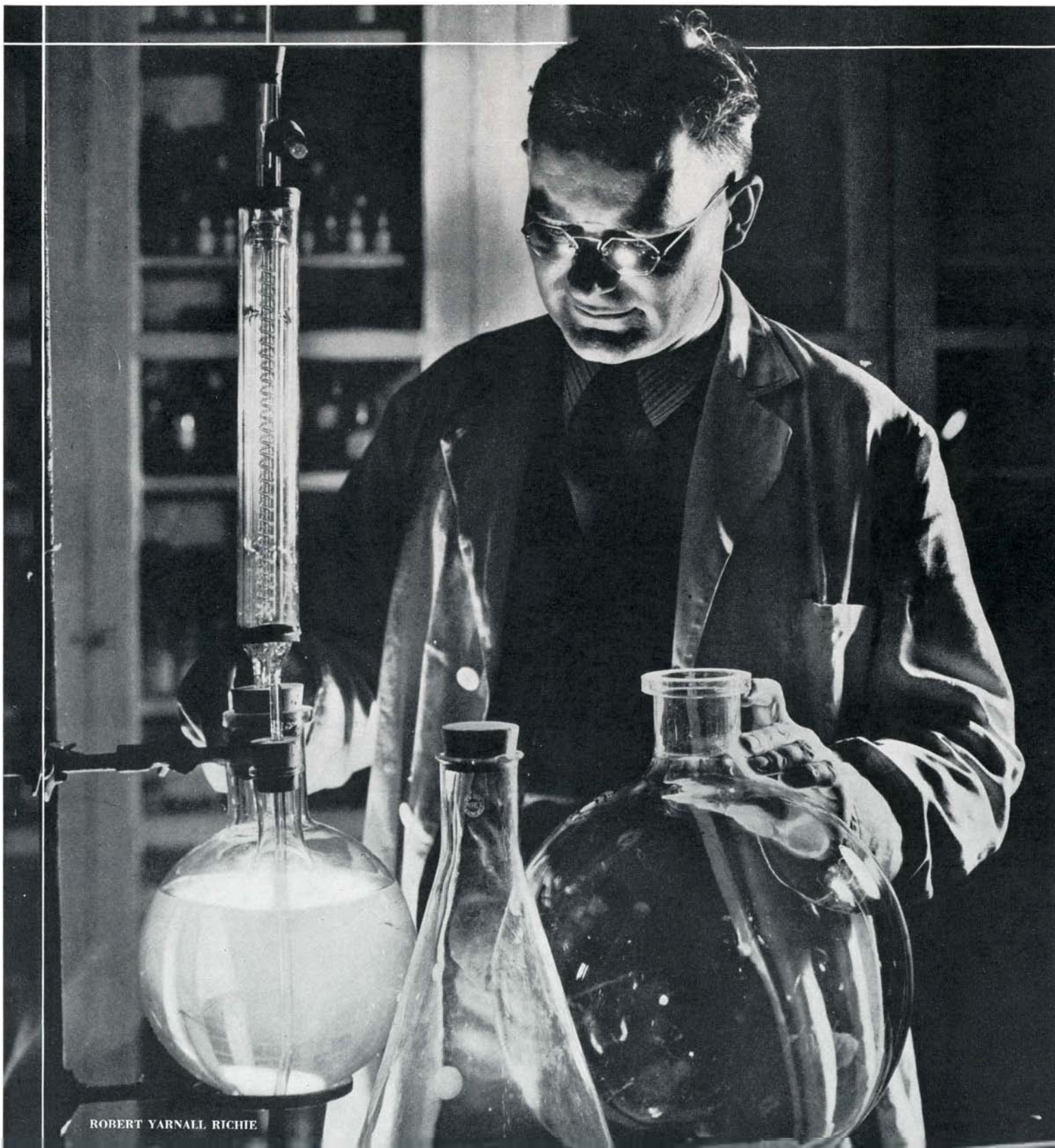
KETTERING Writes on "Research and Industry"

