hot project" for immediate action. In 16 days final layouts for production models were drafted, and three weeks later the first M7's were delivered at the Aberdeen Proving Ground in Maryland for testing.

Part of the genius behind the development of the M7 was the fact that it was made of component parts which had hitherto been tested and standardized for other armaments, so after only minor revisions in machine guns and armor the new weapons were soon going secretly overseas in quantity.

Before the end of 1942 they were hitting Rommel hard on all the African fronts, serving as tank killers by firing armor piercing shells and as the Nemesis of the 88's by firing high-explosive shells —all the time jockeying for position in a manner well beyond the capabilities of the immobile Nazi howitzers.

Development work of the type which resulted in the M7 is conducted by the War Department's recently activated Tank-Automotive Center in Detroit. If a new variety of tank is needed for invasion of Europe, a lighter gun mount for traversing swamps of the Solomons, or a revised armored car for reaching mountain fastnesses of Burma, the job of designing and producing the conveyors of cyanide devolves upon the TAC. With so many of the Allies relying on us for war machinery, the job has become colossal. The production of Ordnance materiel has risen 71,000 percent in 30 months; present contracts at the TAC total $25,000,000,000.

In the program are many surprises for Hitler, Hirohito, and Mussolini. One mentioned by Major Gen. Levin H. Campbell, Jr., Chief of Ordnance, is a 240-mm. howitzer capable of shooting a 350-pound TNT shell with sufficient accuracy "to lay it right on the city hall steps."

The TAC is a slice of the War Department, lifted from the congested banks of the Potomac and placed in the center of the automotive industry of Michigan. It is a concentration of 99 percent of all the tank and automotive work of the Ordnance Department, and serving at its headquarters are numerous liaison officers of the British, Russians, Chinese, and other Allies who get American mechanized legs to speed their fighting armies.

Work of the TAC spans the world. In addition to keeping in constant communication with task forces across the seven seas, it tests its tanks and vehicles in the heat and sand of California, on the beaches of Florida and Maine, in the snows and rocks of Colorado, on the blizzard-swept plateaus of Manitoba, and at the wide expanse of Aberdeen.

The modern and balanced team of vehicles handled by the TAC includes items ranging from 60-ton tanks to featherweight military bicycles. On the list are complete assortments of light, medium and heavy tanks, reconnaissance vehicles, jeeps, amphibians, scout cars, gyro-stabilized tank guns, command cars, self-propelled artillery and anti-aircraft weapons, cargo vehicles, personnel carriers, and motor transport vehicles. In all, there are more than 200 varieties of tanks and wheeled vehicles.

Not the least of the TAC's problems is that of standardization and simplification of vehicles—a subject that sounds minor and until the war became global failed to make much impression on some Army officers. But with the war now conducted on far-flung battlefronts, requiring supply and repair depots at every scene of operation, standardization of parts has become a problem of first magnitude.

At one time the primary aim was to get serviceable vehicles into action as swiftly as possible, regardless of how much uniformity of design existed. Quantitatively this was a good job, but the result was that so many varieties of vehicles were reaching war zones to perform the same type of service that the maintenance problem became unnecessarily acute.

Every tank or truck with a different type of engine, axle, transmission, wheel bearing, or chassis needed different spare parts and tools, as well as specially trained maintenance crews. An average tank has 30,000 parts and 200 special tools. Multiplying these figures by the number of variations in component parts — parts which could often be identical—carried

The M7 tank destroyer and gun-emplacement blaster

the maintenance problem into astronomical digits and left many supply depots issuing cries of anguish instead of spare parts.

After serving eight months on African deserts, Lieut. Col. Joseph M. Colby, chief of the TAC's Development Branch, returned to this country and remarked:

"Our greatest thrill in Egypt came at a time when we received a set of major overhaul tools for the Continental engine. Our greatest disappointment occurred when we opened that package and found that this lovely set of American tools was for the Guiberson Diesel engine. We had no Guiberson Diesel engines in Egypt.

"The greatest improvement which we can now make in simplifying our maintenance problem is the simplification of the equipment to be maintained. In a theater of operations we can train men to take care of one engine and we can furnish tools and spare parts for one engine, but if this one type of engine is increased to three or four different types, it means that the burden of each of the essential elements of maintenance—trained men, spare parts, tools, and facilities—is increased in direct proportion to the number of different items to be maintained."

AN EARLY step in the standardization move was to establish a simplification section in the TAC, with Lieut. Col. Frank A. Mickle, former associate professor of mechanical engineering at the University of Michigan, heading the group. Standardization of the tank engine was one of the first objectives, and one engine soon was chosen for mass production.

The TAC has five branches, Development being the first to deal with a new vehicle. The next is Engineering, which determines the serviceability and maintainability of new types of equipment. Then come Manufacturing, charged with having vehicles produced by private manufacturers and arsenals from coast to coast; Supply, which must have the finished materiel delivered to task forces throughout the world in proper quantities and at proper moments; and Maintenance, charged with the enormous job of keeping rolling stock rolling.

Detroit was already teeming with activity when the TAC arrived in town, and to secure office quarters it was necessary for the War Department to lease the Union Guardian Building, a 40-story downtown office structure then occupied by 160 private tenants. But this space was not enough, so several floors in the near-by Buhl Building and in the Fisher Building uptown were also taken.

To house some of the 400 Army officers and 3600 civilians who came from every state to work at the TAC, the government obtained 500 rooms in hotels such as the Book-Cadillac, Statler, and Fort Shelby, paying half the rent and allowing the workers to occupy the rooms for ten or fifteen days by paying the other half. At the end of that period the workers had to find permanent lodgings, and to ease the rent burden the TAC obtained occupancy priorities on apartments in several low-cost housing developments.

In line with its policy of assigning to industry as large a role as possible in the conduct of the war, the Army installed Brig. Gen. Alfred R. Glancy as Deputy Chief of Ordnance in charge of the TAC. He is an old-time automobile manufacturer, having been president of the Pontiac Motor Car Company and a vice president of General Motors, and he was partly responsible for the industrial success of southern Michigan.

NO STICKLER for military formalities, and thoroughly irked by duplications of effort in some government offices, General Glancy is running the TAC as he would an automobile company. His aides may have high military rank, but in the armament production cycle they are just hired hands. Task forces are his clients. And the shortest distance for him between two points is a straight line, bypassing organizational flubdubbery and bureaucratic protocol by a method which he whimsically calls "Mrs. Glancy's treatment."

The general shuns armed guards. A badge system of identification for his civilian workers, designed by old-time Army officers after the fashion of a system used to protect offices in Washington, was short lived when General Glancy began his corner-cutting. He can get much more excited over a discovery that one type of grease can be used in a tank which hitherto required five types than he can over a discovery by some highly-schooled officer that secret documents are being stamped with green ink instead of specified red ink. This attitude mystifies some Army men.

His desire for efficiency ahead of protocol is catching. When a school for mechanics in one of the Ford factories needed five engines for study—engines which were rolling off an assembly line a few hundred feet away—Army regulations required that the engines be shipped first to the Rock Island Arsenal, from which the school could requisition them. The Glancy treatment was used by aides, however, and the five engines were rolled across the floor to the school, leaving the formalities for some one else to worry about when inventories are taken.

THESE shortcuts occasionally lead to confusion. The librarian of the TAC was moved 19 times during the "shaking down" process in the Union Guardian Building, and then one Saturday afternoon General Glancy decided there was no need for the library anyway. In 20 minutes books and pamphlets were torn from the shelves, ending three months of work. But on the following Monday morning the general was convinced that the library had some value and should be restored. William Schild, the librarian, put things back in shape. Not long afterward, however, he was moved the twentieth time and decided to leave the TAC and return to his former job as sales manager of a Chicago paper company.

Brig. Gen. John K. Christmas, long an authority on tanks, is Deputy Chief of the TAC, and the general staff includes a mixture of men whose fighting experience goes back to 1917 and others who have just stepped from executive offices of the large automobile companies into uniforms of captains, majors, and lieutenant colonels—and higher.

Among these new officers are Lieut. Col. Benjamin Ourisman, who had one of the largest automobile agencies in the world; Colonel Graeme K. Howard, former vice president and overseas manager for General Motors, and Lieut. Col. Felix Doran Jr., former manager of the Fleet Division of General Motors. In addition, General Glancy brought to his civilian staff such men as Lee Anderson, long a kingpin in the advertising work of General Motors, Chrysler, Hupp Motors, and Packard.

Typical of the experienced Army men who are being shoved to the top in the TAC is Colonel Colby. Thirty-eight years old and of almost boyish appearance, he was graduated from West Point in 1929, served in the air corps and cavalry and then went to work in earnest on tank design. In 1933 he helped perfect the first modern tank, known as combat car T4, which had the first radial aircraft engine used in a tank, rubber jointed tracks, and a controlled differential that permitted smooth steering. Compared with the 4 to 8 mile-an-hour speed of the World War tanks, the T4 could travel 55 miles an hour on wheels and 37 on tracks.

Another tank destroyer, mounted on a Half-Trac chassis

Colonel Colby's wrath rises when he hears of Army men who believe the tank is the only important vehicle in modern battle and that heavy artillery should still be pulled muzzle backward by separate tractors instead of being mounted on tank chassis. From his experience as a boxing champion at West Point and as a cavalryman in the field, Colonel Colby gained firm convictions that maneuverability and unification of all offensive forces is imperative.

"The principles of war do not change," he said. "After my observations of operations in the Middle East and after having closely studied German moves in the lowlands, France, Poland, Czechoslovakia, Norway, and Russia, I am convinced that the principles of war have not changed since the day Alexander rode at the head of his heavily armed cavalry.

"Security, reconnaissance, mass movement, and reserve hold their same importance. The only thing that is new in this war is speed. The tank has entered the battlefield and has changed the pace from that of the foot soldier to that of the mechanized vehicle.

Tractor-drawn heavy cannon, ready for rough cross-country travel

"THE backfield men of a football team are its most spectacular players. They get all the publicity and, therefore, there is a common tendency among most young people to want to be quarterbacks, halfbacks, and fullbacks. But any one who has played the game knows that the success of the quarterback is based on the efficient functioning of the ends, the tackles, the guards, and the centers, and their coördinated operations as a team.

"Because the tank has been the pacesetter of this highly mobilized war, publicity has been centered on the tank, with little publicity given to the other members of the combat team which enable the tank to become effective. If a quarterback is able to run faster, it is essential to give him fast interference. Because the tank has increased the pace of the battlefield, it is essential that the speed of the other elements of the combat team—reconnaissance, communication, support artillery, and others—be likewise increased."

Co-operating with the TAC are numerous civilian and governmental agencies. The Industry Integration Committees, composed of leading industrialists, handle specific problems such as allocation of alloy steels, tools, dies, armor plate, and tank tracks. They keep industry operating like one large family, pooling resources and headaches; they enable manufacturers to deal directly with one another, swapping parts, raw materials, machine tools, and improved methods of operation.

The United States Tank Engine Committee, with the heads of the larger automobile companies as members, is performing a difficult job on tank engine improvement, standardization, and production.

When Colonel Colby returned from Africa and reported that Rommel's early successes had been due to his emphasis on maintenance, using 20 percent of his entire army on repair work and being able even to restore broken tanks to service while battles were raging, new emphasis was placed in Detroit on schooling for United States maintenance men.

The TAC consequently is collaborating now with the Military Training Division of Ordnance in promoting 13 large schools for the training of ordnance soldiers in the repair and maintenance of tanks and wheeled vehicles. Here, again, industry has been put to work. The schools are operated in automobile factories, with the companies furnishing all equipment as well as the teaching staff.

"Got to be damned sure no boy's ghost will ever say, 'If your training program had only done its job,'" is the slogan emblazoned on walls of these schools.

Bakers, lingerie salesmen, jewelers, pretzel makers, gasoline dealers, and grocery clerks are among the students who are learning, with a few weeks training, to repair everything from a gyrostabilizer to a 3000-pound tank track. On completion of the course of study they are sent to Africa, Europe, Asia, and Australia to keep the Army's machinery running.

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DECKING MATERIAL Has Many Military and Industrial Uses

ESPECIALLY adapted to war and cargo ships, a new lightweight decking material with myriad potential applications was announced recently by the Goodyear Tire & Rubber Company. O. C. Pahline, manager of the company's flooring department, said the new material is known as "Dektred."

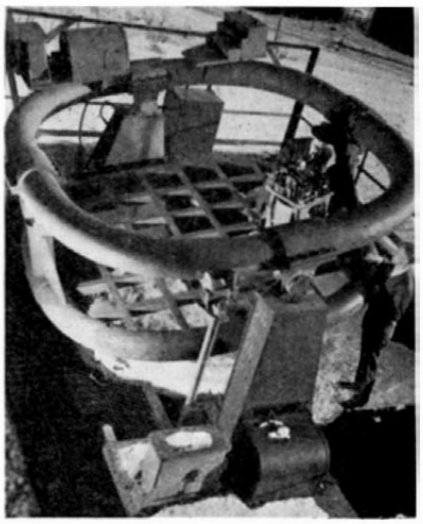
Easily-applied and long-wearing, "Dektred" can be used on metal, wood, concrete, and many other types of services where tests have shown exceptional serviceability. Under government and Goodyear auspices, "Dektred" has been tested in temperatures ranging from 50 degrees below zero to 160 degrees above zero, Fahrenheit. These tests showed, Pahline disclosed, that "Dektred" is unimpaired by cold. It may soften slightly in high temperatures, he said, but returns to normal when temperatures are lowered. In other tests "Dektred" was described as completely resistant to the action of oils, greases, gasoline, salt, sulfur, and cleansing detergents such as soap.

It is produced in a thick liquid and is applied by spraying or with steel trowel. As it is self-levelling, repairs can be made with no appearance of patchwork, it is claimed.

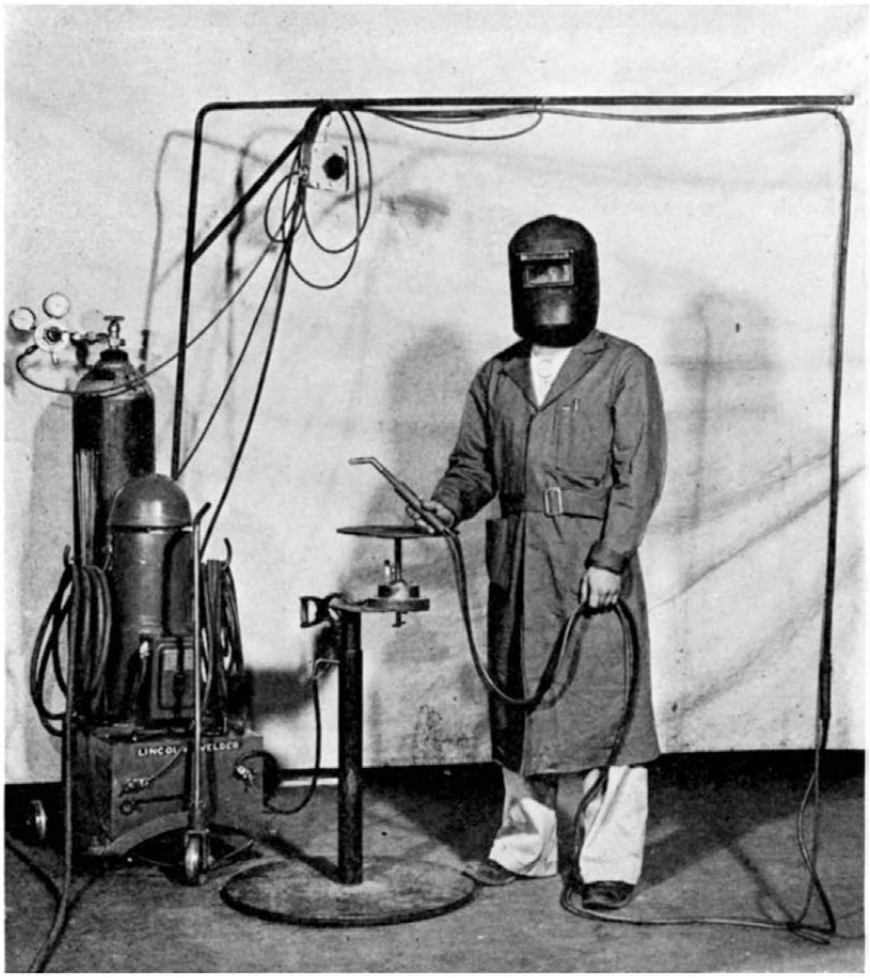
"SEA-SICKNESS" MACHINE Puts Equipment Through Severe Paces

IN ORDER to test various types of naval equipment and to make sure in advance that it will be able to withstand all the ups and downs of a warship ploughing through the high seas, a Scorsby testing device has been installed at a plant of the General Electric Company.

One of our photographs shows this machine in use, with a development engineer risking sea-sickness by riding with equipment under test.



Mechanical "wave-maker," which simulates the ocean's roll and pitch



Helium arc welding equipment, with swinging overhead cable and hose support

Helium Aids in Welding

Method Requiring No Flux Gives Many Advantages in Welding Magnesium, Important in Aircraft Fabrication

S. R. WINTERS

LIKE a two-edged sword, helium—the non-inflammable light-weight gas, of which the United States has a virtual monopoly—is now able to function in the two-fold role of buoying up submarine-spotting blimps and of speeding the production of war-planes. The first-named use is according to normal practice; whereas it is novel procedure to employ helium in a welding process in the manufacture of aircraft.

A new welding torch and a method developed by engineers of the Northrop Aircraft, Inc., make possible the new process of helium welding. Somebody has said that success in life is the triumphant embodiment of many little things; similarly, some of our large airplanes involve the use of hundreds of thousands of tiny rivets. Hence the customary riveting procedure has been cumbersome and time-consuming.

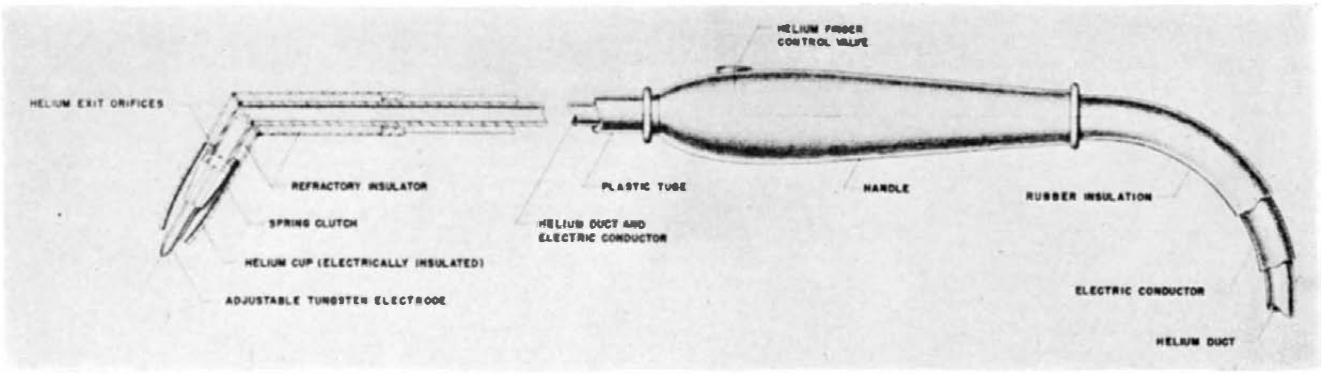
The helium welding process renders possible and practical the fusion of inflammable metals, such as magnesium; the latter, owing to its extreme lightness, is being employed increasingly in airplane construction. When utilized in the shape of sheets, as in the covering for wings, fuselage, and other parts of the flying machine, magnesium has heretofore ordinarily been gas-welded, but now may be "Heliarc" welded with no danger of entrapping flux (as in gas welding) because none is used, except that supplied by the action of the helium. Furthermore, the use of flux promotes corrosion, which makes for hazardous conditions on magnesium.

When magnesium is blanketed with a covering of a monatomic inert gas, such as helium, it will not ignite. Also, according to welding authorities, magnesium and various alloys thereof, such as, for example, the different grades of "Dowmetal," rapidly lose their stiffness upon being heated at relatively high temperatures. The new weld produced with the helium blanket, however, is said to be about equal in strength to the magnesium metal itself. Under service conditions, it has been determined that in the welding of magnesium the cast-structure of the weld has about 85 percent of the strength of the originally wrought metal, in pounds per square inch. Since this new welding-torch process affords the means of making a magnesium weld wherein the area of the weld section may be increased approximately 100 percent over that obtainable by other methods, the weld portion is stronger than the adjacent material.

To obtain the protective blanket of helium, the inventors of the process have designed a special electric torch having a hollow handle and nozzle through which the non-inflammable gas can be passed. The helium valve of the Northrop Heliarc welding torch is opened just before striking of the arc between the tungsten electrode and the parent metal. Helium has more than five times the specific heat of air and when in motion forestalls the amassing of heat around the weld. Thus the welding process is surrounded by relatively cool atmosphere, affording a better fusion and penetration with less distortion than obtained in other welding processes.

A sort of hit-and-run procedure, the arc is struck by a light brushing action and immediately drawn away from the metal. The "Heliarc" torch tips, soon to be available to the whole aircraft industry, are of three sizes, held at different angles of 40, 60, and 90 degrees. The new torch may be employed for pencil welding or, by means of a longer handle bar, a grip is available for heavy welding. Another design of this torch, yet to be made available for the industry, is one that feeds the filler rod automatically, which is said to afford more uniform results than when the present hand-fed rods are used.