SCIENTIFIC AMERICAN

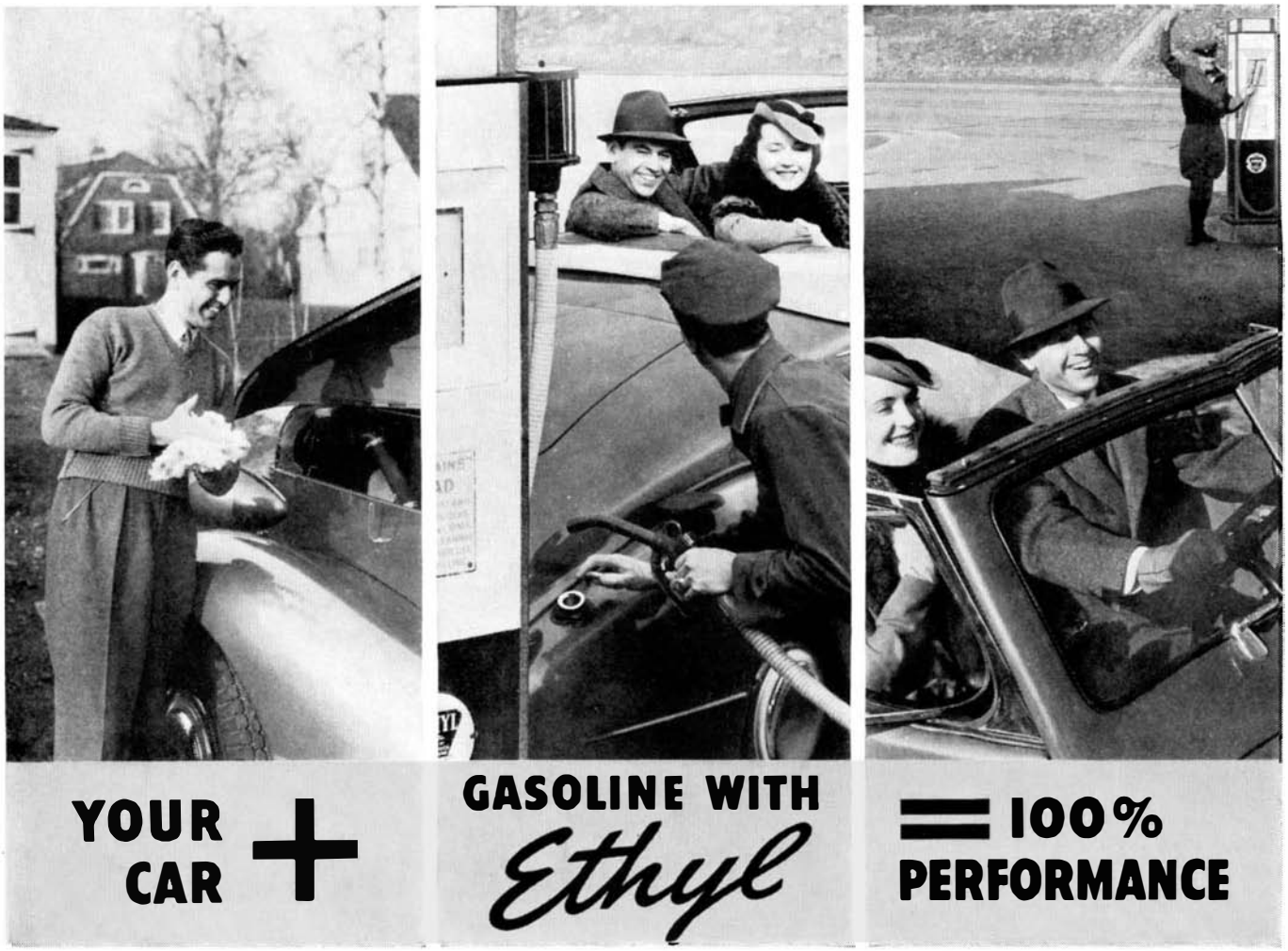
May · 1937

35c a Copy



ROBERT YARNALL RICHIE

How to get
A BETTER RUN FOR YOUR MONEY



AND THIS IS WHY:

1 You get more anti-knock fluid (containing lead tetraethyl) at pumps marked "Ethyl" than you get in the best regular-grade gasoline.

2 You get all-round quality (including quick starting) that is *double-tested*—by the oil company and by the Ethyl Gasoline Corporation.

3 You get 100% performance from your high compression engine.

4 You save on oil as well as gas by preventing knock and overheating.

WITH ETHYL ANTI-KNOCK COMPOUND ETHYL GASOLINE CORPORATION

NEXT TIME GET ETHYL . . . A BETTER RUN FOR YOUR MONEY

The SCIENTIFIC AMERICAN DIGEST

SCIENTIFIC AMERICAN

Owned and published by Munn & Company, Inc.; Orson D. Munn, President; John P. Davis, Treasurer; I. Sheldon Tilney, Secretary; all at 24 West 40th Street, New York, N. Y.

NINETY-THIRD YEAR • ORSON D. MUNN, Editor

CONTENTS · MAY · 1937

AS pointed out so ably by Mr. Kettering in his article, "Research and Industry," starting on page 285 of this issue, research is the life blood of any industry that is constantly searching for new products and new uses for old products. Symbolical of industrial research is our cover photograph showing an assemblage of laboratory equipment in preparation for the vacuum distillation of an essential oil in the research laboratory of Givaudan-Delawanna, Inc.

SCIENTIFIC AMERICAN, May, 1937. Vol. No. 156, No. 5, entered at the New York, N. Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Greenwich, Conn. Published monthly by Munn & Company, Inc., 24 West 40th Street, New York City.

Subscription price $4.00 per year. Canada $4.50. Foreign $5.00. Manuscripts are submitted at the author's risk and cannot be returned unless accompanied by postage.