The general set-up for producing a butt-weld includes a pair of magnesium sheets which are held securely in a jig, the edges to be welded being scarfed. The angle formed by the latter is about 90 degrees, this varying somewhat with the thickness and specific chemical structure of the magnesium or alloys being welded. The lower edges of the scarfs are closely adjacent, and the sheets are usually positioned in a horizontal plane, so that down-hand welding may be used, but there is no trouble in welding vertically or overhead. Just beneath the scarfed edges of the sheet is stationed a backing plate, ordinarily of steel and having a central semi-elliptical channel thereon, centered with regard to the aligned edges of the scarfs. The backing plate may, logically, be an integral part of the jig. For best results, the chilling effect of the backing plates on the weld can be reduced by suitable heat-transfer means, preferably electric, embedded in

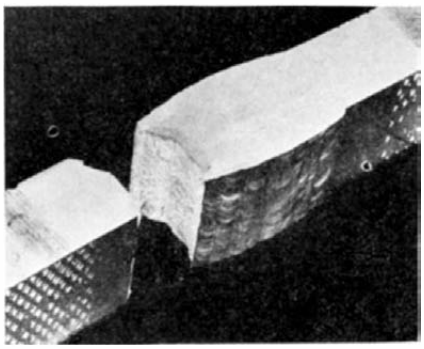


Sectional drawing of one type of Heliarc welding torch, with electric conductor and helium duct in one covering

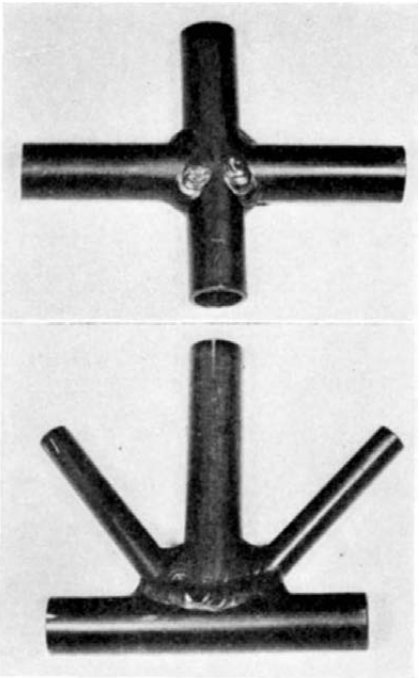
the backing plate. On small jigs, heating with a gas torch is satisfactory.

In this process of fabricating aircraft parts from magnesium, the most satisfactory results are obtainable by feeding the filler rod into the molten pool at the edge of the arc. Inasmuch as the radiated heat from the arc heats the filler rod excessively, an angle of 60 to 90 degrees must be kept between the rod and the electrode. The latter varies in size from 1/16 of an inch to 1/4 of an inch, depending upon the thickness of the metal being welded and the heat necessary The torch is held as near the weld as possible to insure the greatest effect from the helium as a preventer of oxidation and as a conductor of heat. Also, a short arc is desirable for best results, since gas holes or poor penetration may result from using too long an arc.

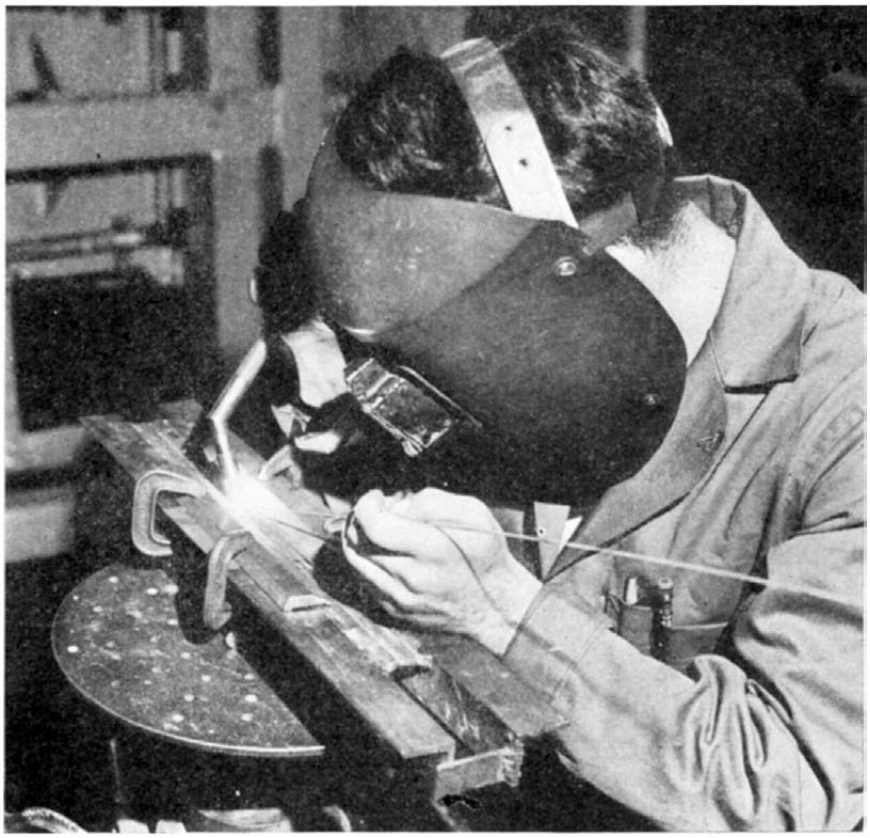
The usual arc-welding machine, with a direct-current generator having a 150-ampere output, is preferable. Higher output machines, functioning at less than 300 amperes, may be employed if lower amperage ranges are obtainable. Obviously, an upright welding machine is desirable, so that a helium tank may be readily attached to it. Separate amperage and voltage regulators are not necessary but are helpful and these devices preferably



This broken Heliarc welded magnesium test specimen shows that the weld is stronger than adjacent parent metal



Two types of Heliarc welds produced in joining Dowmetal-J tubes with wall thicknesses of .040 of an inch



Heliarc welding, illustrating use of back-up strip and angle of filler rod

should have a continuous sequence of five increments of current control. A 200-cubic-foot helium tank will, on the average, do 35 hours of continuous welding with a medium-sized torch. Commercially pure helium is required.

If the magnesium sheets vary in thickness from .040 to .10 of an inch, an open-circuit generator voltage of from 40 to 60 volts is suitable, the amperage varying from 35 to 75 amperes, in accordance with the demands of the job. Helium is then permitted to flow at low pressure—¾ of a pound per square inch—through the nozzle to emerge from the open end around the tip of the tungsten rod. Then the arc is struck against the object to be welded and, as previously mentioned, the magnesium-alloy filler rod is fed into the edge of the pool rather than into the scarf. The arc is moved to the bottom of the latter, then to the top of the bead, as the metal from the filler-rod is melted in the arc. This procedure insures complete fusion of the metal, the arc being maintained close to the puddle formed by the metal melting from the filler-rod and the sheet edges. According to the inventors, the cold filler-rod should never touch the

tungsten electrode and should not be used to form the puddle by an inexperienced welder; to do so will produce an undesirable gas pocket. The filler-rod is used simply to feed metal into the arc. The puddle is then formed by movement of the tungsten electrode, with the weld metal being directed in a flow from the side from the filler-rod. If these desired conditions prevail, the tungsten does not make deposits in the weld, but is transformed to tungsten oxide, and either vanishes as a gas or makes deposits on the magnesium sheets as magnesium tungstic oxide—a dust scale which may be brushed off later. As a further contribution to more perfect welding, the end of the welding torch is so designed as to prevent oxygen from being drawn into the arc area by action of the outflowing helium.

It is a comforting thought to envision the speeding up of fabrication in an airplane factory in California as having a vital relationship to an offensive by Soviet Russia; to a sweep of English or American bombing planes over German-occupied coastal cities or thousands of feet above the burning sands of the North African dessert. In this global war the successful welding of magnesium parts for airplanes in California is one of the links that will forge a weapon for the defeat of the aggressor nations, wherever their ugly and venomous heads may rear themselves.

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CORKS
"Cow Apple" Roots May Be Source of Substitute

TESTS have been carried out in Jamaica with a view to using a locally grown plant as a substitute material for cork, say recent trade reports.

This new product has been developed from the roots of a swamp plant known in Jamaica as "cow apple." The botanical name of this plant, which is found in large quantities in the swampy areas around the island, is *Annona palustris.*

Corks from this root have been made experimentally by one Jamaican firm. It is stated that they are not satisfactory for corking bottles of rum, but could probably be used for vinegar and similar liquid products.—*The Chemurgic Digest.*

INDUSTRIAL ANALYSIS
Speeded by Use of Mass Spectrometer

IN A CLOSELY guarded laboratory in the heart of a Philadelphia oil refinery, physicists have achieved a new triumph in the application of electronics to the war effort. The achievement is the industrial use of the mass spectrometer. The research organizations of The Atlantic Refining Company, and of the Consolidated Engineering Corporation have co-operated to bring this device to practical use in a manner which will expedite the manufacture of aviation gasoline.

This development makes possible a marked improvement in the analysis of gases which are used in making high-octane aviation gasoline and synthetic rubber stocks, and opens the door to unlimited research in these fields. In addition to improving present production methods, it is expected that the mass spectrometer may pave the way for entirely new gasolines.

Accelerated manufacture of gasoline and synthetic rubber is anticipated

The use of the mass spectrometer permits analysis of some gases that cannot be separated by distillation procedure. Such extension of the ability to determine hydrocarbons in gasoline may lead to the development of better, or even new gasolines. The new method is eight times as rapid as the old, resulting in closer control of plant operations, because rapid analysis of samples permits much more frequent testing and checking of plant equipment.

Because of its importance to war production, the instrument is now being operated under a policy which limits disclosure of its results to those engaged in the national effort to manufacture greatly increased quantities of high-grade aviation fuels, and details of construction and operation are blanketed under secrecy orders. Weighing slightly more than two tons, and small enough to fit into an ordinary-sized kitchen, the mass spectrometer looks like a high-powered radio transmitter.

INVISIBLE "RAINCOAT"
New Chemical Waterproofs Many Kinds of Materials

AN INVISIBLE "raincoat" which can be formed on cloth, paper, and many other materials by exposing them to chemical vapors, thereby making them water-repellent, has been developed in one of the General Electric Research Laboratories, Dr. William D. Coolidge, Director of Research, has announced. Many possible uses of this new method of waterproofing are now being studied. One of the most important so far is the treatment of ceramic insulators for radio equipment used by the armed forces of the United States.

Such insulators lose much of their electrical resistance when exposed to high humidity. This causes formation of a thin film of moisture on their surfaces and allows the currents to leak away. It has been the practice to coat them with wax, but the new chemical treatment is about nine times as effective, and its results are permanent.

The process was discovered by Dr. Winton I. Patnode, research chemist. Various chemicals are used, one class being known as methyl chlor silanes. In a closed cabinet, the articles to be treated are exposed for a few minutes to vapors from such a compound. Then they are taken out and, if necessary, are exposed to ammonia vapor. This is to neutralize corrosive acids which may collect during treatment.

Dr. Patnode is not able to explain exactly what happens in the process, but the result is that an extremely thin film, which resists wetting, is formed on the surface. This "raincoat" is so thin that its structure cannot be determined by chemical analysis. It cannot be seen under a high-powered microscope. But, whatever its nature, it prevents water from spreading to form a continuous film. If moisture does collect, it is in the form of small isolated drops. In the case of the ceramic insulators, these do not allow electricity to pass because they are separated from each other.

The treating liquid vaporizes at a temperature below the boiling point of water. However, the water-repellent film is not volatile, but remains permanently. It is not affected by temperatures as high as 550 degrees, Fahrenheit, applied for short intervals, nor by cleaning fluids such as carbon tetrachloride, naphtha, or gasoline. It is only mildly affected by continuous exposure to sun and rain.

PLASTIC FORMS
Rival Steel in Toughness, Are Much Lighter

A PLASTIC which, it is predicted, will increase airplane production by 50 percent, has been developed in the chemical engineering laboratories of Columbia University, in co-operation with plastic manufacturers and plane producers. The material will be used in making forming blocks, dies, and jigs upon which the metal parts of airplanes are fabricated. It has been found far superior to the present-day materials used for the same purpose such as wood, steel, and various alloys. The tough characteristics of the plastic, such as high impact strength, hardness, low compressibility and durability, make it rival steel in many respects, but with only one-fifth of its weight.

This new plastic, known as Thermo-Cast, possesses the unique property which permits it to be melted and cast into shapes without the use of pressure somewhat the same as metal, but at much lower temperatures and with more exactness of mold dimensions.

It is still pretty much of a "new born baby" with a future beyond present-day imaginations. In place of the present airplane composed of small sections of

metal pieces held with literally thousands of rivets and requiring many more thousands of holes to be drilled, and the rivets offering sufficient wind resistance to reduce the speed of our airplanes by as much as 10 to 15 percent, the airplane of tomorrow may be made in large sections, stamped out as a whole on plastic forms and with the use of plastic punches.

Resembling red sealing wax, the product is described as a thermo-plastic material which is readily reduced to a molten state by heating to 200 degrees, Centigrade. The melt can be easily poured into simple molds, in the same manner that metal castings are made, in order to transform the plastic into the desirable shapes for the metal working operations.

ELECTRONIC FUTURE
Is Seen as Bright in Many Industries

THERE ARE vast untapped potentialities in the use of electron tubes in research and industry as well as in communications, according to the current issue of *Electronics* magazine. Over the past few years, it is stated, light beams employed in conjunction with photo-electric relays have enjoyed an increased usefulness in industry. In a similar way, ultra-high-frequency beams may well find some applications along the lines of photo-electric relays but applied where light will not function due to the fact that it will not go through certain materials or will not readily carry a sufficient distance. There are many possibilities in the use of television principles for industry. Routine clerical details attending such simple procedures as a purchase in a department store, the buying of a railroad ticket, the sorting and distribution of mail, and payroll accounting as well as a host of other clerical operations, will readily come to mind.

Other expansion of applications are looked for in power conversion, high-frequency heating, motor control, electronic calculators, and so on. At the end of the war a situation may arise which is quite unusual: "Tens of thousands of men who have joined the military services or are in government employ," states *Electronics*, "are acquiring knowledge and experience on electron tubes and electronic devices at ultra-high-frequencies. These men with knowledge and skill will return home with up-to-the-minute knowledge so that those who remained at home in industry will be at a relative disadvantage and will have much to learn to keep abreast in the electronic field."

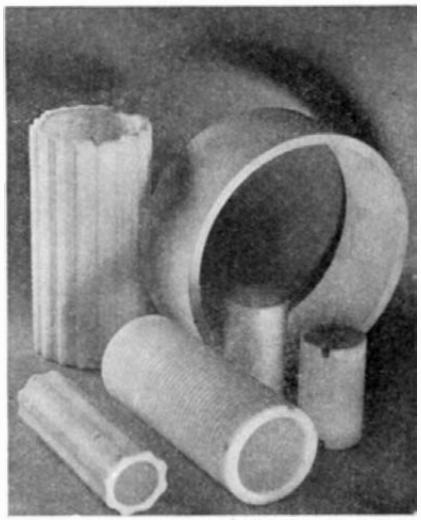
The advantages of high-frequency heating equipment, using electron tubes, are now being more generally appreciated. Surface hardening of small steel parts has introduced the subject into the industrial field, where it will undoubtedly spread to other applications as it becomes better known and understood. An important factor, it is pointed out, is that high-frequency heating can be made selective, so that there is heating of only certain portions or materials of the body in the high-frequency field. The value of this aspect of high-frequency heating will come to be more generally recognized and utilized. Then, too, certain industrial processes may be effectively handled only by this means.

For a number of industrial applications requiring small electric motors, the D.C. motor still has certain desirable characteristics that cannot be duplicated with any type of A.C. motor. This is particularly true for certain light machine-tool applications. On the other hand, A.C. distribution systems are becoming more universally employed, so that the localities where small D.C. motors can be directly utilized are very limited. The electron tube steps in as an almost perfect solution to this problem. It provides variable voltage D.C. from constant potential alternating current. Such electronic motor control equipment even provides characteristics not readily obtainable from a straight D.C. supply. Tubes have a bright future here.

INSULATION
Made by New Glass Process

A NEW line of electrical insulation known as Multiform Insulators provides the American electrical industry with a new insulation supply at a time when war requirements are straining existing facilities. The manufacturing process for producing these insulators, developed by the Corning Glass Works, has kicked out the window many production barriers that have faced the glass industry throughout its long history.

Conventional glass-making methods—blowing, pressing, and drawing—have produced, to be sure, a multiplicity of glassware. But the glassware made by these conventional methods has had definite limitations, a major one being that shapes have had to be relatively simple. Further, special design features such as holes, grooves, or threads have been major headaches for glass men. The glass industry has made many glass parts with these features—but in almost all cases it has been a slow and expensive operation. It has also been difficult with conventional glass-making methods to hold close tolerances that could enable glass parts to compete with metal parts.



Bushing ring and coil forms

The result of these limitations of shape, design, and accuracy has been that the use of glass has been precluded in many instances where the qualities of the material have been ideally suitable. In the insulation field, for instance, the remarkable electrical qualities of glass have, in the past, been put to use only in insulators of comparatively simple shape—such as standoff, strain, or bowl-shaped entering insulators—that were adaptable to conventional manufacturing methods. There has remained outside the reach of glass, consequently, the great bulk of the insulation field—the thousands of intricate-shaped insulators that go into radio receivers and transmitters, refrigerators, and other electrical equipment. The new Multiform process has now made electrical glass available for insulation in a wide variety of shapes.

The Multiform process involves a combination of cold-molding batch materials and subsequent fusing. Finished ware, in contrast with the more familiar types of glassware, is opaque or translucent; but it is a true glass. The process has made available products that run the gamut from small insulating beads, several thousand to the pound, to large insulators weighing 25 pounds or more. Countersunk and tapped holes are practicable, as are both external and internal threads and grooves.

In addition to a wide range of shapes and sizes and special design features, these products can be made accurately to close tolerances and from almost any glass composition, the choice depending upon the qualities required. Insulators made by the Multiform process are somewhat less strong mechanically—under comparable conditions—than products of the same composition fabricated by conventional glass-making methods. The mechanical strength has proved adequate, however, for a very broad group of electrical insulators.

In dielectric strength, the new insulators have slightly lower values than do conventionally formed products of the same composition. The dielectric strengths—500 volts per mil or more—are sufficient, however, for all ordinary applications and, generally, are much higher than the dielectric strengths of other ceramic products. Among the advantages claimed for Multiform insulators are minimum frequency drift, negligible water absorption, and low loss factor.

AIR JARS BOLTS
Millions of Vibrations Test Holding Qualities of Nuts

IF YOU cannot jar a nut off a bolt after 3,000,000 sharp jolts, no amount of jarring will remove it. Upon this theory The Tinnerman Products, Inc., test their self-locking speed nuts which the company produces by the million for airplanes and other war machines of the United Nations. Occasionally more severe tests are made—as many as 10,800,000,000 vibrations.

The testing machine developed by the company uses an air hammer to vibrate a steel bar about two feet long and two inches wide. The bar is clamped onto the piston of the air cylinder, and the nuts are fastened onto plates carried by the metal bar.

A hand screw-driver is used to tighten the bolts with a force that would ordinarily be used by a factory worker.

The armature carrying the speed nuts under test is vibrated by the air cylinder

Self-locking speed-nuts are jarred

at an amplitude of 1/16 of an inch. The frequency of the vibration is measured by a vibrometer, as shown in the illustration, and is adjusted to 3500 cycles per minute. The tests are run on an average of 35 hours, but some are conducted for as long as 1000 hours.

SCRAP HAULING

Reduced by Application of New Finishing Program

IN AN EFFORT to speed aircraft production and reduce the transportation of aluminum scrap, the Reynolds Metals Company has adopted the plan of stamping and finishing metal airplane parts at its factory rather than shipping the raw aluminum stock to the aircraft plants for processing there, the Aeronautical Chamber of Commerce of America reports.

Parts are being routed, stamped, sheared, and shaped at the Reynolds plants, and the scrap produced in the process is sent back to the furnaces for reclamation virtually under the same roof. Further efficiency is achieved by utilizing small pieces of scrap for shaping smaller parts.

Officials of the Douglas Aircraft Company's midwest plant, where Reynolds pre-fabricated parts are now in use, declare that the plan has already effected vast savings in production time, facilities, and costs.

Burt C. Monesmith, materials superintendent at the Douglas works, estimates that from 100 tons of raw aluminum stock which might go to an aircraft plant, not more than 70 tons of it can be worked into finished parts—leaving a scrap residue of 30 percent. Such scrap ordinarily has to be shipped back to the aluminum mill for remelting.

The plan to eliminate this cross-hauling of waste aluminum was devised by R. S. Reynolds, president of the aluminum firm. This company, although it has been in production for but three years, is now turning out more of the metal than did France and England combined as late as 1939.

NICOTINE

Sources Being Sought as Shortage Develops

WITH AN estimated shortage of 300,000 pounds of nicotine, chemists are seeking new sources of what used to be a surplus commodity, according to *Chemical and Engineering News*. An unprecedented demand for nicotinic acid, a part of the vitamin-B complex, to fortify white flour, and restricted importation from the Pacific of the insecticides pyrethrum and derris, which can be replaced partially by nicotine, have created the nicotine shortage, it is pointed out by M. J. Copley, R. K. Eskew, and J. J. Willaman of the United States Eastern Regional Research Laboratory, Philadelphia, which has undertaken a research program to find more extended industrial uses for tobacco. There also has been an increased agricultural use of nicotine for food production.

Practically all of the million pounds of nicotine recovered annually in this country has until recently been used in insecticides. Now new and more efficient nicotine insecticides are sought to replace derris and pyrethrum. A jump from 10,000 pounds of nicotinic acid produced in 1940 for the treatment of pellagra to an estimated 200,000 pounds for flour fortification this year has eaten up supplies of nicotine, the best known material for making nicotinic acid.

In an attempt to make up the deficit, a considerable poundage of low-grade tobacco of certain types will be diverted from the ordinary leaf channels to nicotine manufacture. Another possible source is the growing of *Nicotiana rustica,* a species of tobacco which is not used for smoking in this country and contains about twice as much nicotine as ordinary tobacco.

"Rustica has been grown experimentally for a great many years in various parts of the country and constitutes a potential source of an appreciable amount of nicotine," it is declared.

"When the laboratory's research program on tobacco was first started," the research workers declare, "the viewpoint was almost wholly that of finding more extensive uses for a surplus commodity. It was felt that more extended use for nicotine, for example, would consume more of the lower grades of tobacco and maintain a better price for the other grades. The change in world conditions, however, has now altered this picture. Instead of wondering how more nicotine could be used, we are wondering where sufficient nicotine can be obtained."

The chemists feel that it would be hazardous to predict where the nicotinic acid of the future will be obtained, but that nicotine is still a logical source. Main objectives are more economical recovery of nicotine from tobacco and improvement in the oxidation of nicotine to nicotinic acid. Quinoline and betapicoline are also possible raw materials for nicotinic acid, and a race has developed among these three starting materials.

LEATHER

Tanning Requirements Being Met by Research

OLD KING Solomon, slipping back over the Styx for a visit now, would surely revise his oft-quoted "way of a man with a maid" verse. Since in it he proclaims only four things "too wonderful" for his comprehension, today he could hardly escape raising the ante to five. He'd surely have to include the wonders of research with, at times, startling connections between unrelated industries.

Latest of these examples appears to be use of spent pickle-liquors from steel mills for tanning leathers. Research directed toward utilizing spent pickle-liquors for possible iron-chrome tannage was eagerly pursued some months ago in view of dwindling chromium stocks, and the fact that about 50 percent of the total United States leather output is chrome-tanned.

Increasing production of domestic chromium ores of non-metallurgical quality is relaxing restrictions so the tanning and chemical industries seem to be assured of ample supplies. Although successful iron tannage would save about 30 percent of normal chromium requirements for tanning, research on spent pickle-liquor tanning has somewhat abated. Leather from steel mills is not so imminent as it was a while back; it still remains a future possibility.

Interruptions of vegetable tanning material imports, however, are cause for concern, even though an earlier trend toward use of domestic tannins has helped keep the situation from becoming too acute. Converted to a 25 percent tannin content, our consumption of vegetable tannins amounts to about 800 million pounds annually, of which foreign types accounted for 60 percent though the ration recently was reduced to 50 percent. Sharp curtailment of available cargo space for delivery of even South American tanning materials —quebracho, divi divi, tarra, and others— further forces larger production of domestic tanstuffs.

Production of chestnut extract, already popular, has increased and investigations of canaigre root, domestic sumac, hemlock, and mangrove are under way. Mangrove bark with a tannin content of 30 percent is available in large quantities in Florida, but high costs of gathering and shipping to extract plants may prove an obstacle to utilization.

However, chances are good that research will solve the tanstuffs problem, and at the same time foster another industry to further extend our future self-sufficiency.—*The Chemical Digest.*

INDUSTRIAL TRENDS

AS RUBBER GOES

WHEN Japan started her drive into the rubber-growing areas of the Far East, she dealt a blow to the rubber industry of the United States, creating a serious shortage of crude rubber. With the industry rapidly gearing itself to war-time production, this blow seemed, for the moment, to be the end, to be the one thing that could mean the difference between final victory and defeat. Rubber was vital to many war machines. Without rubber, we were licked before we really got started.

But as time went on and opportunity presented itself to take stock of the situation, there came the realization to many that the blow was really to be considered as an aid to the United States in more ways than one. Regardless of how the factors of speed may be viewed, often in the light of political leanings, a synthetic rubber industry sprang from the laboratories of the United States.

Although it is not possible to make direct statements as to synthetic rubber production at present or in the immediate future, it is an open secret that plants now being constructed will have sufficient capacity to more than fill the country's requirements of today and many tomorrows. What will be the base from which it is made is still a question, although the petroleum advocates appear to have most of the convincing arguments on their side. This in spite of dwindling petroleum reserves, since it has been established that to make sufficient butadiene to produce 800,000 tons of rubber a year (our largest annual consumption in pre-war days was 765,000 tons) would would demand only some 2 percent of our largest peace-time production of petroleum.

Synthetic rubber is even now meeting the tests on the toughest proving grounds in the world—war. It is, of course, being tested in tires and, reports have it, is showing up remarkably well. Then it must be remembered that synthetic rubber has many desirable qualities not found in natural rubber. Among these are resistance to the attacks of gasoline, oils, and other solvents of natural rubber, better aging characteristics under adverse conditions, greater adaptability during manufacture to definite ends, and so on.

From all this it becomes apparent that synthetic rubber has an unlimited future, if other factors do not interfere too much. For example, there is the question of what will happen to the synthetic rubber industry when natural rubber once more becomes available. Tariffs may be erected to protect the industry if, by that time, the price of synthetic has not been reduced sufficiently to make it a direct competitor of natural. Or it may work out that the Far East will be so badly in need of re-established markets that natural rubber will reappear in the United States, while the synthetic industry will receive the artificial respiration of subsidy, again assuming that a price differential exists.

However the financial angle works out, it is now certain that synthetic will find substantial post-war markets, whether alone or in combination with the natural product. Already the laboratories are working on the problem of adapting existing—but frozen—markets to synthetic rubber for after-the-war operations. At the same time, new markets are being developed.

Itemizing a few of the known possible uses of synthetic will point the way sufficiently to indicate the enormous markets which the material can command in days to come: Rubber springs for vehicles, with all the obvious advantages over metals; long conveyor belts for use on huge construction projects, speeding up work and reducing labor requirements; rubber containers and container linings for transporting liquids; water pipes that will stretch when frozen but will not break; women's hose that will have astonishing wearing qualities; tubeless tires—the list could be extended indefinitely to include uses that will affect the daily lives of every man-in-the-street.

WHERE IS OIL HEADING?

THE SEEMING gigantic inroads that the present war is making in our crude-oil reserves were hinted at in the preceding note on synthetic rubber. Just how big a dent will be made cannot be foreseen at the moment, but that it will be big indeed is to be guessed from the way in which the petroleum industry is tightening up its operations and giving the gun to research work aimed at higher efficiency in processing as well as at the discovery of new resources.

What we are directly concerned with here is that, on the eve of a breath-taking expansion of the chemical industry based on petroleum as a raw material and dealt with on this page in past issues, there appears on the horizon a possibility of developing shortages in the raw material itself. These shortages, however, despite the furore that they have caused in the daily press, are not too serious when viewed in a calm over-all survey.

It is true, indeed, that since 1938 we have been using petroleum in this country in excess of the amounts discovered. Obviously, since oil is not a crop that can be planted year after year, if this keeps up indefinitely things are going to be bad. There are, however, other answers. Proved oil areas are being drawn on as much as possible, and new explorations are not keeping pace. The reason here is the gamble involved in exploration, plus increased cost of the work and priority restrictions, all tending toward a reluctance on the part of oil gamblers to risk too many dry holes. This angle is being attacked by the government in the form of encouragement of wild-catters, encouragement which may soon bear fruit. Then, too, there is the fact that all oil is not the best for all purposes. Some of it will produce high-octane gasoline, while oil from other fields will not. Conversely, some oil is better as the chemical industry's raw material mentioned before, so that there appears to be some chance here of a set of checks and balances that will help in the long run.

Then there are other ways of oil conservation that are being put into effect. For example, natural gas, often wasted, is being put to use as a replacement for oil in heating, where distribution and storage means make this feasible. Oil-shale deposits are known; other new ones, notably in Alberta, have been discovered and are being worked. Coal as a source of oil has been known for a long time, and can easily enter the petroleum picture when the pressure becomes too great.

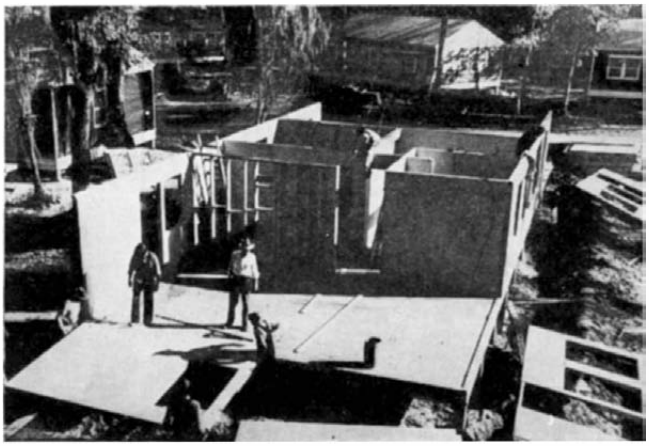
Here, it would then seem, the big war dent being made in our oil resources—while it is no figment of the imagination by any manner of means—is not one which spells disaster to the petroleum industry or which means that John Public has been permanently taken out of his automobile and put on his feet for local locomotion. What the dent really means is that the industry as a whole is working more directly toward efficient conservation rather than with no thought for the needs of tomorrow.

HOW STEEL IS ORDERED

A NEW TREND in the steel industry, brought about by the exigencies of war-time production, bids fair to inaugurate an entirely new method of specifying a particular type of steel desired by a steel user. At the turn of the century alloy steels were almost unknown, the user merely specifying that he wanted soft, medium, or hard. Then came World War I, with a tremendous rise in the demand for steel, both as to quantity and quality. Alloy steels came into their own and users started to order steel by specifying its exact chemical formula. In some cases a steel order would be received by a producer in which several different types would be specified, differing from each other by only a fraction of a percent in one or more of the alloying metals.

Such procedure, of course, complicated steel making to an enormous extent. When World War II stepped up the demand for all types of steels, however, these wasteful measures had to be curtailed; shortages of certain alloying metals, also, led to the realization that steels could efficiently be ordered by specifying their physical properties rather than exact chemical formulas. This method is being found quite satisfactory to the consumer as well as to the producer and is now being followed in many industries without letting down on quality in any respect.

—*The Editors*



At 9 A.M. three trucks (upper left) rolled onto the building site, carrying all the material for the construction of a six-room house, as described below. By 10 A.M. the flooring had been laid over the foundations that had previously been prepared. At 10:30 A.M. the center section was raised into place. The photo above shows a close-up of the work in progress, taken between the last mentioned hour and 12 o'clock noon, at which time the roofing panels and sheathing were going into place, the ceiling sections having already been set. By 3:20 PM the building was completed and ready for occupancy, as at left. The success of this method of construction rests on the application of many "tricks" such as those described below, including the use of double-headed nails, pre-fabricated wall sections which slide into place, framing sections, and so on

A House in Six Hours

Three Trucks Haul All Materials for a Six-Room House Which Is Put Together With Double-Headed Nails

PROVIDING a six-room home for two families in less than a full working day is illustrated in the accompanying pictures showing three phases of demountable house erection operations for war workers in South Carolina. Ten men, including six carpenters and four laborers, put together the house shown in the six hours and 20 minutes between 9 A.M. and 3:30 P.M.

The materials for the entire house just filled three trucks (shown in the first picture). The wall sections, ceiling sections, roof parcels, partitions, and other major units were pre-assembled in the contractor's mill and, as loaded on the trucks, were ready to be put together according to a simple numbering system.

First step in construction was placing of flooring over foundations that were laid out and prepared ahead of time by other work crews, who also put down sewer and water lines.

The first section to be put up was the center partition dividing the house into separate dwelling units for two families. One of the key construction principles of demountable housing used in these structures is the use of short metal straps, with holes in each end to receive double-headed nails. Rows of these straps tie the walls to the foundation, brace the corners and perform other strengthening functions. The double-headed nails—the only kind used in these homes—provide a major part of the demountable element. The first head is driven flush with the strap or the wood, while an offset section of the nail allows another head to remain projecting. This projecting head permits all nails to be drawn easily and rapidly without damage to the structure, should need for demounting or removal arise.

Extending toward the lower foreground of the second photograph above, along the floor, are two narrow wooden strips. The strip on the left has already been nailed in place, to mark the position where a partition will be erected. Each wall section, partition, and other unit of these demountable houses has a groove in its edge that fits over strips such as these. Entire prefabricated walls can be slid into place by this tongue-and-groove principle, and, when set, the sections are tied down by the metal straps and double-headed nails.

Another feature is the use of Upson board on the partitions and inner sides of wall sections. Outside coverings of the sections are of three-ply plywood.

The section of framing at the left center of the second picture is a special section, left without covering at the mill in order to make easy the installation of pipes and electrical conduit. These pipes and lines are installed while erection proceeds, and as soon as the installation of utilities is finshed, the wallboard covering, precut to fit, is nailed over the bare framing.

By noon of the day of erection, the house was well on its way to completion. All of the wall panels as well as the inside partitions had been erected; windows had been set and gables erected. The ceiling sections had been set in place above the rooms and the first roof panel had been placed. A protective layer of asphalt felt is placed over the roof boarding before shingling.

By 3:20 P.M. the building was complete, with asbestos shingling on the walls and asphalt shingles on the roof. Doors were hung, porches and steps added, and other details completed. Landscaping, however, remained to be done, and plumbing and electric fixtures were still to be attached to connections that were already in place. Contractors on this project—a part of a 2400-unit project—are Skinner and Ruddock of Charleston.

Text and illustrations courtesy "Engineering News-Record."

Fighting Fires Aloft

Precautions Taken on the Clipper Planes to Reduce Fire Hazard to an Absolute Minimum

IF, BY any remote chance, fire should break out in one of the four 1600-horsepower engines of a Pan American Clipper on a transatlantic flight, it's a safe bet that passengers wouldn't even know it. For the flight engineer would step calmly to a control board, turn a valve, and put out the fire with a blast of flame-smothering vapor.

That's how well-organized the fire-protection equipment is set up on these 42-ton flying boats that pioneered America's aerial life lines to Europe, Africa, and Asia. So carefully have Pan American engineers planned for every eventuality that this great airline has, for example, completed approximately a thousand transatlantic crossings without a single fatality or serious accident due to fire.

The way this ingenious fire-protection functions can be seen during the regular "turn-around" overhaulings which the Clippers get at the Marine Terminal of the New York Municipal Airport at the completion of each transatlantic trip. These overhauls, which involve going over the entire ship with a figurative fine-tooth comb in less than 24 hours, also include frequent inspections and testing of the fire-extinguishing systems.

First step in the fire system's check-up is the removal and weighing of the carbon-dioxide cylinders—the heart of the extinguishing equipment. These containers, which hold liquified carbon dioxide under terrific pressure, provide the vapor which is capable of smothering an engine fire even though the plane is in full flight miles above the Atlantic. If the cylinders show the prescribed weight, the inspector knows that no leakage has occured during previous flights and an adequate supply of the liquid is available.

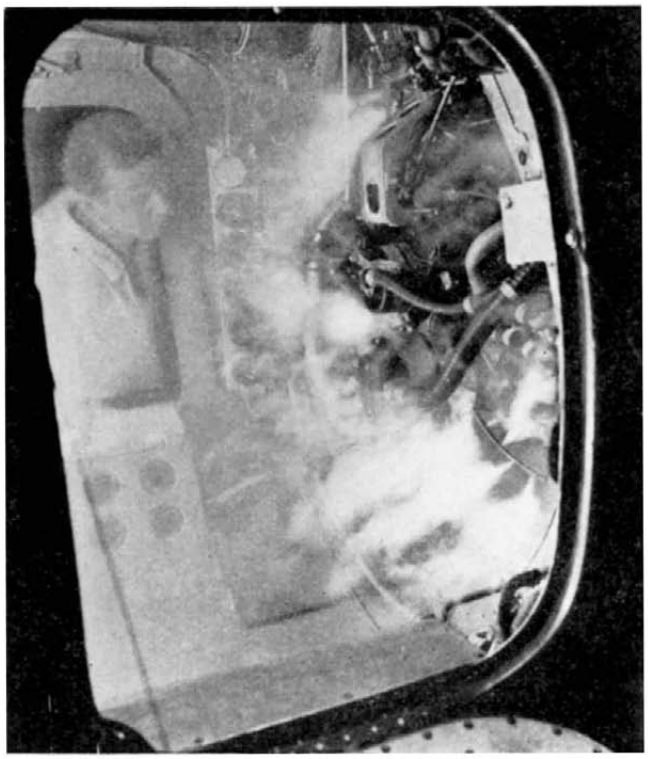
Another step in the check-up system, but which is done at less frequent intervals, is complete discharge of the carbon dioxide through the plane's gas distribution system. One of the hundreds of maintenance engineers who swarm over the Clipper during these speedy overhauls aims the control valve first at one motor then at the others in order to make sure that the vapor instantly reaches the scene of potential fire. Other engineers stand by each nacelle to check on the gas discharge, which also serves to remove any dirt accumulations from the piping and shows up possible leaks.

This piping leads almost directly from the carbon-dioxide cylinder to the four engines, but passes through the control panel where the flight engineer can set his valves to discharge the gas into any one burning engine. A double carbon-dioxide container is also provided to give a burning engine a second shot of gas in the event that the first one does not completely extinguish the flames.

In addition to this unique built-in fire extinguishing system, each clipper also carries portable carbon-dioxide guns in each engine nacelle. These portable units, which have pistol grips and triggers, each contain two pounds of liquid carbon dioxide and are used like a "Tommy" gun for fighting localized fires within the wing cavity or engine compartments, all of which are accessible to the crew during flight.

The way in which carbon dioxide works is worthy of note. Discharge of the liquid, which instantaneously becomes a gas when it hits the air, reduces the oxygen content of the air to 15 percent or less, at which point most fires cannot burn. Even in the terrific air blast entering the radial engines during flight, the gas effectively reduces the oxygen content for a few split seconds—long enough for the flames to be snuffed out and remedial measures taken to prevent re-ignition.

Right: **The control panel from which any one of the four motors on a Clipper ship can be flooded with carbon dioxide gas.** ***Below:*** **An unusual photograph of a Clipper motor enveloped in a fog of fire-smothering gas during a test discharge.** ***Lower right:*** **Preparing to weigh carbon-dioxide containers during a routine check**



Planet Companions

Three Faint Companions of Stars Are Half Way In Mass Between a Star and a Planet

HENRY NORRIS RUSSELL, Ph.D.

Head of the Department of Astronomy and Director of the Observatory at Princeton University. Research Associate at the Mount Wilson Observatory of the Carnegie Institution of Washington

ASTRONOMICAL discoveries of importance are sometimes, though rarely, made at a glance—as when a dozen people recognize a nova which has grown to brightness overnight. More of them arise from a planned and deliberate search, such as that of Pluto, after hundreds of thousands of star-images had been inspected, in a photographic campaign so designed as to assure the ultimate discovery of a distant planet, if one bright enough to be observed existed. The most renowned of all such discoveries—that of Neptune—came in yet another way, as a result of the application of painstaking calculations to long and accurate series of observations made for other purposes, with no thought of the discovery to which eventually they led.

A discovery of unusual interest, made in this last way—indeed, two of the same kind—has just been discussed in the technical literature and, under the principle which has always ruled in these columns, become available for discussion.

Two observers, working independently, have found that two different stars among our nearest neighbors are attended by companions, in orbital motion about them, which are of such small mass that it is practically certain that they are dark bodies, and have a good claim to be called planets.

It has long been realized that, if the stars have planets circulating around them, there is no hope at all of detecting them as we observe the planets of our own system, by reflected light. A planet twice the diameter of Jupiter and distant from the nearest star, Alpha Centauri, as far as Jupiter is from the Sun, and shining by reflected light, would appear to us like a star of the 21st magnitude—that is, barely bright enough to be photographed with a 100-inch telescope, under the best conditions, if it stood alone on a dark sky. It would actually be within a few seconds of arc of its primary, whose light, a hundred million times brighter, would drown it out hopelessly.

There is, however, another way in which a planet might reveal its presence. If any two bodies, such as the Earth and Moon, form a pair in orbital motion, the gravitational attraction of the Earth on the Moon, measured in units of force, is exactly equal to that of the Moon on the Earth; but the motion of the more massive body is less affected by this equal force. Neither one describes an orbit about the other as a fixed center; but both circulate in orbits of the same shape but different sizes about their common center of gravity, keeping on opposite sides of it. The Earth is (in round numbers) 80 times as massive as the Moon; so that, while the Moon describes its orbit at a distance of 240,000 miles from the common center, the Earth (more precisely its center) circulates about this point in an orbit a little less than 3000 miles in radius.

It is the center of gravity which describes an orbit about the Sun, in accordance with Kepler's laws. Should we calculate the motion from these laws, we would find the actual Earth at new Moon 3000 miles farther from the Sun than the predicted value. At the full phase, when the Moon is outside the Earth's orbit, the Earth is 3000 miles inside. At first quarter the Moon is behind and the Earth ahead, and so on.

NOW MAKE, for the moment, the physically absurd asumption that the Moon was absolutely black, reflecting no light at all. Only the Earth would be visible to a distant observer. We may imagine him looking from such an angle that the Moon never eclipses the Earth, even partially. Even so, he could discover the Moon, by making a sufficiently long and accurate series of observations of the position of the Earth relative to the Sun. Comparing them with theoretical motions in an elliptic orbit, he would find that, whereas this satisfied the observations of the other planets, the Earth's motion would show a small but persistent oscillation, in a period of 27 1/3 days (one sidereal month). He would thence conclude, correctly, that the Earth was attended by an invisible satellite having this period.

If he could find the Earth's mass in some other way—say by the effects of its attraction on the motion of the other planets—he could then calculate how far away this satellite would have to be to possess the known orbital period. This distance would come out 80 times the radius of the observed oscillation, and he would then be sure that the Earth was attended by an invisible satellite 1/80 as massive as its primary.

The alert reader of this analogy will naturally inquire why it is said that the observations of the other planets would not reveal deviations from Kepler's laws, although most of them have satellites. The answer is that the masses of these satellites are but a very small fraction of those of their primaries, 1/3500 for the largest satellite of Saturn, and at most 1/10,000 for the satellites of Jupiter. The resulting oscillations would be too small to be detected. (A small oscillation of Neptune, due to the atraction of its one known satellite, has actually been observed.)

This illustration has been developed at length, because it illustrates fully the principles which must be applied in the case of a star. A very small satellite will produce too small an effect to be observable. The detection of small oscillations, and hence of small attendants, demands two things. First, the star must be one of our near neighbors in space. For similar physical properties of the system (period and masses of the two components) the range of the oscillations, in miles, will be the same. The nearer the star, the bigger will be this oscillation, measured in hundredths of a second of arc upon the heavens.

SECOND, our observations must have the highest possible accuracy—that is, they must be based on photographs made with telescopes of long focus. The technique of such observation has been fully developed. Results of high accuracy, with an average error of about 0″.03 from a single plate, can be obtained by comparing the measures of stars not more than 10′ or so apart in the sky, so long as these are of about the same brightness—or reduced to the same brightness by some device which does not distort the images. But still more accurate measures, with an average error about 0″.005, can be made of the relative positions of the two components of a double star; provided that these are nearly of the same brightness. In this case, dozens of exposures of the pair can be made and measured on a single plate, and the average result from two or three plates may reach the remarkable accuracy just stated.

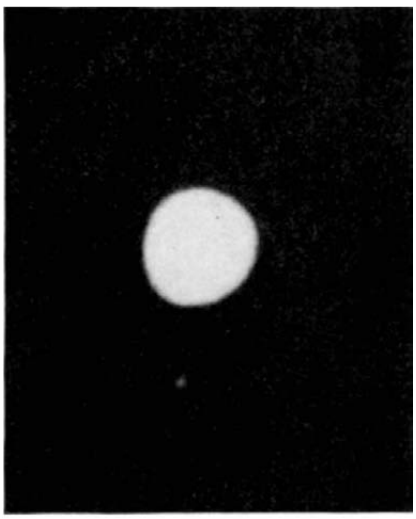
Observations of both these types have been made in great numbers—in the first case to determine the parallaxes of stars, and in the second, to study the motion of binary pairs. It is usually found that the observations are represented, within the limit of their accuracy, by motion in an elliptic orbit in the second case, and by rectilinear motion in the first, combined with the apparent oscillation resulting from observation from the moving Earth. But sometimes these standard assumptions prove insufficient to account for the measures, and it is evident that some additional motion is present—which, when the observations are continued long enough, turns out to be a periodic oscillation.

The oldest examples of such behavior were found nearly a century ago for Sirius and Procyon. Here the oscillations are so large that they can be detected even with the relatively low accuracy of meridian observations. Bessel showed, long ago, that Sirius must have a companion revolving about it in a period of about 50 years, and Procyon in one of 40. Both these bodies have since been seen with powerful telescopes, and followed through a whole revolution. The companion of

Sirius has a mass nearly equal to the Sun's; that of Procyon is one third as great. They are faint, but self-luminous stars—excellent examples of the now well-known white dwarfs.

A few more cases of the same sort have been found in the course of parallax observations. A notable example has just been found by Dr. Reuyl, of the McCormick Observatory, at the University of Virginia. It is a faint red dwarf star, known as Cincinnati 1244, since this is its number in a star-catalogue published by that Observatory. Observations from 1915 to 1942 are now available, and show that, after allowance for a proper motion of 0″.490 per year and a parallax of 0″.201, there remains an oscillation with a period of 26.5 years, corresponding to motion in an orbit of eccentricity 0.6 and with a mean distance of 0″.11 between the bright star and the center of gravity, which corresponds to an actual distance of only 50,000,000 miles.

TO FIND HOW far off the companion is on the other side, the mass of the visible star must be known. For faint red dwarfs of this sort, there is a close relation between the mass and the real brightness. The latter is 1/35 of the Sun's and, by comparison with other known cases, the mass should be 0.35 times the Sun's. It follows from Kepler's laws that the mean distance of the invisible companion from its primary should be 600,000,000 miles. The invisible star is therefore 11 times as far from the center of gravity as the visible one, and should have but 1/11



Neptune and its unnamed satellite, photographed with the 40-inch refractor at Yerkes. The diameter and orbit diameter are comparable with those of our Moon, but the orbit is inclined at about 40 degrees to that of the planet and the orbital motion is retrograde—that is, from east to west

of its mass, or a little less than 1/30 of the Sun's. From the general run of the relation between mass and brightness, there can be no doubt that a star of this very small mass would be unobservably faint.

Double-star observations, however, have revealed still more remarkable objects. Dr. Strand, of the Sproul Observatory at Swarthmore, has made a number of very thorough studies of these, described in Scientific American, March 1942, page 135, including one of the famous system 61 Cygni, consisting of two stars, one twice as bright as the other, in orbital motion with a period of 720 years. This is one of the nearest stars in the sky (parallax 0″.294, distance 11 light-years). The two components are nearly equal in mass, 0.58 and 0.55 times the Sun's mass.

Precise photographic observations of this pair have been made since 1914 by various observers. Both these and the earlier, less accurate visual observations, were used by Strand in computing his orbit—a task which required weeks of laborious calculation. When the calculated and observed positions were compared, a small, but unquestionable, oscillation appeared. Only observations of the highest precision could have detected it, for its extreme range is little more than 0″.03—which, on photographs taken with a telescope 30 feet long, corresponds to but a 20,000th part of an inch. Compared with the positions calculated from the large orbit, the star drifts slowly eastward for 3.5 years, swings back westward in less than half this time, and repeats the process with a period of 4.9 years. The inequality of the two intervals shows that the orbit of the close pair is highly eccentric. The north-and-south motion is smaller, but definite. Combining them, Dr. Strand finds that the bright star moves around the center of gravity of itself and the invisible companion in an orbit of eccentricity 0.7 nearly edgewise toward us (inclination 80°). The mean radius of this orbit is 0″.020 (allowance being made for effects of foreshortening). At the star's distance, this corresponds to 6,300,000 miles—by all odds the smallest orbit as yet known among the stars.

So far the situation is absolutely clear; but it is not yet known which of the two visible stars has the dark companion. The measures give only the relative position of the two, and this is equally affected by an eastward shift of one as by a westward displacement of the other by the same amount. There are two ways in which this uncertainty might be dispelled. Measurements of the positions of both stars, relative to others in the field of view, would show which one is moving uniformly, and which shows the oscillation; but, even on the best photographs, the much larger distances involved could not be measured with the extreme accuracy required. A second way is more hopeful. The motion of the star in the small orbit would alter its velocity toward or from the Sun by a maximum range of a little more than one kilometer per second. This is easily within the accuracy of measurement of powerful spectrographs. The next favorable opportunity will come in 1946 and 1947; and after that, we may know which star has the companion.

	A3	B2	C0	D1	E2	F3	G4
	0.00	*7593.16*	*7750.75*	*7810.79*	*7927.46*	*8095.24*	*8307.61*
j1 *30787.30*			23036.52	22976.52	22859.86		
k2 *30858.77*				23047.95	22931.30	22763.57	
l3 *30965.42*					23037.94	22870.19	22657.83
m4 *31106.35*						23011.12	22798.75
n5 *31280.37*							(22972.72)
o0 *33338.26*				(25527.47)			
p1 *33423.81*			25673.05	25613.01	25496.36		
q2 *33542.12*				25731.31	25614.61	25446.95	
r3 *33671.57*					25744.08	25576.37	25363.96
s4 *33816.13*						25720.92	25508.48
t2 *27728.82*	27728.80	20135.67			19801.36	19633.61	
u3 *27820.24*	27820.20	20227.07				19725.04	19512.62
v4 *27935.26*	27935.26)						

Answer to last month's spectroscopic "cross-word puzzle." Numbers in parenthesis are "unkeyed" and added to show how they go. All are keyed into the large diagram

THE MOST interesting question, namely, what is the mass of the companion, need not wait for an answer, for the masses of the two bright stars are so nearly equal that the distance of a companion revolving about either one in a period of 4.9 years would be substantially the same, 223,000,000 miles. This is 35 times the distance of the bright star from the center of gravity. Hence the mass of the companion must be 1/34 of that of the brighter star, or 0.016 times the Sun's mass.

This is only one tenth as great as the smallest mass that has even been observed in a visible star, and 16 times the mass of Jupiter—so that the newly discovered body may at least be described as half way between a star and a planet.

When its discovery was announced by Dr. Strand at a meeting last winter, it stood quite alone, as by far the least massive body known to exist outside the solar system. Since then it has found a rival. Dr. Reuyl, from similar photographic observations of the binary star 70 Ophiuchi, finds a similar small oscillation, with period 17 years, and half-range 0″.015. The parallax is 0″.20, so that the distance from the center of gravity comes out 7,000,000 miles. This is an approximate value, as it has not yet been practicable to determine the eccentricity of the small orbit.

As in the preceding case, it is not possible at present to tell whether the companion belongs to the brighter or fainter star of the visual pair. In the first case, its mass comes out 0.012 times the Sun's; in the second, 0.008.

Here, then, we have another body of almost planetary mass. The question whether it should really be called a planet is one of the most interesting which has been before the astronomical public for a long time; but its discussion must be postponed till next month. — *Manitou Springs, Colorado, March 22, 1943.*

New Key to the North

When Peace Comes, the Alcan Highway Will Unlock Nature's Rich Storehouse of the Great Northwest

A. D. RATHBONE, IV

JUST 150 years ago this spring the first white man ever to cross the American continent north of Mexico stood near what is today the southern terminus of the Alaska, or Alcan, Highway. In the wildest flights of his imagination—and his was, indeed, an active mind—he could not have conceived that Fort St. John, then a tiny trading post on the Peace River, would one day become an important way-station on an 1800-mile highway vital to the defense of his native Great Britain and her allies. Nonetheless, that canny young Scotsman, Sir Alexander Mackenzie, had fought his way up hundreds of miles of the Peace River in 1793 for the same reason that motivated a meeting of representatives of the United States and Canadian governments 140 years later.

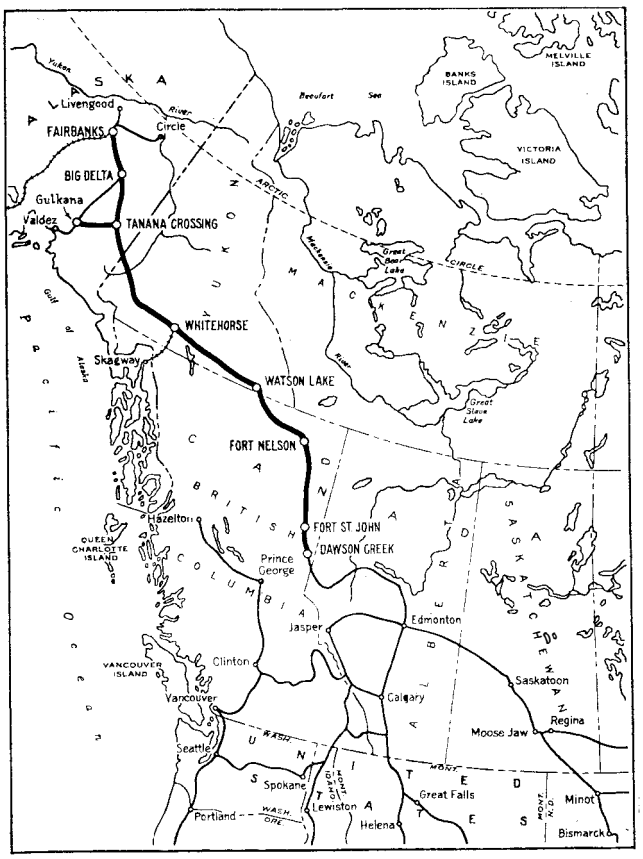
The intrepid explorer and the joint committee of 1933 were both searching for practical routes that would further the economic development of their respective nations—one of man's major activities from the earliest age of barter and exchange to the vast ramifications of today's international trade.

Seldom have the economic lives of two great countries been confronted with so many varied possibilities of future growth through the opening of a single new trade route as have Canada and the United States by completion of the Alcan Highway—and probably never has such an important link been put into service with comparable scientific ingenuity and speed.

So long as the necessities of war utilize the facilities of this new, and as yet incomplete, road to the utmost, it may be too early to attempt specific prophecies as to its after-the-war use, but certainly it is not premature to speculate on general peacetime possibilities, especially when such speculation can be based on known facts concerning feasibility of agriculture, mining, manufacturing, exploration, and recreation in this newly opened area. As to settlement and investment of capital necessary to foment development of this hitherto little known section of the continent, history is crammed with stories of the call of the frontier. When this newest call comes after the war, it seems unlikely that it will go unheeded.

What is there about this latest highway engineering miracle besides its present strategic use and the romance of its construction that would cause present speculation regarding its future adaptation? After all, there is a railroad network throughout the more populous section of Alberta Province; more sparsely settled British Columbia is also served by the "Iron Horse;" the great Mackenzie-Athabaska-Peace River system is splendidly organized for water-borne commerce during the warmer months; Canadian and Alaskan commercial aviation has performed winter and summer impossibles for many years. Why, then, should an 1800-mile road, traversing some of the wildest parts of British Columbia, Yukon Territory, and Alaska, be of such potential economic interest to the future—save, perhaps, to anglers and hunters?

Primarily, the answer lies in sudden and drastic war-wrought changes in transportation methods, by sea, on land, and in the air. Thousands of tons of freight must be moved as rapidly as possible between points not heretofore considered in the same traffic category, or, at least not served by adequate facilities. Motor truck roads which, under normal peace-time conditions, would be considered too costly, or unfeasible for other reasons, are built over mountains and across deserts. In many of these instances it is entirely reasonable to expect the consequential effect which such strategic highways must exert, as they have always exerted, on the lives of the existing population in the area thus served, and on the lives of those who, because of increased ease of transportation, will become residents of the area. Particularly has this been true if the newly served section contains natural resources and agricultural possibilities. These abound in Alberta, British Columbia, the Yukon Territory, and Alaska, despite popular conception that much of the Great Northwest consists of impassable muskeg, impenetrable forests, unsurmountable mountains—all cloaked in a climate too rigidly frigid to grow anything but icicles throughout most of the year.



Route of the 1800-mile Alcan Highway

Even the young Mackenzie, in 1788, wrote in his journal of luxuriant growths of garden produce in far-north Alberta. He mentioned turnips, carrots, parsnips, potatoes, cabbages, and said: "There is not the least doubt but the soil would be very productive." It has been all of this, and with a vegetation generally comparable with that of Maine and a winter climate less severe than that of North Dakota, Alberta has progressed far in farming and stock raising since the days of the fur traders.

More recently, however, the Province has claimed a place among mineral-producing states of this continent. Surveys of newly discovered northern oil sands brought estimates of from 100 to 250 million barrels, of which about 1 percent is at present economically available. Said the Edmonton Journal, editorially: "The federal (Canadian) government already has set aside $40,000,000 for construction and equipment of a plant to make rubber. Extraction of petroleum from McMurray oil sands . . . may lead to the development of a great synthetic rubber manufacturing plant at or near these northern Alberta deposits."

Lead-zinc lodes near Great Slave Lake, just above Alberta's northern boundary, compare favorably with those of the famous Couer D'Alene district in Idaho. Still farther north, on Great Bear lake, are the world's richest radium deposits and silver ore that is seldom exceeded in value anywhere. Alberta's southern coal fields have long produced favorably, and of later years three fourths of the salt used in the province is mined within her boundaries. Copper, nickel, tungsten, tin —all vital today and unquestionably of

value tomorrow—are known to exist in considerable quantities, while the total list of lesser minerals found in Alberta would reach a score or more.

Although no part of the Alcan Highway itself is in Alberta, its southern terminus, at Dawson Creek, just over the border in British Columbia, is reached by a 500-mile standard-gage branch railroad which, in turn, connects with the main line Canadian National and a branch of the Canadian Pacific at Edmonton. The many miles of railroad sidings, the scores of warehouses, the unloading platforms, all Army-built for war-time service at Dawson Creek, will still be there for possible commercial use when peace comes. As present plans do not contemplate extending the highway south of Dawson Creek, the Province of Alberta and the city of Edmonton will play their role in the economic scheme of things to come by providing the connecting rail link between Alaska and the United States.

All photographs courtesy Caterpillar Tractor Co.

Much of the Alcan Highway was constructed through timber. In this stretch tractors and trailbuilders cleared the heavy bush growth; scrapers and graders followed; this stretch of the road is surfaced for all-weather use, with adequate drainage ditches

WHEN a tried and tough Colonel of the Army Engineers said, "Guts and tractors built that road," he must have had in mind, among other sections of the Alcan Highway, the 662-mile stretch from Dawson Creek to Watson Lake, during which it skirts some of the tallest and roughest of the Canadian Rockies and attains to an elevation of 4212 feet, the highest point on the highway. The 366,255 square miles of British Columbia have always been hard and cruel, but the mountains with their severe climate and the milder, more temperate valleys hold much that man considers valuable. Early known for its coastal fisheries and its gold. Canada's westernmost province has been a tough economic nut to crack. However, as the Dominion's chief copper producing state today, with known extensive deposits of lead, coal, zinc, silver, and gold, with huge forests of excellent Douglas fir—all of which will eventually reach the world's markets in greater quantities than at present—British Columbia's economic future needs transportation as much as any other factor to assure her continued progress.

Partially due to topographical features, soils of the province are non-uniform in texture and composition, varying from fertile dark loam and muck to light sandy and gravelly areas. Proper irrigation in the southern interior has produced abundant harvests of fruits, vegetables, and field crops, including alfalfa. In the Peace River Block, sliced by the Alcan Highway, huge virgin agricultural sections that are suited for mixed farming and grain await the plow. The new road to the continent's "upstairs," together with amplification of existing railroad and aviation facilities, will play its part in the commercialization of British Columbia's huge "backyard."

Reminiscent of "Main Street" in any American village prior to the advent of the automobile, the principal thoroughfare of this Alcan Highway town will offer better than mud-hole traction to future truck and bus traffic, and because of economic forces, it may become a busy thoroughfare in a new city of the north country

To the fame of "The Spell of the Yukon," builders of the Alcan Highway have added a new lore, no less fascinating than that of the Klondike and its gold rush. Engineers and construction men doubtless agree with Robert W. Service's indictment, "It's the cussedest land that I know." Although for the most part the Yukon is a vast plateau, in the southwest, through which the highway winds, are portions of the Rockies, including 19,850-foot Mt. Logan, highest point in Canada. Because of its far-northern isolation, and with Pacific winds that might otherwise temper the climate cut off by mountains, the long Yukon winters are bitter cold. Brief summers, however, are often actually hot and the almost 24-hour-long days produce fairly good crops of grain and roots in some sections. But it is with minerals, timber, and Alpine-like vistas with unbounded summer recreation possibilities that the Yukon will bid for future economic wealth. There are gold, silver, lead, copper, and coal in the rough and rugged terrain; there are rich forests of spruce and poplar; there are fabulous fish in the lakes and streams, and it is a hunter's paradise which will attract the sportsman, the nature lover, and the vacationist, with the millions of dollars such trade brings to well-organized vacation lands.

Whitehorse, Yukon's principal city, houses about a quarter of the territory's population of 4687. Owing its birth to Klondike days, the town is also the northern terminus of the narrow-gage White

Pass & Yukon Railroad, also of gold rush fame, which traverses a torturous 111-mile mountain trail to Skagway, Alaska, at the head of the Inside Passage, route of sea-borne commerce to Vancouver, Seattle, and points south. As the junction point of rail and highway transportation to the interior, with a modern airport already in operation prior to the war, Whitehorse may well find itself on the threshold of becoming the future metropolis of the Yukon.

The Alaska-Yukon border is 325 miles west of Whitehorse, via the Alcan High-

Since 1670 Hudson's Bay Company has been only commercial enterprise in many back-of-behind sections that will now be served by Alcan Highway

way, and 100 miles further is Tanana Crossing, where the highway splits, one arm running west to Gulkana and a connecting road to Valdez, on the Gulf of Alaska. The Alcan's other branch rolls on another 100 miles to Big Delta, its northern terminus, 1582 miles from Dawson Creek, where it connects with Alaska's own system of 2366 miles of roadways. Thus, by truck and by rail, are the commercial centers of Anchorage, Seward, Fairbanks, Valdez, and other smaller Alaskan communities joined to Edmonton, in Alberta, to Spokane, to Minneapolis, to Chicago, to New York.

Of Alaska's economic future, little need be said, save to recall that its original purchase price of $7,200,000 has been returned thousands of times over by its exports of furs, timber, fish, gold, silver, platinum, copper, coal, and petroleum. Often thought of more as a recreational area than as an economic factor in the life of the nation, Alaska's agricultural possibilities have yet to be plumbed to their depths. Wildlife resources are estimated at $100,000,000; the 1940 salmon pack was valued at $31,000,000; more than $26,000,000 worth of gold was mined in the same year, and other products rank in big figures.

Whether, some day, the "Iron Horse" will join forces with the Alcan Highway, the coastal steamship lines, and the fast-growing aviation industry in linking ever more closely the economic lives of Alaska, the Yukon, British Columbia, and Alberta with the United States is something that must await a future answer. As for "the road that couldn't be built," it is in full war-time operation, providing means of transport for 60,000 to 70,000 tons of cargo per month. Thousands of trucks rolled all winter carrying soldiers and supplies to Alaskan posts, according to Secretary of War Stimson's announcement, and they brought back tons upon tons of strategic raw materials.

First built on an 18- to 24-foot width through a minimum 32-foot clearing, the Alcan Highway will be widened throughout its entire length this summer to a 24-foot graveled roadway. Eventually, the pile trestles which bridge the many streams will be replaced by permanent structures. Then, too, cuts, fills, and grades will be improved from their war-time emergency status to the broader, safer, more conservative construction. When the days of unlimited gasoline and rubber return, we may be sure that not only will the Alcan Highway find its proper commercial niche, but also that it will serve as an unexcelled scenic and recreational jaunt for thousands of travel-hungry Americans.

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MYOPES

Eugenically Speaking, Near-Sighted Persons Shouldn't Mate

MYOPIA is believed by science to be hereditary. In an address before the American Medical Association, Lawrence T. Post, M.D., St. Louis ophthalmologist, stated that "there is little evidence to show that this is usually anything but a hereditary defect handed down just as other physical characteristics are. Continued stressing of the importance of judicious mating may result in its diminution and finally bring about its end.

"Even if it is impossible to bring about complete eugenic mating, it may at least be feasible to prevent the marriage of two people afflicted with extreme nearsightedness. Failure to do this is probably the principal reason for the very large incidence of this defect among the Germans today."

NYLON SCREENS

Will Replace Many Metal Screens After the War

AN ENTIRELY new window screen, chemically made, and containing no metal, will be available to American householders after the war. It is made of nylon, now used exclusively for vital military purposes. Having all of the good characteristics of metal screening, and many qualities besides, it can be produced in any color, it will not stain the sills, it will not corrode, it requires no painting, and tests indicate it has extraordinary durability. Pencils or other sharp-pointed objects can be shoved through it without damage; the strength and elasticity of the strands is so great that they come back into place merely by rubbing them with the fingers.

In many cases the new screens will not even have to be put up in the spring and taken down in the fall. They will just be rolled up and down on tracks like a window shade.

The idea of making screens out of nylon occurred to Du Pont chemists and engineers several years ago, at the time the first nylon toothbrushes were being turned out—even before hosiery was introduced. But the new child of Du Pont's creative chemistry, derived from the hydrocarbons of coal, the nitrogen and oxygen of air, the hydrogen of water, made such a sensational hit in hosiery and brushes that the manufacturers were kept busy trying to supply a segment of the demand for those articles. The screens had to wait. Soon, however, our entrance into the war called nylon into service for parachute cloth.

Meanwhile a few screens had been erected at various points for preliminary tests. They stood up well even along the seashore, where salt spray rusts or corrodes metal screens very rapidly. Tests also showed that the nylon screen was so strong and resilient that when something bumps into it no permanent bulge is left.

One of the outstanding advantages is the "ingrained" color, which does away with painting. And since there is neither paint, rust, nor corrosion product to peel off or run down the frames and window sills, the staining from these sources is reduced to zero.

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BEDS—The first non-metal beds ordered by the Army in half a century are collapsible and are being manufactured of synthetic-resin-glued hardwood—half a million of them in 15 factories throughout the country.

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SYNTHETIC INSECTICIDES

Food Loss May be Averted by Development

IF FARMS in the United States this summer escape an insect scourge that not only would balk the necessary 30 percent increase in vegetable crops but might well cut our food supply far below normal years, the credit will go to American chemists for their foresight and determination.

For this summer the stage is set for an invasion of bean beetles, pea aphids, cabbage loopers, leaf hoppers, worms, soldier-bugs, and weevils which can devastate far more than the billion dollars' worth of vegetable crops destroyed in normal years. The stage setting consists of a serious shortage of rotenone—the toxic ingredient in imported derris or cubé root—which has held these vegetable destroyers in check for the past dozen years. This crucial war year finds us with less than half of our normal year's supply of this insect-killing ammunition—the rest of it being shut off by Jap battle fleets and German submarines.

The picture would be black were it not for the fact that American chemists had started searching for a synthetic insecticide to equal the effectiveness of natural rotenone long before the war. A group of chemists began research on this problem way back in 1926. For 12 years, in the laboratories of Rohm & Haas Company, they concocted lethal brews for insects, but their efforts received scant attention from growers as long as rotenone

was plentiful. But these chemists continued work till finally, in 1938, they perfected an insecticide promising enough to try out on peas, beans, and other vegetables.

For years growers and agricultural authorities held firmly to the belief that you couldn't kill pea aphids and cabbage loopers, bean beetles and other insects by using insect dusts containing any less than ¾ to 1 percent rotenone. Yet, in 1938, experimenters found that by adding this new laboratory-made insecticide, a thiocyanate known as Lethane, they could get as effective a dust with only half the amount of rotenone normally used in dusts. For example, on the Mexican Bean Beetle, whose taste for beans has carried him to nearly every state where beans grow, the addition of 2 percent Lethane halved the amount of rotenone used.

COMPRESSED FOOD
Wrapped in Cellophane, Saves Cargo Space

"NUTRITIONAL ammunition," stamped out in presses to save tons of cargo space and wrapped in cellophane to save steel and tin, is being shipped abroad in vast quantities.

Dehydration and compression may be considered as steps taken to get rid of two space-consuming stowaways in ships carrying food abroad to Lend-Lease consumers and to our fighting forces. One stowaway was water, the other air.

Removing the water telescopes, on the average, ten tons of raw food down to one ton, and reduces the space required by 50 to 90 percent, depending on the food product. It also improves keeping qualities and in many cases rules out the need for refrigeration.

Compression squeezes out the second space-robber, air, and saves 35 to 75 percent of the already reduced precious cargo space. Experience indicates that the compression further improves the keeping qualities of the food. By removing most of the air, the opportunity for oxidation, one of the contributing causes of food spoilage, is reduced. Compression also cuts down the food surface area exposed to what little air remains.

The necessity of keeping meats, fruits, vegetables, eggs, and other foods in good condition during the long and difficult trip from an American farm to an Allied or American battlefront imposes important responsibilities not only upon the method of preparation but upon the packaging. Some of the foods are consigned to Arctic regions. Others are headed for the humid tropics where mildew, insects, and heat make it difficult to keep food even in normal times. During the war some of the food cases may stand on wet beaches, exposed to the sun and surf, until busy soldiers can move them to a better place.

Because of the shortage of tin and steel, cans are available for only a portion of the food being exported. Therefore technical men of the Du Pont Company's Cellophane Division began studies some time ago looking toward the replacement of metal by this thin transparent film and various laminations of it. Severe tests confirmed the value of cellophane as a moisture-vapor-proof, dust-proof, and germ-proof protective covering for foods, either alone or in laminated form with other materials. As a result of these tests cellophane in its various forms is highly regarded by various government agencies for the packaging of dehydrated food for Lend-Lease and Army use.

In the compression process as developed by the inventor, John C. Donnelly of the Auto Ordnance Co., each type of food is considered as an individual problem, and the temperature and pressure employed adjusted to fit particular requirements. Some of the dehydrated food is quick frozen at temperatures from 20 above to 20 below zero, Fahrenheit, and held at low temperatures during compression to keep the fat globules from breaking down. Pressures employed range from 250 to 2500 pounds per square inch. The aim in all cases is to compress the food without destroying its caloric or vitamin values.

The food can be compressed at the rate of 170 cakes a minute, in some instances. As soon as each cake is formed by the press it goes into a cellophane wrapping machine, which keeps pace with the press. The touch of a heated sealing bar on the cellophane wrapper seals the contents from air and moisture.

Cost of the process, it is pointed out, is no more than packaging the same food in tin cans. In fact, in many cases it is less. Compressed foods now include potatoes, carrots, cabbage, onions, soy bean flour, apples, soup mix, eggs, beets, and cabbage soup. Some of the products are compressed into cakes slightly larger than a yeast cake. Others are put up in one-pound units. A package no larger than a small shoe box contains enough compressed potatoes to serve 100 men.

Eggs, because of their high nutritive value, have been an important Lend-Lease and Army item. Dried, they take up only a sixth as much space as in the shell, and when compressed the bulk is further reduced by half. A 14-pound package of compressed dehydrated eggs contains the equivalent of 537 fresh ones. Expressed in another way, a dozen eggs, dried and compressed, ride in approximately the cargo space that is needed for only one egg in the shell.

CONTAINER CLOSURE
Makes Possible Re-Use of Glass Jars

MILLIONS of "thrifty lids" will be available this season to assist the housewife in putting up fruits and vegetables at home. The thrifty lid, a war-time closure device which makes possible the re-use of commercial glass containers for preserving foods at home, was developed by The Owens-Illinois Glass Company. The successful distribution of millions of thrifty

Vacuum caps for jar re-use

lids last year has resulted in the release of sufficient metal this year to further assist the American housewife with her home preserving.

The thrifty lid was originally developed to fit the 63mm. opening of glass coffee containers. It may be used on any commercial glass container having the same size opening, with the aid of the original metal screw cap that comes with the jar.

Since metal screw caps for glass coffee are gradually being replaced with paper caps, housewives are advised to save metal caps along with coffee containers and other jars she is holding for household use.

The thrifty lid itself is a thin, composition-lined metal disk which may be purchased singly or in quantities of a dozen. It is used in combination with the metal screw cap that came on the jar originally. The first step is to scrape all of the composition lining out of the inside of this original metal screw cap. It is very important to remove this completely, since any remaining lining may adhere to the top of the thrifty lid during processing.

From then on regular preserving methods are followed. The jars are filled with the food to be processed, the thrifty lid is placed on the neck of the jar and the original cap is screwed over it to hold it in place. After processing, when the jars have cooled, the screw cap may be removed and used over again. The thrifty lid is held in place by vacuum, and, of course, may be used only once.

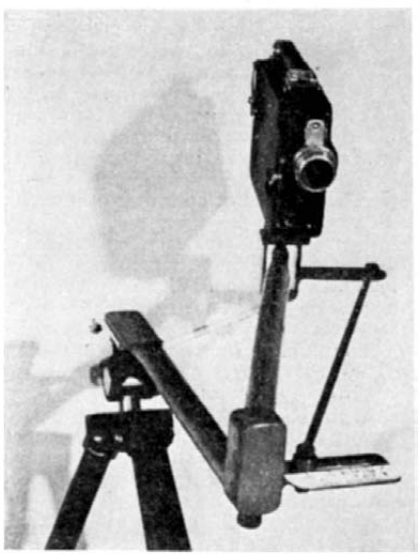
THIRD DIMENSION
Effect Obtained With Conventional Movie Camera

AN ENTIRELY new principle for the projection of third dimensional moving pictures has been developed by Everett H. Bickley, of Philadelphia. Through the use of a "swing mount" it is possible to obtain the illusion of depth in a projected moving picture without the use of special cameras, films, projectors, or screens.

As our photographs show, the camera is mounted on one end of a set of movable arms, another end being attached to the tripod. The design of the arms is such that the camera is rigidly held against vibration yet can be swung freely from side to side.

In taking the picture, the scene is composed in the finder and the exposure is made in the usual way except that the camera is swung very slowly back and forth during the taking of the picture. Speed of the swing is about eight seconds in each direction.

The resulting third dimensional effect is obtained because, while the camera swings on the arms, it is kept pointed at the principal object by means of an auxiliary arm which keeps the lens correctly aimed throughout the swing. Since the



Focusing the swing mount

Focusing the swing mount

lens steadily and continuously aims at the point of principal focus, through adjustment of one of the arms, all blur is avoided, the interest is not distracted by the swing of the camera, and the appearance of third dimension is created by the movement of the foreground and the background.

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NETS—Fishermen in west coast waters are now using purse-seine floats made of glass instead of cork. These floats are enclosed by woven rope pockets which protect against smashing and breakage, are more durable, and last longer than cork.

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CHEMURGIC RUBBER
Made from a Base of Vegetable Oils

COMMERCIAL production of a new synthetic rubber, using a base of domestic vegetable oils not considered suitable for edible purposes, has been under way for several months, it was announced recently by Dr. N. E. Van Stone, vice president of the Sherwin-Williams Co., in charge of operations. Called "KemPol," the vegetable-oil rubber substitute is a development of the Sherwin-Williams research laboratory's work with "drying oils" used in paint manufacture.

Unlike most chemurgic rubbers, KemPol requires no critical equipment for its manufacture and the volume of production will be limited only by the amount of oil available for the purpose.

Tensile strength, elongation, and abrasion resistance of KemPol are not on a par with those of natural rubber, although in many other properties it compares so favorably with natural rubber as to enable its use in many products such as treads, mats, pads, erasers, gaskets, braided hose, and so on. Since no toxic raw materials are used in the manufacture of KemPol, it may be used for such other work as jar rings and various types of seals for food containers.

KemPol lends itself readily to emulsification and—with certain limitations—to solutions, so that a number of successful applications in the fields of fabric coating, tapes, adhesives, and sealing compounds have resulted. KemPol sponges easily, offering many possibilities in that field.

KemPol also shows considerable promise as an extender for natural reclaimed, and the Buna and Butyl rubbers, with all

of which it is readily compatible. The customary fillers, extenders, and accelerators have been found to work well with KemPol and standard rubber making equipment, as found in the average rubber plant, is entirely adequate for the purpose.

Tensile strength of the new "rubber" is 300-500 pounds per square inch, and elongation is 100-150 percent. After aging 72 hours at 170 degrees, Fahrenheit, tensile strength increases about 100 percent and elongation decreases about 33 percent.

ROOFING
Shingles Held in Place by "Spot Welding"

VARIOUS types of roofing materials — roll roofing, strip shingles, and so on— can be applied with the use of a minimum number of nails through the application of a "spot welding" system developed by Paraffine Companies, Inc.

Roofing applied by this method is held in place with about 50 percent of the usual number of nails, while a cementing material, Hydroseal, is applied in spots between layers. These spots of adhesive, it is claimed, hold the roofing securely against the force of a 50 mile an hour wind.

POST-WAR TRANSPORTATION
Highway Vehicles Will be Improved in Many Ways

MANY developments of the war production period can undoubtedly be applied to peacetime vehicles with beneficial results, if industry is given a free hand. This was recently emphasized by Robert F. Black, President of The White Motor Company, when reviewing technological changes and developments in the design and use of motor transportation units.

Speaking of engineering possibilities, Mr. Black said that "when the war stopped production, it pigeon-holed many improvements which had been recently developed or were still under development. It is unlikely," he opined, "that the first commercial vehicles to be produced immediately after the war will differ radically in general design from those in production last year. The immediate need in all probability will be too great to allow quick and drastic redesign.

"Yet, just as World War I was the cradle in which the motor truck was nurtured, so World War II can easily be responsible for evolution of entirely new departures in vehicle design. Large scale production of motor trucks for the armed services can easily mean, for instance, that designs which have not had much popularity among operators in the past, may by their performance stir a general commercial demand.

"It appears inevitable that a trend toward higher horsepower in truck engines should set in. The war has brought in large scale production of 100-octane gasoline for airplanes. One would expect increase in engine compression ratios to take advantage of the higher anti-knock qualities of the new fuels. Within the realm of possibility is introduction of super-chargers on truck engines.

"It is anticipated in the industry that there will be a continuing demand for more and more automatic and semi-automatic operation of transmissions in heavier trucks and busses. It is the further view of many engineering minds that there will be a marked increase in the output of trucks with front as well as rear driving axles. Rapid strides have been made in recent years with this type of vehicle in its development for the all-purpose needs of the Army.

"Experience being gained in the current conflict will lead the way for reducing net weights of the vehicles so as to increase the payload to be carried and thereby decrease the cost of the transportation. Unquestionably there will be further improvement of the safety features of the vehicles due to research that was on the way before the war, as well as experience now being gained.

"The industry is watching closely the advances that are applied to aviation to see what can be adopted for the motor truck and bus, just as motor vehicle developments have been applied in aircraft development and even, in recent years, by the railroads."

While offering these future possibilities, Mr. Black said that no experienced truck man would undertake to chart out a definite evolutionary pattern for the years ahead. The reasons, he said, are found in the factors which have shaped truck, bus, and trailer history to date.

"In other words, the motor vehicle is limited by the highway systems and the terrain traversed; motor vehicle development is affected profoundly for good or bad, by restrictions and regulations; the engineering of engines and vehicles is fluid and subject to changes of very great proportions; and, most important of all, the positive force in the development and improvement of truck, bus, or trailer is the one created by the ideas and wants

of tens of thousands of people all over the country, each with a job to do, and each wanting a vehicle that can handle it. Commercial vehicles must adapt themselves to the load rather than the other way around."

PACKAGED COFFEE
Enough for Two Cups in Aluminum Foil Packet

COFFEE now goes to the front in snug, feather-weight packets, each containing sufficient coffee concentrate for two generous cups. Standard equipment in ration K, these packages are made of aluminum

Aluminum foil protects coffee

foil one thousandth of an inch in thickness and coated on one side with a thin film of a thermal plastic for hermetically heat-sealing all four edges.

This type of packet is impervious to light and moisture and is resistant to the effects of either the intense heat of the tropics or the extreme cold of the far north. The aluminum foil gives the packet ample strength and effectively shuts out light, while the plastic coatings, both inside and out, serve their respective purpose of heat-sealing the packet, strengthening and protecting it against rough handling. The powdered coffee in a single package weighs barely five grams, and the filled capsule weighs only six grams. An equivalent amount of coffee of a normal grind weighs twenty-five grams, not counting the weight of the container.

Results obtained in the field are highly satisfactory. Soldiers report that the capsules are easy to handle and the coffee simple to prepare. Where a fire is not available, the powder may be mixed with cold water.

HEALTH EXPERTS
Will be in Greatest Post-War Demand

HEALTH, foundation of the nation, will demand the most trained experts after the war, according to E. E. Crabb, president of Investors Syndicate, in a report on predictions of 346 American colleges, technical schools, and universities.

"Nearly one of every three predictions by American educators on post-war demands for trained experts, perhaps reflecting the maxim, 'health alone is victory,' forecasts health or allied activities," continued Mr. Crabb. "Over a fifth of the replies mentioned business or associated fields. Natural sciences received 18.4 percent, other professions 13.2 percent, social work 6.4 percent, miscellaneous experts 3.6 percent, and government specialists 3.4 percent of the total.

"Ten occupations accounted for 72.36 percent of the total mentions in the list of 65 specific types of experts. The number of times such experts were mentioned and their percentages to the total follow: doctors 118, or 11.6 percent; engineers 104, or 10.2 percent; foreign trade specialists 99, or 9.7 percent; teachers 98, or 9.7 percent; nutritionists and social workers each 54, or 5.3 percent; occupational therapists 46, or 4.5 percent; dentists 37, or 3.5 percent; economists 33, or 3.2 percent; and business administrators 31, or 3 percent."

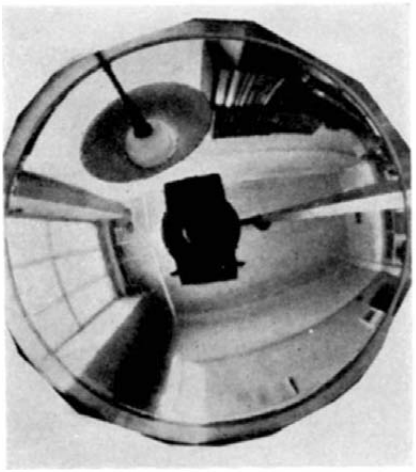
"What trained experts will be most in demand after the war?" the nation's higher educational institutions were asked. Three hundred and forty-six schools—261 co-educational, 54 women's, and 31 men's—replied, many of them mentioning more than one type of experts in their aggregate of 1071 mentions.

Doctors led the list in both co-educational and men's colleges. Teachers headed the list in women's schools. Engineers came second in both co-educational and men's universities, while nutritionists held that place in women's institutions. Foreign trade ranked third in both co-educational and men's faculties, though sixth in women's colleges. Medical technologists took third place in schools exclusively for women.

"FISH-EYE" CAMERA
Aids in Study of Lighting Problems

PHOTOGRAPHS made with a "fish-eye" camera, which show everything in a room above its own level, enable engineers to solve quickly problems of illumination which would otherwise require elaborate and lengthy calculations. This "illuminagraphic camera," it is stated, will be specially valuable for studying the illumination in airplane and other war factories, built without windows and lighted with large areas of fluorescent lamps.

Set-up of the "fish-eye" camera



A picture made with the "fish-eye"

In an experimental model, a camera of customary type is mounted on an iron stand, and pointed toward a curved mirror. The curve of this mirror has to be adjusted very accurately. The result is that a photograph taken of the reflection shows the area of extended light sources, such as a window which shows the sky, or a bank of fluorescent lamps, in exact proportion to the amount of light which a surface at the location of the mirror receives from the light source.

Even if the area from which the illumination comes is irregular, it can be measured easily on the photographs with an instrument called a planimeter. When the brightness of the source is known, the actual illumination at the mirror can be determined.

Both the camera itself and the support are visible in the picture, but they take up a small area, and ordinarily would not affect the result. It is not necessary that the mirror be horizontal. It can, for example, be placed at an angle, as to measure the illumination of a sloping drawing board. By determining the amount of light received from a window, and between its various parts, such as the upper and lower sashes, the most efficient lighting may be planned.

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WOODLOTS—Well-managed farm woodlands in the Lake States are capable of yielding annual returns of $5 or more per acre, as compared with present average returns of less than $3 per acre, according to the United States Department of Agriculture.

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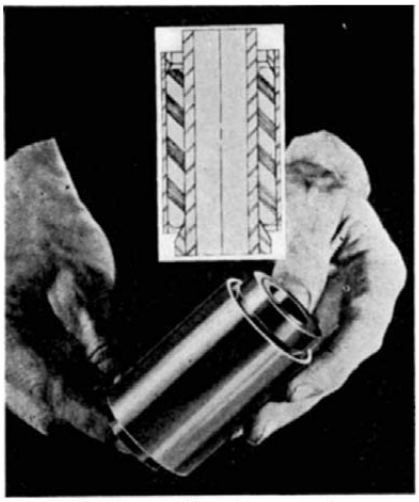
ENGINE MOUNTING
Insulates Vibration, Uses Less Rubber

AN INSULATED engine mounting that reduces the amount of steel and rubber required by 17 percent and can be had in almost any combination of metals and rubber, or synthetics, to suit individual requirements, is used primarily to insulate vibration, absorb shock, and com-

pensate for misalignment in heavy-duty equipment.

The design of the mounting and the principle of assembling the rubber wall between an inner and outer wall of metal are relatively new to the United States, the assembly being held together by a mechanical rather than chemical bond. Thus the members are held together with the elasticity of the live rubber which forms the insulating medium as well as the bonding member. This mechanical bond not only permits the reduction in the amount of rubber employed (the mechanical type of bond being considerably more efficient) but also allows the use of synthetics or "full reclaim rubber" instead of pure rubber.

Loads that are far in excess of the rated capacity of the mounting must first equal the shear strength of the rubber before the bond will "slip." Even should this occur, the engine would still remain operative, as the amount of "fall" would not exceed one-fourth of an inch and the support mounting would merely change from an "insulated" to a "solid" type of support.



Failure-proof engine mounting

CIRRHOSIS

It Now Isn't the Alcohol But Remains Alcohol-linked

THE BELIEF that cirrhosis of the liver is caused by the toxic effect of alcohol or of toxic substances present in alcoholic liquors is giving way to the conviction that dietary deficiencies often associated with chronic alcoholism are, more probably, the factors responsible, according to the review of scientific literature in *Nutrition Reviews* (New York).

The new concept derives support from two different sources: animal experiments in which cirrhosis has been produced by deficient diets, and therapeutic studies which suggest that high protein diets and administration of the vitamin B-complex, and in particular choline, favorably influence the course of some patients with hepatic cirrhosis.

Evidence from experiments on laboratory animals indicates that liver damage and cirrhosis may result from deficiencies

of the vitamin B-complex, or of protein. For instance, cirrhosis has been produced in rabbits on diets which lacked yeast. Rats fed rations deficient in the vitamin B-complex develop fatty degeneration and necrosis of the liver; they can be protected from this degenerative change if the B-vitamins are supplied. Dogs fed diets low in protein, deficient at least evidence of hepatic damage which can be corrected if the deficiency is eliminated.

Much recent investigative interest has centered about the importance of protein and some of the amino acids in hepatic physiology. The general plan of these studies has been to feed rats synthetic diets low in protein, deficient at least in some members of the vitamin B-complex, and containing varied amounts of carbohydrate and fat. A large percentage of the animals subjected to this regime developed fatty infiltration of the liver, necrosis of hepatic cells which usually begins in the central or midzonal areas of the liver lobule, and periportal cirrhosis. Hemorrhage frequently accompanies the necrosis. These changes have been prevented in whole or in part by feeding choline, brewers' yeast, a combination of crystalline thiamine, riboflavin, pyridoxine, pantothenic acid, and choline.

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NIGHT SIGHT—Just as night fliers are selected by special eye tests for ability to see in the dark, so employes in photo-film plants are chosen, since they must work without illumination to produce modern super-sensitive films. At some plants a "change room" is provided where men finishing work can slowly adjust their eyes to daylight brightness.

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VIRUS KILLER
Found in the Ultra-Violet Ray

THE DISEASE-CARRYING virus, spreader of wartime epidemics, has an "Achilles heel" that makes it vulnerable to ultra-violet rays and consequent destruction, according to Dr. Harvey C. Rentschler, director of research at the Westinghouse Lamp Division. Experiments with these tiny particles of chemical substance have indicated, he says, that "bullets of ultra-violet light" must strike a certain spot in the virus before it is "killed" or injured, but when such accurate shots are made, it means certain annihilation for the disease carrier.

"This ability of ultra-violet to inactivate virus means that science now has an effective weapon to use in the battles against influenza, infantile paralysis, and the common cold, among other diseases thought to be caused by virus," he declares.

Dr. Rentschler, under whose direction the germ-killing Sterilamp was developed for practical application, has conducted thousands of tests to determine the exact amount of ultra-violet radiation required to inactivate virus in various quantities and conditions.

"We have known that air-borne bacteria can be completely destroyed when subjected to enough radiation at the correct wave length," he explains, "but our experiments with bacteriophage, a type of virus, have produced curious results.

"We found in one experiment, for example, that six arbitrary units of ultra-violet radiation will inactivate 50 percent of the bacteriophage sample and that 12 units will destroy 75 percent. When we applied 400 units, better than 99.9 percent of the virus particles were inactivated.

Exposing viruses to ultra-violet

We have yet to achieve 100 percent destruction consistently, however, since even such a heavy barrage of ultra-violet rays apparently misses the 'Achilles heel' of a few virus particles.

"Bacteriophage particles and probably other viruses seem to be destroyed when a photon of ultra-violet light of the proper energy hits the proper band in the molecule," states Dr. Rentschler. "In the case of bacteria, on the other hand, our tests have shown that the killing action is caused by the accumulated energy of the different photons.

"In other words, photons, which might be called 'bullets of light,' must strike a vital spot on the virus molecule or else the virus is unharmed. When bacteria are struck at any point, however, they receive either a partial or fatal injury."

The viruses, which many believe to be merely chemical compounds and not living organisms like bacteria, have been found to be a widespread cause of disease in man, animals, plants, and insects, Dr. Rentschler points out. They are so small that they pass through all filters and can be seen only for a moment in outline by the powerful electron microscope.

RIBBON RENEWER
For Typewriters, Lengthens Life, Is Inexpensive

WITH a simple little device, and the necessary chemical fluid, it is now possible to lengthen the useful life of office machine ribbons at a reported cost of 1½ cents each.

The manufacturer of the device claims that the average typewriter ribbon can give three to five times the normal service if it is given a periodic treatment with the chemical, which restores the original brilliance and keeps the ribbon soft and pliable, thereby preventing wear.

The reviving is done by merely rewinding the ribbon through a simple applicator device which is filled with the fluid. It is not necessary to remove the ribbon from the typewriter.

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SALVAGE—Mexico plans to salvage a sunken gunboat, the *Vera Cruz*, to help provide scrap for her growing steel production. According to a Mexican radio broadcast, the gunboat was sunk by its own crew in 1914 to prevent it from falling into the hands of revolutionists.

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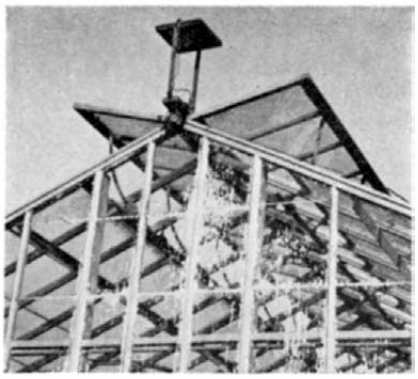
FIRE BLANKET
Designed to Extinguish Flaming Clothing

FOR USE in war industries and by air raid wardens, first-aid stations, and so on, a new heat-resistant flameproof blanket has been recently made available. This blanket is contained in a convenient casing which may be hung on the wall or carried in the hand and from which the blanket can be instantly removed. In case of fire, the blanket is pulled out of the case and thrown around burning clothing.

SUNLIGHT RECORDS
Made by Use of Self-Operating Device

AT THE Ohio State University's green houses, where sunlight data are important in the study of soilless horticulture, constant records are made by the use of a detector consisting of either a photoelectric cell or an Eppley pyrheliometer. The detector is exposed on the small platform shown in the accompanying photograph, just outside the greenhouse, and is connected by leads to a Micromax recorder, located in a laboratory some distance away.



Detector of sunlight

Except for minor attachments, the Micromax is exactly like those generally used for recording of temperature. It is a self-balancing potentiometer, hence is unaffected by changes in the resistance of the leadwires. It has no calibrated

springs; no helixes; no jewelled bearings. It is self-standardizing, driven by an electric motor, and holds ample supplies of ink and chart, hence operates for days or even weeks with no attention, thus freeing its user for other work.

IMPACT SWITCH
Acts to Prevent Fire in Plane Crashes

ANOTHER in the long list of safety devices developed for United States Army and Navy planes is an ingenious "impact switch" which automatically discharges several pounds of liquid carbon dioxide into the engine compartment when a combat plane crashes. The device, developed by engineers of Walter Kidde & Company, functions as an automatic fireman to release clouds of fire-killing vapor into an engine compartment even though the pilot is unconscious or rendered incapable of quick action. The switch contains a trigger device which can be set to go off under a force greater than any encountered during the sharp dives and twists of aerial dog fighting or rough landings on bumpy fields.

Switch that prevents crash fires

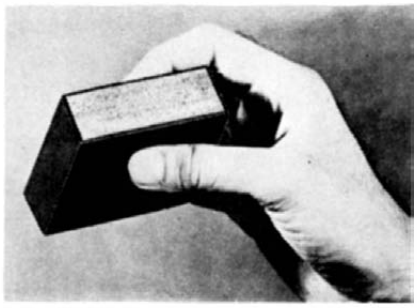
GASKET
Combines Sponge Rubber and a Synthetic

SPONGE rubber gaskets covered with a smooth coating of natural rubber or Ameripol synthetic rubber by the extrusion process are now being used in products of war, mainly airplanes and tanks, where they are proving their value as a sealing member in severe service. After the war, this new type gasket is expected to find wide use on refrigerators, automobiles, and other products.

When made with a covering of Ameripol, the synthetic rubber developed by B. F. Goodrich, the new gasket withstands the destructive action of oils and greases which have so often spelled destruction to refrigerator door gaskets made of natural rubber. The ability of this synthetic

rubber to withstand extremely low temperatures also will make the new development especially valuable in the refrigeration industry. The gasket has a much lower permanent set than the tubular type heretofore used on refrigerators and automobiles, and is as soft and compresses as well as the older type.

In the new process, the sponge rubber filler used is molded in slab form, slit



Section of new extruded gasket

into strips, and fed through a special extruding machine to obtain the smooth covering which varies in thickness according to specifications.

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TOOL EXPANSION—A fine machine tool cannot turn out the same size article during a cool midnight shift as during a hot noon shift, unless the temperature at the machine is the same. Heat expands the tool and may vary the size of the part enough to disrupt a final assembly line completely.

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VITAMINEWS

Make Room for More Vitamins—

They're Being Discovered

THE LATEST tally on the number of B vitamins shows that there are at least a dozen separate compounds in this group, the vitamin B-complex. Evidence for the existence of seven relatively new members of the group, and what they are likely to mean in terms of human nutrition and control of still unconquered diseases, was presented by Prof. C. A. Elvehjem, of the University of Wisconsin, at a recent meeting of the Society of Sigma Xi.

Biochemists and nutritionists now speak of six B vitamins with considerable familiarity, Prof. Elvehjem said. These six are thiamine, riboflavin, nicotinic acid, pantothenic acid, pyridoxine, and choline.

Experiments by many scientists as well as those of Prof. Elvehjem and his staff have recently demonstrated vitamin-like activities for biotin, which is now available in pure form; inositol and p-aminobenzoic acid, two known chemical compounds; folic acid, which is being studied extensively as a growth factor for bacteria; two chemically unknown factors needed by the chick for growth and for feather production; and one or more factors of significance in guinea pig nutrition.

Rather definite evidence is available to show that biotin is of importance in human nutrition, Prof. Elvehjem said. Little can be said about inositol in human nutrition.

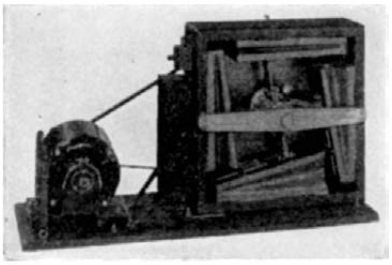
The fact that a number of animals do require this compound makes it necessary to at least consider its possible essential nature in humans. p-Aminobenzoic acid can undoubtedly produce certain effects in the human.

Indirect evidence, including studies on man's close relative, the monkey, suggests that folic acid may also have significance in human nutrition.

VACUUM PUMPS
Employ Bellows Driven by Electric Motors

A POSITIVE-TYPE vacuum pump for production and laboratory application is available in two standard sizes, supplied with individual electric-motor drives, or without motors for use with an available power source.

The pump employs four bellows mounted within a square wood frame, connected to each other and to the pump



Smooth running, low maintenance

outlet by a channel running through the frame. Bellows, which are successively expanded to exhaust air or gas from the equipment to which the pump is connected, are driven by a revolving shaft through connecting straps. The shaft is V-belt driven at a relatively slow speed, approximately 200 revolutions per minute, contributing to a smooth running unit and low maintenance.

Flexible sides of the bellows are made of leather, as are intake and exhaust valves. All joints are gasketed by neoprene cloth, and the frame or case has a black wrinkle finish. The larger of the two units is rated at 15 cubic feet displacement at four inches of mercury. Bellows are six inches wide, and pumps individually driven use a ½-horsepower motor. The smaller unit, rated at seven cubic feet displacement at four inches of mercury, has four-inch bellows and uses a 1/6-horsepower motor. The pumps, made by American Automatic Typewriter Company, are equipped with governors to vary their capacities, and to prevent excessive wear on pump parts, the power transmission unit, or the motor when air or gas has been exhausted to the capacity of the pump.

WELDING GLASSES
Permit Better View of the Operation

AN EYE-PROTECTION glass which permits eyes of gas welders to pierce blinding glare and see welding operations from

beginning to end was announced recently by Dr. E. D. Tillyer, research director of the American Optical Company, who said that the new glass is expected to increase the production of welded battle equipment for the Army and Navy.

Previously, he stated, the glare of flame-welding made it impossible for welders to see exactly what they were doing—a

Welders can now see their work

factor slowing the welding of planes, tanks, ships, and other military equipment.

Lenses made from the new glass, it is reported, now let a welder look through the cloudy yellow flames of burning sodium vapors and see clearly the welding rod and the molten area.

"This greater vision," Dr. Tillyer, declared, "not only helps speed a welder's production, but the glass also protects his eyes by absorbing dangerous invisible ultra-violet and infra-red rays generated during the welding operation."

Dr. Tillyer disclosed that the new glass was developed by adding didymium, a rare metal, to the composition of a standard welding glass, the result being a distinctively new glass with exceptional ray-absorbing properties in the visible and invisible portions of the spectrum.

• • •

GLYCERIN—Nitroglycerin is so critically needed for bombs and torpedoes, for dynamite used in mining metal ores and coal, for building military installations, and other war work that the government now permits soap manufacture only when glycerin is recovered.

• • •

ANCIENT NEW MEXICANS Lived a Simple Life, as Revealed by Research

PREHISTORIC Americans who lived in western New Mexico during a period dating from a thousand or so years before the Christian era to about A.D. 700 suffered physically from malnutrition due to inadequate diet. Mentally they tended to be isolationists. These conclusions are reached in research conducted into evidence regarding their lives, unearthed by Dr. Paul S. Martin, chief curator of anthropology at Field Museum of Natural History, and associated archeologists. The results are published in a book issued by Field Museum Press—"The SU Site—Excavations at a Mogollon Village." The research was conducted over several years by the Field Museum Archeological Expeditions to the Southwest, led by Dr. Martin.

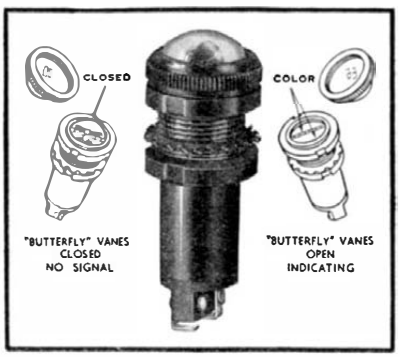
The SU site, where ancient ruins of several villages were excavated, is located in a canyon of the Apache National Forest. The people whose history was studied are an extinct Indian tribe known as the Mogollones. The extensive collections resulting from the excavations, including pottery, remains of old house types, human and animal burials, implements, and various other kinds of artifacts have been subjected to intensive investigation at the museum, and to comparisons with similar material collected from sites representing other prehistoric cultures of this and nearby regions, some related to the Mogollon, and some distinct.

Mogollon culture was an undeveloped, unsophisticated, unalloyed, unvarnished, homespun kind of culture with no striking or dramatic features. The general Mogollon cultural pattern was unadorned and lowly and based on almost minimal requirements. It was homogeneous, non-expansive in that it probably sought no, or few, contacts with other cultures. When Pueblo Indian influences drifted into the Mogollon area, the resistance of the Mogollon culture was so mild that the Pueblo culture became the dominant one.

The people of the SU site hunted little ... projectile points are scarce.... Fishing was probably not carried on, for no fish bones were found. Agriculture, too, was probably unimportant in their economy. . . . It seems safe to assume they lived mostly on seeds, roots, berries, nuts, insects.

INDICATOR SIGNAL Uses Fluorescence Instead of a Small Lamp

WORKING under "black light" from the usual sources within aircraft, a new indicator signal includes a fluorescent unit which gives a positive indication whenever



Indicator and the vane action

the "butterfly" vanes which cover it are opened. Operation of these shutters is by means of a built-in solenoid which opens the vanes instantly to show signals. When not indicating, the Signalette unit, as the indicator is called, is black. Current consumption is only about 1.5 watts.

Latest Helicopter

Is a Two-Seater with Enclosed Cockpit; Will Assist in Allied Convoy Protection Against Subs

ALEXANDER KLEMIN
Aviation Editor, Scientific American. Research Professor, Daniel Guggenheim School of Aeronautics, New York University

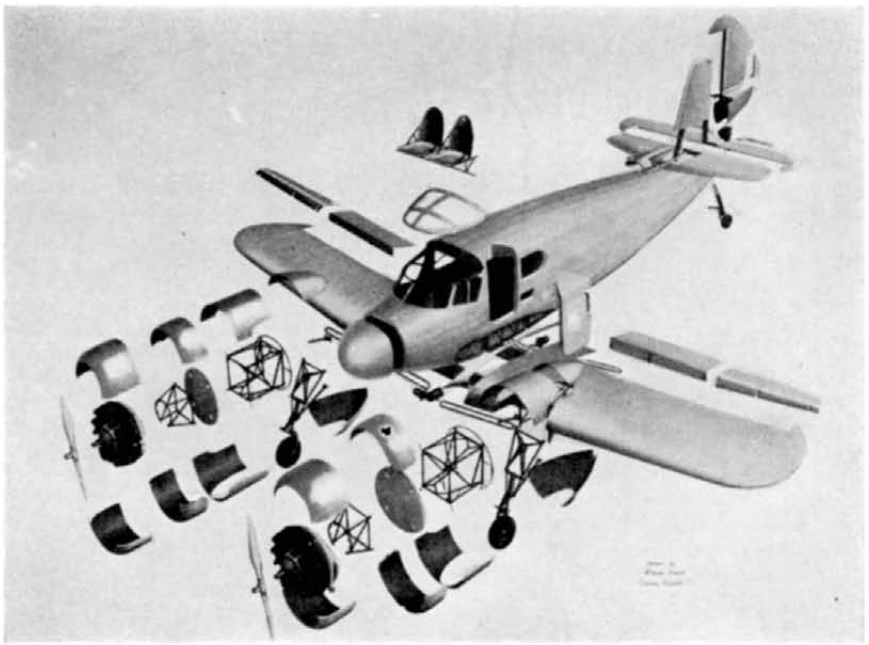
IT IS GOOD news for the helicopter advocates and still better news for our anti-submarine command, that the British have ordered 250 of these aircraft to serve in convoy protection across the ocean. Perhaps our readers will remember that a suggestion for this use of helicopters and autogiros was made by W. Wallace Kellett several years ago, and since then others have made similar suggestions to which naval authorities have finally given practical approval. This makes it all the more desirable that full encouragement be given to the helicopter, for which each day brings the possibility of greater uses. The Army has immediate and realistic motive in fostering the craft. For example, it can be used for liaison and message carrying behind the combat lines. A telephone line, dropped from the craft to the ground, would make possible the delivery of messages in inaccessible spots. The helicopter might also be used as an aerial ambulance equipped with litters, particularly in jungle areas.

One of our photographs shows the latest embodiment of the Sikorsky helicopter, in which the nose is somewhat blunter than in the previous models, and the pilot's cockpit is fully enclosed. The main rotor is now 36 feet long and the small vertical airscrew at the tail takes up the torque, gives directional control, and is seven and one-half feet in diameter. The helicopter weighs 2400 pounds and is about 38 feet long. There are seats for the pilot and one passenger. The seven-cylinder Warner radial engine provides the power. The delivery flight of the first United States Army helicopter from the Sikorsky plant to Wright Field covered five days, actually consisted of 16 different flights, and established an individual flight distance record of 92 airline miles. A record speed of 82 miles per hour and a climb to 5000 feet were also made by this machine. The pilot, C. L. Morris, reported that in spite of the most bumpy weather the ship behaved beautifully and showed excellent stability and control. Altogether, the helicopter situation at the present time may be regarded as highly promising.

"EXPLODED" SKETCH Enables Mechanics to Grasp Fundamentals

ONE OF OUR illustrations shows a type of airplane drawing which is rapidly becoming popular and proving of value in training mechanics for assembly, maintenance, and repair work. Such drawings have the advantage of giving a new man

Demonstrating the maneuverability of the helicopter



Mechanics in training learn readily from such "exploded" sketches as this one

an immediate perception of the main subassemblies of the airplane and of their relationships to one another. Shown in our photograph is one of the Cessna AT-17 "Bobcats," an advanced trainer. It is remarkable how quickly new mechanics can follow and learn from this type of drawing. A glance shows the four upper parts of the cowling on either side of the engine nacelles, and likewise the four lower parts. The nacelle is evidently constructed throughout of welded tubes with a mounting ring for the motor itself. There is an inner flap and an outer aileron on the wing.—*A.K.*

COLD TUNNEL
Has High Power for Aerodynamical Testing

A NEW wind tunnel, being assembled by the engineers of the York Ice Machinery Corporation for installation at the Army Air Forces Experimental Station at Wright Field, will be 600 feet long and built in the shape of a huge "O". A 40,000 horsepower motor will circulate the air at 600 miles an hour and at pressures and altitudes corresponding to flight at altitudes of 40,000 feet.

As the wind travels around the first turn in the tunnel, it will pass over a network of cooling coils chilled by as much as the equivalent of 8000 tons of ice refrigeration. The temperature of the cooling coils will be 70 degrees below zero, Fahrenheit, while decompression pumps will reduce the pressure in the tunnel to only 2.7 pounds per square inch. As the air expands from the wide section of the tunnel to the narrow working section at the throat, the expansion will further reduce the air temperature until it drops to 67 degrees below zero.

In making a test, engineers will place models in the tunnel's throat and close an airtight door and watch effects through observation holes after high altitude conditions have become established.

To cool the giant motor which drives two 40-foot fans, each with 16 blades, more than 85,000 feet of filtered air a minute will be required.

To prepare the tunnel for each test, tons of calcium chloride solution will have to be cooled and stored in tanks up to a period of 20 hours, and the motors driving the refrigerating compressor will themselves have a total of 2250 horsepower.

The importance of the problems which it will be possible to investigate in the tunnel can scarcely be over-emphasized. Ice formation at high altitudes, while better understood, has not yet been completely conquered, and here will be a ready weapon. The behavior of wings, engines, nacelles, and other aircraft parts under these abnormal atmospheric conditions will be studied not only from the point of view of ice formation, but from the standpoint of compressibility effect which may tend to increase their drag to a considerable extent.

While refrigerated wind tunnels have been previously available at Langley Field and in the laboratories of the Goodrich Company, they have been relatively small and of slow air speed. The new tunnel will improve experimental facilities tremendously.—*A. K.*

BICYCLE LAMPS
Used On Cargo-Carrying Parachutes

THE tail-light formerly made for bicycles has proved adaptable for use with parachutes. Now to each cargo parachute a lamp and a small dry cell are fastened to make it easier for paratroopers to locate supplies dropped to them at night. The same lamp and battery combination are also fastened to life preservers to make it easier to see the swimmer, and to make it easier for him to know where he is going. Westinghouse is responsible for this useful adaptation of another peacetime product to military needs.—*A. K.*

New Products

PLANT SWEEPER

A MECHANIZED floor sweeper which cleans at the rate of 16,000 square feet per hour has recently been announced by the Moto-Mower Company. Operated by

16,000 square feet per hour

one man or woman, this model provides a whole sweeping department for the average size plant.

The mechanized sweeper, replacing the old-fashioned broom, releases men to do other work around the shop. Our illustration shows the Detroit model Moto-Sweeper being used in and around machinery in a tool, dye, and fixture shop where heavy metal machinings are as readily picked up as are the lighter dirt and dust.

QUICK-DRYING OIL

A DRY film that is quickly formed and which is both hard and tough can now be obtained through the use of a processed linseed oil designed for use in the manufacture of paint, enamel, and varnish. Designated by the manufacturer, National Lead Company, as 710 Oil, it is available in three types for differing processes. Paints compounded with the material are stated to be rapid drying, to adhere well, and to be of good gloss.

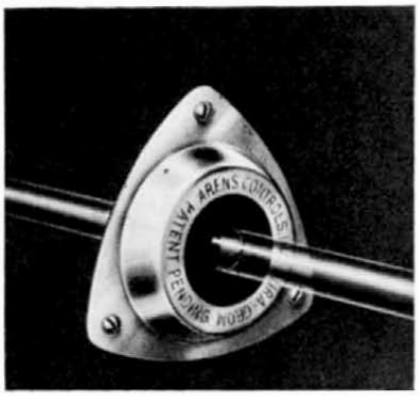
LINE SUPPORT

A FUME- and water-tight support for air, oil, and hydraulic lines, electrical cables, flexible remote control casings, and so on, through a firewall or bulkhead, is provided by Dura-Grom, recently announced. It eliminates many quick disconnect and firewall fittings, and slips over a line, cable, or tube to fit snugly against the wall.

This new grommet consists of only two parts: an oil-resisting synthetic rubber disk, and a cadmium plated steel cup retainer for securely attaching grommet to wall. The packing member is an oil-resisting synthetic rubber block which affords many times the bearing surface characteristic of the old-fashioned grommet. The retainer cup has an opening large enough to slip over an assembled line or tube, including end fittings, eliminating dis-assembly of fittings during installation.

Multiple lines can be supported by a single Dura-Grom, individual openings being provided in the rubber disk for each line.

In addition to the fume- and water-tight features, Dura-Grom is said to save time on installation since complete tube assembly may be slipped through firewall and Dura-Grom retainer and permanently



Fume- and water-tight

fastened at the ends. The split rubber disk is then easily installed by slipping it over the line, sliding the retainer into place and bolting it to the firewall, completing the installation.

CUSHIONED ABRASIVE

A LIGHT yet effective abrasive action is to be had through the use of an elastic-rubber compound impregnated with an abrasive, the rubber binding cushioning the abrasive to provide a smooth finish

on the work to which the material is applied. This cushioned abrasive, known as "Brightboy," removes light burrs and rough edges from die stampings, smoothes and finishes parts after surfacing or grinding, cleans and polishes edged tools, and so on. The elastic-bonded abrasive is available in tablet and stick form as well as in the form of wheels up to six inches in diameter, thus making the abrasive available for a wide range of operations.

EXTENSION BRUSH HANDLE

A PAINT brush or scraping tool may be secured by spring clips to the end of a new extension handle recently announced by Breinig Brothers, Incorporated, to


For hard-to-get-at places

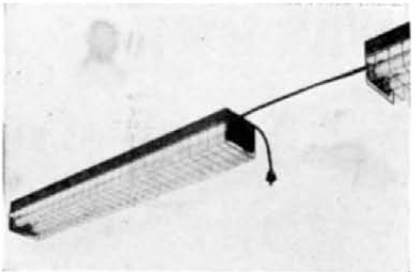
enable the operator to reach out-of-the-way places or high areas of walls or ceilings.

The angle which the short arm at the end of the extension handle assumes with relationship to the handle itself is controlled by the operator through a length of tape, and can be varied to suit the surface and position of the work.

DUPLEX LIGHT

A DOUBLE-CIRCUIT mechanic's light with receptacles for plugging in small power tools and additional fixtures, being produced by the Lumidor Manufacturing Company, permits as many as four lights to be connected in line to a maximum of 60 feet from a single outlet, according to the manufacturer.

The "Mechanic's Light" was originally designed to illuminate the fuselage interiors of large aircraft during construction but the unit is being widely adapted to other industrial uses.


Small power tools may be connected

A 24-inch unit containing two 20-watt lamps and a 48-inch unit containing two 40-watt lamps are offered. Both units are available for either 50 or 60 cycle current. Brackets for hanging and a hinged wire lamp guard are standard equipment.

TANK AND PIPE LINING

FAR DOWN on the list of critical materials is a synthetic resin called Resoweld which is now available as a lining for tanks, pipes, fittings, pumps, and similar industrial equipment.

Designed to take the place of natural rubber linings where rubber cannot be used because of war requirements, Resoweld will resist alcohol, petroleum, gasoline, vegetable oils, and soaps, as well as nitric acid (with the exception of fuming nitric acid) and chromic acid. This new material is black in color and is thermoplastic, which indicates that practically the same application processes can be used as for natural rubber linings.

ELECTRIC FURNACE

OFFERING an economical, convenient, and rapid means of heat-treating small metal parts, as well as many laboratory advantages, a new electric furnace, shown in


Wide heat ranges are available

one of our illustrations, has inside dimensions of 3¾ inches in length and depth and four inches in width. Uses of the furnace include hardening or pre-heating, drawing and tempering, normalizing and annealing, enameling, and so on. In the laboratory the same unit may be used as an auxiliary furnace or to fill exacting requirements for testing or development work. Heat ranges up to 1500 degrees, Fahrenheit, may be obtained through rheostat adjustment, while provision is made for cutting out the series resistance and allowing rapid heating to maximum temperatures in a minimum of time.

PLASTIC SHEET

A LAMINATED plastic sheet which has an opaque center and transparent faces has been developed for the manufacture of nameplates, tool checks, instrument dials,

and so on, to specifications. The opaque center carries printing or other marking, placed prior to the laminating operation, and the resulting sheet can be die cut, stamped, or drilled. The final permanent assembly measures .050 of an inch in thickness, is fire resistant, withstands a temperature to 200 degrees, Fahrenheit, and can be had in single or combination colors. Made by Plastic Fabricators, Inc., this sheet is available under the trade name of Durashield.

PART PRINTER

PRINTING of name, number, and so on, on shims, washers, name plates, and similar articles is speeded up by the foot-operated printing device illustrated herewith. At each pedal stroke the printing

Rubber, cork, plastic, felt, fiber, and other parts may be successfully printed on this machine

impression is made, while on the return stroke the printing dies or type are re-inked for the next impression. An adjustment is provided for locating various sizes of parts to be marked, these parts being placed in position when the foot pedal is up. The weight of this new Acromark printing machine is under 100 pounds, and it has been used succesfully to print on rubber, cork, plastic, cardboard, and similar pieces.

ALUMINIZED STEEL

BODY characteristics of mild steel with surface characteristics of aluminum are now provided in a new aluminum coated steel sheet. The material can be put through forming and drawing operations without peeling or flaking and is reported to be equivalent to solid aluminum sheet in corrosion resistance. Various thicknesses are available, a 16-gage sheet of the coated steel employing 5 percent as much aluminum as a solid aluminum sheet of the same thickness. The metal withstands temperatures up to 1000 degrees, Fahrenheit, without discoloration.

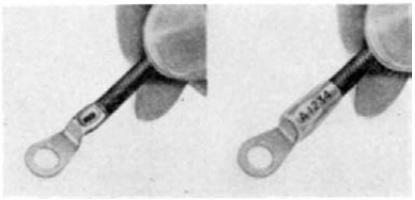
FLOOR PROTECTION

DESIGNED to protect walls, work benches, and similar surfaces from paint, oil, or grease spillage, Turco Duramask is painted over such surfaces and allowed to dry. This material is a thick, white liquid which is non-corrosive, non-flammable, yet is soluble in water. Thus, when paint or other materials are spilled on Duramask coated surfaces the accumulation can be readily washed off with water.

This paint-like material is applied thickly with a large brush, whereupon it sets within 30 minutes. When it is to be removed, together with accumulated surface spillage, it may be flushed off with a hose, mopped up, or removed with a floor squeegee.

SOLDERLESS TERMINALS

A SMALL wire terminal, which is rapidly applied to electrical conductors by means of specially designed pliers or by



One of the new solderless wire terminals, with and without insulating sleeve

a pneumatic press, is applicable to various types of cables and wires ranging in size from Number 22 to Number 10. These lugs are available with various tongue shapes and dimensions, with or without an insulating sleeve upon which identification numbers can be marked, and with or without a sighthole for inspection of the connection.

PLASTIC THICKNESS GAGE

THICKNESS feeler gage and shim stock of predetermined thickness is now available in a plastic material, the color of which identifies the thickness of the particular piece. The material is available in a range of 12 thicknesses from .001 to .030 of an inch and is known as Artus shim and feeler gage stock.

RIVET SQUEEZER

SUFFICIENT pressure to set up to 5/32 inch flat, round, or brazier-head aluminum rivets is obtained through the use of the Redi-Set hand tool shown in the accompanying illustration. The toggle handle

Plane of riveting center can be changed to exactly suit the rivets to be used

assembly is mounted so that it rotates at the head to permit accurate alignment over the rivet. Interchangeable dies are available for different sizes and shapes of rivets. The tool may be had with throat dimensions of 1¾ or 2½ inches and measures two inches between its faces.

Our Book Corner

THE BOOK DEPARTMENT of Scientific American is conducted, with the co-operation of the Editors, to make available for you a comprehensive book service. Each month the Editors select and review in these columns new books in a wide range of scientific and technical fields. In addition, they are ready at all times to advise you regarding the best available books on any subject. You are invited to use this service freely. Tell our Book Department what kind of books you want and you will be furnished with the names of available books, including prices. When inquiring about books, please be specific; remember that we can be of the greatest help only when you tell us just what you are looking for. Books listed in these columns may be ordered from our Book Department.

THE MODEL PLANE ANNUAL 1943

By David C. Cooke and Jesse Davidson

MODEL plane construction and flying has led many a person directly into branches of commercial or military aviation. Hence the information presented here on model plane design and construction assumes particular significance at the moment. (224 pages, 7 by 10 inches, lavishly illustrated with photographs and drawings.)—$2.60 postpaid.—*A.P.P.*

INTRODUCTION TO NAVAL ARCHITECTURE

By John P. Comstock

SUBSTANTIALLY the course in theoretical naval architecture given hull-drawing apprentices at Newport News Shipbuilding and Dry Dock Company by the author. Suitable for high-school graduates who have not had college mathematics, it explains fundamentals of naval architecture, how they are inter-related and progressively applied in ship designing. Not a substitute for standard references on this subject, but a study book and a guide to such publications. (209 pages, 5¾ by 9 inches, diagrams, tables, index.)—$4.10 postpaid.—*A.D.R., IV.*

FUNDAMENTALS OF MACHINES

By Charles E. Dull and Ira G. Newlin

AIMED at high school age pupils to serve as a pre-induction course, the text of this book will be found satisfactory as a simple but comprehensive reference source on the whole broad subject of basic machine principles. Supplementary material includes a glossary of terms, selected laboratory experiments, a mathematics refresher, a series of useful tables, and an index. (547 pages, 5½ by 8 inches, a large number of drawings and photographs.)—$2.10 postpaid.—*A.P.P.*

WINGED MARS. VOLUME I: THE GERMAN AIR WEAPON—1870-1914

By John R. Cuneo

IN THIS book the author has done what the very latest authors on military aviation are doing—he has reviewed the growth of military aeronautics from the point of view of its use in strategy and tactics. But while Seversky, Ziff, Michie are attempting to define the functions and duties of the airplane of today, Volume I of Winged Mars studies the lessons of the past. It is most instructive, since this view is kept steadily to the front, to read of German military ballooning and of the beginning of anti-aircraft defense. In his chapter "Role of French Air Weapon" the author points out that the French did not have faith in aviation except for reconnaissance, and this lack of faith appears as one of the causes of the French disaster. While this book may not be of outstanding interest to the general public, it will be of very great interest to all those concerned with military or naval aviation, and from that point of view it will find its way into many technical and professional libraries, public and private. (338 pages, many drawings.)—$2.60 postpaid.—*A. K.*

THE AMAZING PETROLEUM INDUSTRY

By B. A. Kalichevsky

MOST IMPORTANT raw material in the world, at the moment, petroleum is also the subject of innumerable industrial and military controversies. Here is good background material to serve in understanding the entire petroleum situation. It highlights the history and present status of petroleum in non-technical language. (234 pages, 5½ by 8 inches, a few drawings.)—$2.35 postpaid.—*A.P.P.*

SERPENT OF THE SEAS

By Commander Harley F. Cope, U. S. N.

A SUBMARINE skipper and a line officer of the Navy, this author knows whereof he speaks when he outlines the world history of submersibles, their construction and motive power. He writes with equal facility on submarine attack, anti-submarine procedure, training of personnel, and the skilful and daring skippers of America's fleet of submersibles. (252 pages, 5½ by 8 inches, 17 illustrations, index.)—$2.60 postpaid.—*A.D.R., IV.*

THE FIRST CENTURY OF FLIGHT IN AMERICA

By Jeremiah Milbank, Jr.

BROUGHT together for the first time in one volume, the widely scattered parts of this country's earliest aeronautical history will probably astound many readers. In 1784, a 13-year old boy was the first American ever to ascend in the air; nine years later came the first aerial voyage, with George Washington as a witness; balloon-reconnaissance played an

important role in certain Civil War engagements; 1878 brought a serious proposal to cross the Atlantic in 36 hours. Although claiming to be no more than an "introductory survey," this book opens up fascinating vistas of technological and social history by covering the period of American aeronautics from its beginning to the time when aviation had supplanted aerostation as the dominant concern of inventors and scientists. (248 pages, 5½ by 8½ inches, 40 illustrations.)—$2.85 postpaid.—*O.D.M.*

AUTOMOTIVE MECHANICS

By James V. Frost

DESIGNED for pre-service study, the text of this book has been made completely understandable to students. It covers motor vehicles from a description of the vehicles themselves through chassis, running gear, and body, to power unit, cooling system, and all the other intricate parts which must be familiar to the successful mechanic. Included are rules of the road, greasing charts and instructions, and a glossary of terms. (545 pages, 6 by 9 inches, over 350 illustrations.)—$2.60 postpaid.—*A.P.P.*

JORDANOFF'S ILLUSTRATED AVIATION DICTIONARY

By Assen Jordanoff

THE book is really a dictionary of aviation terms and does not deviate from its fine purpose: the correct definition of aviation terms, suitably illustrated by simple, clear, and striking sketches. The selection of terms is excellent and includes almost all those aviation words likely to be needed by any except the best informed specialists. It covers such widely diversified fields as airplane strength; elementary aerodynamics; airships; propellers; rotating wing aircraft; instruments; and the like. A curious appendix exists in a glossary of aviation slanguage. (415 pages, 7½ by 10 inches, 2057 drawings.)—$3.60 postpaid.—*A. K.*

THE HOUSE OF GOODYEAR

By Hugh Allen

AN HISTORICAL survey of one company which has grown up with the rubber business, yet a survey which more than hits the high spots of the whole rubber industry. This is a particularly timely treatment of a vitally important and interesting subject. (417 pages, 6½ by 9½ inches.)—$2.10 postpaid.—*A.P.P.*

FUNDAMENTALS OF PERSPECTIVE

By Theodore DePostels, A.I.A.

A METHOD of showing the order, or sequence, in which lines of a perspective are drawn. Each line of a constructed perspective is numbered in the examples shown, and its direction is indicated by an arrow. To further clarify the examples, four colors are used to show what is given, what are the essential elements, what lines are needed for the construction of the perspective, and finally, the perspective

The Editors Recommend

Best Sellers in Science

PLASTICS — ***By J. H. Dubois.*** Meaty information on the whole general subject of plastics, presented in narrative form for easy reading. Tabulations of properties of plastics, plus basic design information, for laymen and technicians alike. **$3.10**

EXPERIMENTAL ELECTRONICS — ***By Ralph H. Muller, R. L. Garman, and M. E. Droz.*** A solid book of eminently practical information on the characteristics and non-communication applications of electron tubes. The text describes experiments and presents results. For students, radio engineers, communications experts, and the serious general reader. **$4.75**

HOW TO READ ELECTRICAL BLUEPRINTS — ***By Gilbert M. Heine and Carl H. Dunlap.*** A chapter on how blueprints are made, plus nine other sections, each of which is devoted to a specialized part of the electrical field, from bell and signal wiring through motor control diagrams to power station blueprints. **$3.10**

GET TOUGH! — ***By Capt. W. E. Fairbairn.*** How-to-win-in-hand-to-hand-fighting directions, by a man who really knows rough-and-tumble methods that are *not* "clean" fighting but *are* designed to win. **$1.10**

CHEMISTRY — ***By Gerald Wendt, Ph.D.*** Chemistry made easier by a presentation that is intermediate between popular works and classroom texts. This book contains the main substance of a first-year college chemistry course, giving the reader better than a sketchy background in this important science. **$2.35**

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(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below.)

ASBESTOS FACTBOOK is a 16-page pamphlet which gives in compact form a wealth of information on asbestos. This includes the origin of asbestos, areas in which it is found, uses of asbestos and asbestos products, and typical analyses. *Asbestos, 16th Floor, Inquirer Building, Philadelphia, Pennsylvania.—10 cents.*

FLAKE SILICA-GRAPHITE PRIMER-PAINT is a four-page folder which gives condensed specifications on this type of surface coating for the protection of exposed metals and wood. Flake silica-graphite is reported to be absolutely inert as a paint pigment and to be unaffected by heat, acids, and alkalies. *Joseph Dixon Crucible Company, Jersey City, New Jersey.—Gratis.*

OUTLINE FOR POST-WAR PLANNING is an eight-page bulletin which presents certain basic elements that must be considered by any foresighted business man when planning an after-the-war selling program. *Tracy, Kent and Company, Inc., 515 Madison Avenue, New York, New York.—Gratis.*

HOT PROCESS WATER SOFTENERS is a 24-page pamphlet which describes the operation of lime and soda hot process water softeners, and the equipment with which this work is done in various industries. Outstanding features of the book are cross-sectional views of water treating plants and equipment. *Graver Tank and Manufacturing Company, Inc., 332 South Michigan Avenue, Chicago, Illinois.—Gratis.*

HOW TO LIGHT YOUR BLOW TORCH is a 22 by 34 inch wall chart which presents a cross section of a torch and a series of photographs which show precisely how to operate it. *Turner Brass Works, Sycamore, Illinois.—Gratis to training schools and war industries.*

AIR CONDITIONING is a 12-page article which deals briefly but concisely with many of the essential requirements for meeting war-time restrictions in heating and air conditioning design. Request Reference Section No. 9. *Industrial Press, 138 Lafayette Street, New York, New York. —25 cents.*

RADIO-FORMULA AND DATA BOOK is a 42-page pocket size pamphlet which presents a convenient collection of material for students and engineers in the field of radio and electronics. *Allied Radio Corporation, 833 West Jackson Boulevard, Chicago, Illinois.—10 cents.*

INTELLIGENT SELFISHNESS AND MANUFACTURING, by James F. Lincoln, is a 12-page dissertation on the whole question of incentive pay for employees and the advantages which accrue to the employer. Essentially the text is a record of the success of the incentive pay procedure as applied by one manufacturer. *The Lincoln Electric Company, Cleveland, Ohio.—Gratis.*

"THE INVISIBLE WORLD"... AND OTHER STORIES is a 20-page booklet which presents a few of the adventures of nine scientists and engineers in the world of electricity. Many photographs and drawings illustrate the men's activities. Bulletin GES-2962. *Publicity Department, General Electric Company, Schenectady, New York.—Gratis.*

DOALL CONTOUR SAWS is a 250-page book with hard board covers which gives details on the development of contour sawing and filing machines, on tools of various types, on basic applications, and so on. Eighty percent of the text is given in picture form, with charts and diagrams presenting a complete grasp of the proper speeds and feeds to be used in the shaping of all basic materials. *Doall Service Company, 1201 Thacker Street, Des Plaines, Illinois.—Gratis.*

KENNAMETAL TOOL MANUAL is a 48-page pocket size booklet which shows typical applications and uses of these industrial tools which are available in more than 30 standard styles and in four grades of hardness. Information is also given on care and handling of these tools as well as on brazing and grinding. *McKenna Metals Company, 100 Lloyd Avenue, Latrobe, Pennsylvania.—Gratis.*

DRESINATE is an eight-page bulletin describing the properties of a rosin-base wetting agent for speeding up the action of alkaline metal cleaning compounds. Various industrial cleaning operations are expedited through its use. Request Bulletin PM-16. *Hercules Powder Company, Wilmington, Delaware.—Gratis.*

MICROMAX PNEUMATIC CONTROL is a 16-page catalog which describes and illustrates the use of this equipment for regulation of pH, conductivity, and other conditions in a wide variety of industrial processes. The control employs a system of balances which detects, while they are very small, any departures from the predetermined control point, and operates simultaneously, by means of air pressure, to correct them. Catalog N-OOB. *Leeds and Northrup Company, 4934 Stenton Avenue, Philadelphia, Pennsylvania.—Gratis.*

ALLOYS FOR UNCLE SAM is an eight-page description of three bronze alloys developed especially for the victory program, and a description of the specifications which they meet. Photomicographs supplement the text. *Ampco Metal, Inc., 1745 South Thirty-Eighth Street, Milwaukee, Wisconsin.—Gratis.*

REFRIGERATION is a 48-page text book for home study, in which are presented the fundamentals of the refrigeration industry. The text describes various types of equipment as well as trouble diagnosis and service work. *Supreme Publications, 328 South Jefferson Street, Chicago, Illinois. —40 cents.*

TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

Editor of the Scientific American books "Amateur Telescope Making" and "Amateur Telescope Making—Advanced"

COLLIMATION is the accurate adjustment of the line of sight through a telescope after the optical elements and mounting are assembled. The number of letters received from telescope makers who indicate surprise that this should prove to be more of a job than they anticipated teaches us that it should have been stated without gloves in "Amateur Telsecope Making" that collimation generally is *not* easy, often is difficult, and usually accounts for hours of profanity and perspiration, and that this should be expected. You wrestle with the adjustments till you tremble, then lie awake after going to bed, trying to think out where you made your mistakes. You wrestle some more the next day, lose your fine disposition, appetite, about 20 pounds in weight, and eventually die of anorexia. But if you don't die, it's a wonderful feeling when you finally do get all the bugs out of the collimation job. So collimation is fine fun.

Collimating a Springfield telescope, with its extra reflection, is only a little harder than collimating a common telescope. We asked Russell Porter, who originated the Springfield, if this weren't true, and he replied that it's easier than falling off a log. From this, we sort of gather that there is a slight discrepancy somewhere. Was he pulling our leg?

Cyril G. Wates, 7718 Jasper Ave., Edmonton, Alta., Canada, has shown interest in collimating problems that wreck less agile intellects, and so we recently showed him a wail received from a Springfield mounting maker who was on the verge of death from collimitis. In return he showed us the reply he had thoughtfully sent to the sufferer. It was so lucid that we asked him to dish it up as an article. Here it is:

"I often find that it helps to visualize the problems involved in collimation if one thinks of the various optical axes as thin steel rods. If these 'rods' will turn freely in imaginary bearings rigidly attached to the mechanical parts of the telescope, collimation is bound to be perfect.

"In Figure 1, *D* represents the declination axis, and *a, b, c,* are cross-threads. I assume that the main mirror has been lined up with *a* and *b*. Now if the diagonal *P* is inserted and adjusted so that cross-wire *c* lines up with *a,* when viewed along the center of the declination axis, the telescope can be rotated on this axis without throwing the cross-hairs out of line, because all the parts involved are solidly connected together. However, the moment prism *H* is put into the path of the rays, another factor is involved, because *H* is *not* connected to the rest of the optical parts; it stands still while everything else turns around.

"Note that it does not make the slightest difference to the collimation whether the declination axis is at right angles to the tube or not, so long as the optical axis of the light cone coincides with the mechanical axis of the declination axis. It might be like Figure 2 without affecting the collimation adversely, since all the parts are united, and once having got the cone of rays truly centered in the declination axis, you may throw the rest of the parts, tube, mirror and diagonal, away, and forget them. This does not mean, of course, that the declination axis need not be at right angles; simply that its rectangularity has no bearing on the collimation.

"Now, let's bring the prism *H* and eyepiece into the picture. These also are fastened together. Consider the point *Q* where the ray *cd* cuts the diagonal surface of the prism. If this point is exactly in the center of the declination axis, it makes no difference, as far as collimation is concerned, if the prism and eyepiece are all cockeyed.

"The whole thing simmers down to this: the ray *cd must* be lined up exactly in the center of the declination axis, and after that condition is secured, all adjustments can be made on the prism *H* and eyepiece without in any way affecting the collimation of the main tube.

"There is, however, a way in which the relationship between the declination axis and main tube affects the collimation. Picture the declination axis connected to the tube by a universal joint. Also picture the mechanical center of the declination axis as a thin rod protruding into the tube, and the optical axis of the tube as another thin rod. Obviously, these rods must intersect. Assume that they do intersect. Then the declination axis could be moved on its joint *longitudinally* without breaking the intersection (Figure 3). One rod slides along the other.

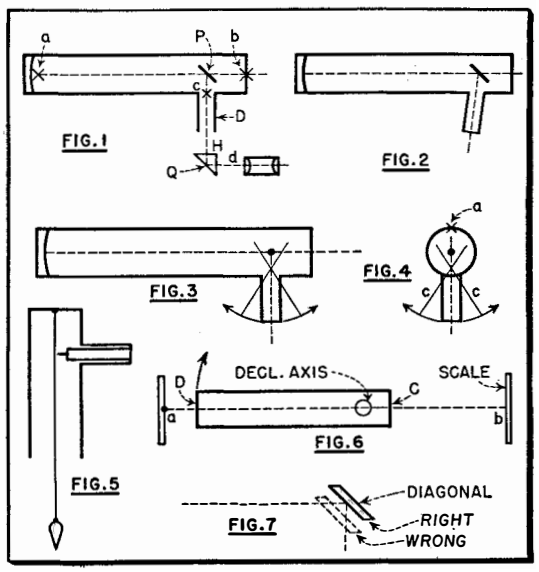
"If, however, the declination axis is moved *crosswise,* the intersection will break at once. (Figure 4). If the intersection is broken, it obviously will be impossible to reflect the central ray so that it follows the center of the declination axis, and I imagine that this is the commonest cause of trouble in collimating a Springfield. The remedy is to shim the tube in its cradle until the declination axis is square-on, but it is more difficult to design a method by which this squaring on may be accurately tested.

"One way would be by means of a wooden rod, turned in the lathe to fit snugly inside the declination axis and having a tiny pin in the center. This could be combined with a plumb-bob hanging axially in the tube (Figure 5). A simpler way is the old one of marking the point *a* (Figure 4) with great exactness, and sighting at it by means of cross-wires in the declination axis.

"Both these methods assume that the inside of the declination axis is concentric with the outside, which may not be the case; also they lack refinement. No pains should be spared to get this adjustment accurate, as everything else depends upon it. If it is not correct, one of two things will happen: either the central ray will be reflected *parallel* to, but not *coincident* with, the mechanical axis of the declination bearing, or the central ray will be cockeyed, like one of the lines *c c* (Figure 4). Either condition is clearly fatal to collimation.

"The best method is probably a modification of one described in 'A.T.M.' for lining up the declination axis, that is, by sighting at fixed posts and reversing the tube. Assuming that this already has been done, new sighting blocks are provided as near to the ends of the tube as will permit the head to be inserted at either end. The set-up is shown diagrammatically in Figure 6.

"In addition to the cross-wires, provide a disk of cardboard which can be attached to either end of the tube, with a 1/16" hole accurately punched to coincide with the intersection of the cross-wires. (I should make the disk first, and attach the cross-wires to intersect in the hole). Putting the disk at *C,* sight toward *a,* and put a dot on the block where the wires fall. Without moving the tube, put the disk at *D* and sight toward *b,* which



Figures 1 to 7: **Collimating a Springfield**

has a scale fastened to it. Note the reading on the scale.

"Without removing the disk, reverse the tube and line up the cross-wires on the dot, at *a*. Transfer the disk to the other end, and sight at the scale. If the reading is not the same as before, it is because the central line of the declination axis does not intersect the line joining the cross-wires (the axis of the tube). It must be made to do so by shimming under the saddle.

"It may be found that, when reversing the tube, it will be impossible to line up the intersection of the cross-wires with the dot. It may fall above or below the dot. In such event, disregard the cross-wire which is at right angles to the declination axis, and merely make the wire that is parallel to the declination axis intersect the dot.

"The adjustment of the tube in the cradle to make both wires coincide with the dot involves shimming in both directions. The best way to accomplish this is a bit of a problem, which may be left to the ingenuity of the worker. Really, it is quite unnecessary to adjust longitudinally by shimming at the ends of the cradle (see Figure 2). All that is required is shims at one side or the other to 'roll' the tube in the cradle and bring its axis into coincidence with the axis of the declination bearing.

"These are the preliminary adjustments. When these are complete, I should start collimating from both ends, and meet in the middle. Insert the main mirror and line up so that the optical axis coincides with the cross-wires. Insert *accurate* cross-wires at the inner end of the declination axis (*c*, Figure 1). A cap should be provided for the eyepiece adapter tube, with a small hole in the exact center. Such a cap can easily be made of tin, and is a very useful gadget.

"Sighting through the cap, see whether the inner end of the declination axis, where the cross-wires are, lines up centrally on the face of the prism. If not, adjust the prism to make it so. I regard this adjustment as the least important of all, since a slight error here will not affect the collimation. It will simply cause a slight chromatic effect on bright images.

"Now insert the diagonal in the main tube. Adjust this until the cross-wires at *a* (Figure 1) coincide with the cross-wires at *c*. It should now be possible to rotate the tube on the declination axis without separating *a* and *c*. If this is so, collimation is complete.

"Note, by the way, that the first adjustment of the diagonal should be to slide it longitudinally in the spider until the eclipse appears truly circular and centered in the declination axis, as viewed through the hole in the cap. Next, adjust by the push-pull screws until the cross-wires line up as nearly as possible. If this adjustment cannot be made exactly, it may be necessary to alter the first adjustment slightly. This is obvious when you consider that the face of the diagonal *must* coincide with the junction point of the two axes, as seen in Figure 7. Wherever I have spoken of the 'diagonal,' 'prism' may, of course, be substituted.

"Summarizing, the various steps are as follows:

1) Make cardboard disk and punch central hole.

2) Stretch cross-wires in main tube, centering by means of disk.

3) Square up declination axis by sighting blocks (Figure 6).

4) Insert and adjust main mirror.

5) Insert and adjust prism *H*.

6) Provide cross-wires in declination axis.

7) Insert diagonal (or prism) and adjust to make cross-wires coincide."

ROTOSCREEN: Before he joined the Army, William Waldeyer, of San Francisco, offered the following to other amateurs: "When an image of the Sun is thrown on cardboard (or any kind of screen, I suppose), the grain of the screen interferes with the sharpness of the image. But if that screen is rotated or moved, the granulations or grains of the screen become invisible, while the image immediately becomes sharp and clear. The image, of course, is thrown on succeeding portions of the rotating screen, and the persistence of vision causes the image to clear up and become sharp. Sunspots, as well as the white flocculi of the Sun, become clearly visible on the screen. The idea seems so obvious that I don't doubt it's already in common usage—only I've never come across it."

Waldeyer made his rig from the motor-driven propeller shaft of a 15-cent toy electric boat.

TEST, never tried but offered for what it may prove to be worth, by J. R. Haviland, author of the long treatise on

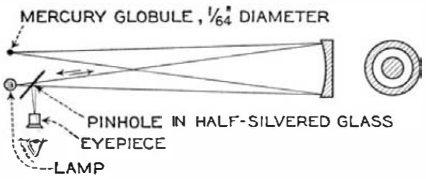


Figure 8: Haviland's proposal

the refracting telescope in "A.T.M.A.", is shown in Figure 8. Theory, says Haviland, suggests that it would be very accurate, but, he asks, will it work practically? He continues:

"Unless the center of the sphere of mercury, mounted on a micrometer screw, is placed accurately at the center of curvature, the image of the pinhole will not be sharp—a few thousandths of an inch of shift will blur it. Use a stop exposing one zone at a time, as sketched. However, as sketched, the returning focus falls concentric with the pinhole in the silver, and there would be difficulty in distinguishing which was which in the eyepiece. Perhaps it would prove necessary to use a pinhole in an opaque screen back of the glass.

"The accuracy would be better than one eighth of a wavelength at the peripheral zones. For large mirrors this test would obviate the use of the customary flats."

IF YOUR local hardware dealer's truck, loaded with a shipment of Pyrex ovenware, should get into an accident and 200 pounds of Pyrex were broken, would you not, as a telescope maker, have the thought: "I could do things with that much Pyrex if only it were in the form of mirror disks"? Wilbur E. Gemmill, chemical engineer, 434 North Beaver St., York, Pa., ran true to amateur form when this happened in his community. He already owned equipment for melting down the fragments and he obeyed his TN instincts. It proved successful.

Into a graphite crucible he put 15 pounds of broken Pyrex and set this in his laboratory furnace. This he raised to 2500°, F., allowed the bubbles to rise through the viscous mass, poured the melt

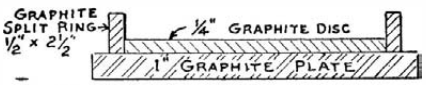


Figure 9: Gemmill's glass mold

into a mold (Figure 9) which had been pre-heated to 1500°, F., in a muffle. He left the poured glass in the muffle for 38 hours, during which the temperature was gradually allowed to fall by changing transformer taps. Next, it was left another 16 hours without heat, and removed at 110°, F.

"The disk made a fine mirror," he writes, "with no evidence of strains when tested with two Polaroids. It was ground, polished, and figured, and has been in use for over a year with beautiful results."

Did it pay? Of course not. Gas—electricity—time: a new Pyrex disk could be bought for less. Yet it did pay out—in fun. "It was done," Gemmill says, "simply because of the intriguing nature of the problem."

"Subsequently," he adds, "I have melted down a local enthusiast's disk in which there was a crack caused by accidental dropping. The large chip thus outlined welded in and the cracks disappeared at about 2200°, F. I am also saving my broken laboratory ware to make two 10" disks to make flats.

"A local amateur made an 8" disk from scrap window glass. The pieces were washed with soap, rinsed, dried, fed, piece by piece, into an iron crucible, raised to 1800°, F., and held several hours for bubbles to rise. Poured into an asbestos-lined iron mold and covered with asbestos paper and iron, the glass was left to cool till no longer plastic. It was then buried in about 15 pounds of house insulating material and allowed to anneal for 24 to 36 hours. It annealed quite well, as checked by two Polaroids, and seemed very uniform. The mirror took and held a good paraboloid."

Again, all this is largely of general interest, alone, to the average amateur, because the necessary furnace is seldom available. Gemmill states that a home-made blower could be rigged up with an oil burner and some sort of retort. Again we have the intangible factor of fun pottering with gadgets, and when some too practical-minded critic comes along to remark, "Does it pay?" you say "No,"—and go on pottering, leaving him shaking his head. He will never understand the mainsprings of the experimental urge.

INDEX TO VOLUME 168, JANUARY—JUNE, 1943

Printed in the U. S. A. Press of the Wilson H. Lee Company, Orange, Connecticut.

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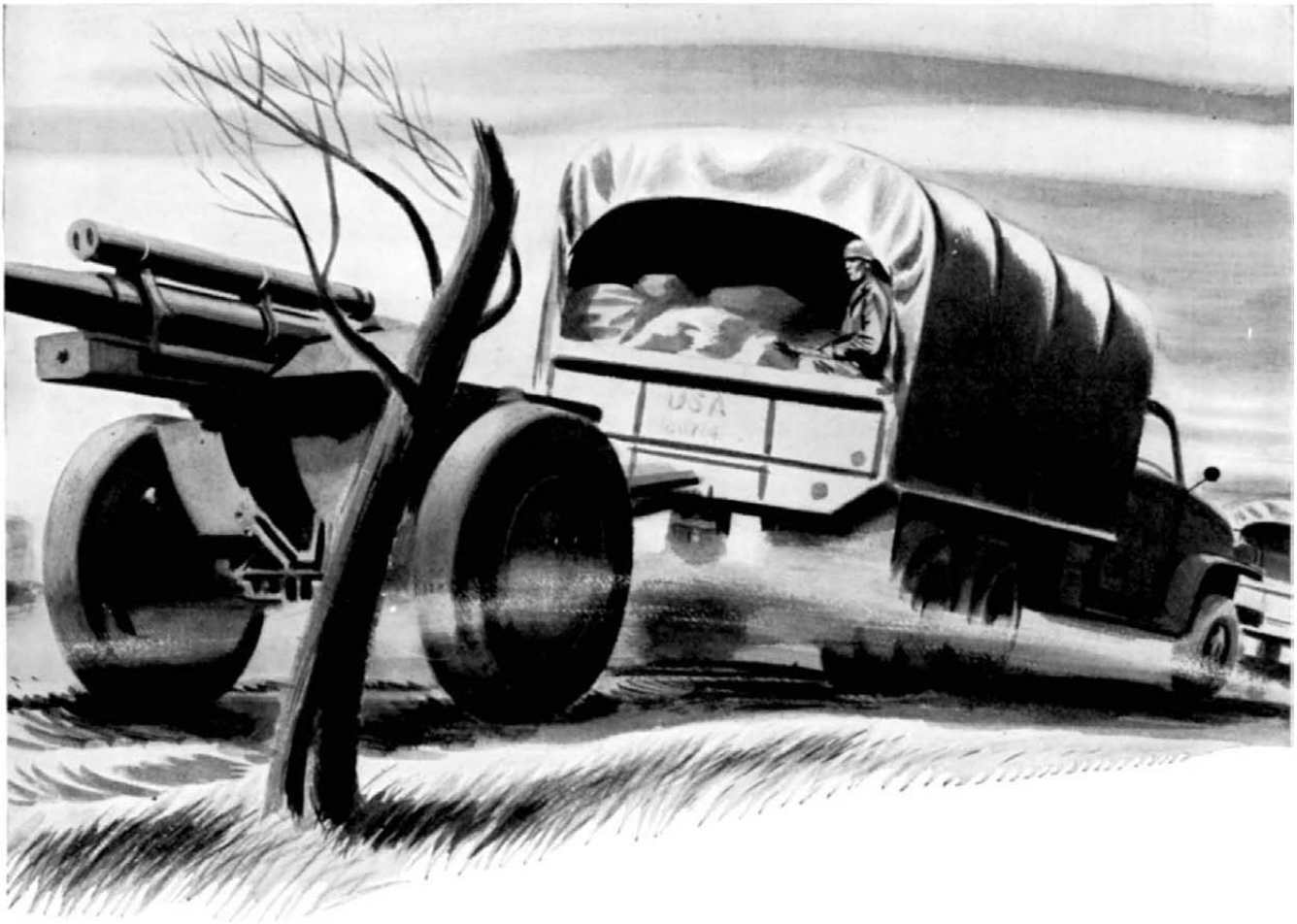

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Recognizing the vital need, Westinghouse Research Engineers set to work to develop a quick, sure method of detecting these flaws.

Their ingenious electromagnetic flaw-detector is based upon the fundamental law that the *permeability* of a heat-treated steel part varies with the degree of hardness.

In actual practice, the bearing race is *completely* demagnetized. Then it is rapidly rotated and strongly magnetized. While the race is still turning at high speed, its magnetic field is explored with a specially designed electromagnetic "pick-up."

Variations in the magnetic field of the bearing race, due to hard or soft spots, induce feeble currents in the pick-up system. These currents are amplified and shown visibly on a cathode-ray oscilloscope.

A uniformly heat-treated bearing race traces a *luminous straight line* on the oscilloscope screen. Faulty heat-treating shows up as a pattern of *hills and valleys.*

The electromagnetic flaw-detector is now being used commercially—a typical example of Westinghouse *electronics at work.*

It assures quality in millions of bearing races for our armed forces, to keep 'em rolling on to victory!

Westinghouse Electric & Manufacturing Company, Pittsburgh, Pennsylvania.

Electronic fingerprints — A Westinghouse Research Engineer demonstrates the principle of the electromagnetic flaw-detector. Hard spots in the steel test piece show up as an irregular line on the oscilloscope screen.

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Electronics at Work