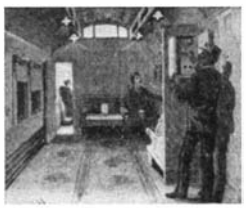
50 YEARS AGO IN . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of May, 1887)

PANAMA CANAL—"The prospects for a canal at Panama seem more illusive as time goes on, and not even the skill and perseverance of the French engineers has, so far, sufficed to lend to the scheme the air of practicability."

CAR LIGHTING—"The apparatus (for the application of the electric light to the illumination of cars) consists of incandescent lamps, supplied by storage batteries of the Julien type. A number of cars, sleeping, parlor, and ordinary ones, and even a baggage car, are now thus lighted, and it is fair to assume an extensive introduction of the system. The public attention has been so forcibly drawn to the dangers of kerosene lamps on railroads, that special interest attaches to the subject of the electric lighting of vehicles of travel."



VACUUM ENGINES—"In the central station of the Rue de Beaubourg, Paris, a 40 horse power plant is now at work actuating vacuum engines in the neighborhood, some of them being situated at a distance of about a third of a mile. Motive power at the central station is provided by a steam engine, which works an air pump producing a partial vacuum in a system of small lead tubes laid underground throughout the district. At the different places where power is required, there are small vacuum engines constructed similar to steam engines."

SUB-SEA—"A writer in one of our contemporaries suggests the development of submarine navigation as one of the works of the future. He contrasts the amount of time and thought which has been expended upon the solution of the problem of flight with the little that has been done in the other field."

DOMESTICATED APES "The ideas of M. Victor Meunier with regard to the domestication of apes are discussed in the new number of the *Revue d'Anthropologie*, by Madame Clemence Royer, the French translator of Darwin. Madame Royer does not doubt that, under a proper system of training, apes might be made good workers. They lack perseverance, indeed, but in general intelligence they are, she thinks, superior to the dog, the horse, or even the elephant."

GAS WELL—"The largest gas well in the world has just been discovered at Fairmount, Indiana. The tests of Professor Orton, State Geologist of Ohio, show that it is flowing nearly twelve million cubic feet per day."

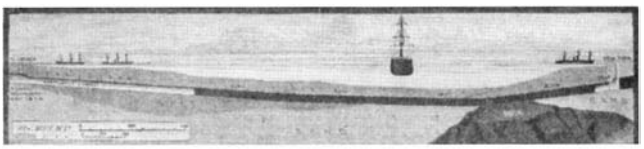
OVERHEAD WIRES—"The city of New Orleans is about to adopt a system of Colonel Flad for overhead wires. This consists in erecting tall towers at the street corners, which will carry the wires over the roofs. . . . The older method of running the wires, telegraphic, telephonic, and electric lighting, on poles will be abolished."

SHOES—"The London (Eng.) *Shoe and Leather Record* describes a system of fastening the soles to boots and shoes, in which the fastenings are driven from the inside, the fastenings being first placed in the insole and then the upper lasted over them."

ASBESTOS—"From Orenburg to Ekaterinburg, Russia is declared to be thickly dotted with asbestos deposits, while near the Verkni Tagil iron works is a hill called the 'Sholkovaya Gora,' or Hill of Silk, which is stated to be entirely composed of asbestos. . . . In the Goroblagsdat district of Perm similar deposits crop above the surface, and any quantity can be obtained for nothing, the mineral possessing no value in the Ural region."

RAILROAD BRIDGE—"The Central Railroad of New Jersey crosses Newark Bay upon a trestle nearly two miles long. Near the eastern end of the trestle is a draw span which, after having performed its duty for many years, and been re-enforced to enable it to accommodate heavier loads, is now being replaced by one more in keeping with modern practice, and better proportioned to carry the heaviest engines now built, and to provide for any increase that may take place in the future" (!)

HUDSON TUNNEL—"In some respects a most remarkable piece of submarine engineering was that begun some twelve years ago, when the first work connected with the tunnel to unite Jersey City and New York by a passage under the bed of the Hudson River was done. Important to the engineer because of its vast magnitude, the difficulty and danger attending its prosecution, and particularly because of the new methods of working introduced; important to commerce, as it would afford a quick and sure means of crossing the river, and would reduce the time between New York and the South and West on each of the great railroads terminating at Jersey City."



FERTILIZER—"The great value of nitrate of soda, a material our cultivators are only beginning to learn the value of, is to hasten the growth of plants early in the season, and for this purpose it has no equal."

CONSERVATIVE MILITARISTS—"Military authorities are by no means agreed that the magazine rifle is superior to the breech-loader for the use of the soldier; and though Europe is hurriedly exchanging the former for the latter, the voice of indignant protest is making itself heard in the military journals, and with no uncertain sound."

PARCEL POST—"The public will be greatly benefited if the scheme, now under consideration by the Hon. A. W. McLelan, Postmaster-General, for creating a parcel post system between Canada and the United States, materializes. At present there is no system whereby parcels can be sent direct."

AND NOW FOR THE FUTURE

¶For men only: Pogonotomy—shavers and shaving, by E. J. Casselman

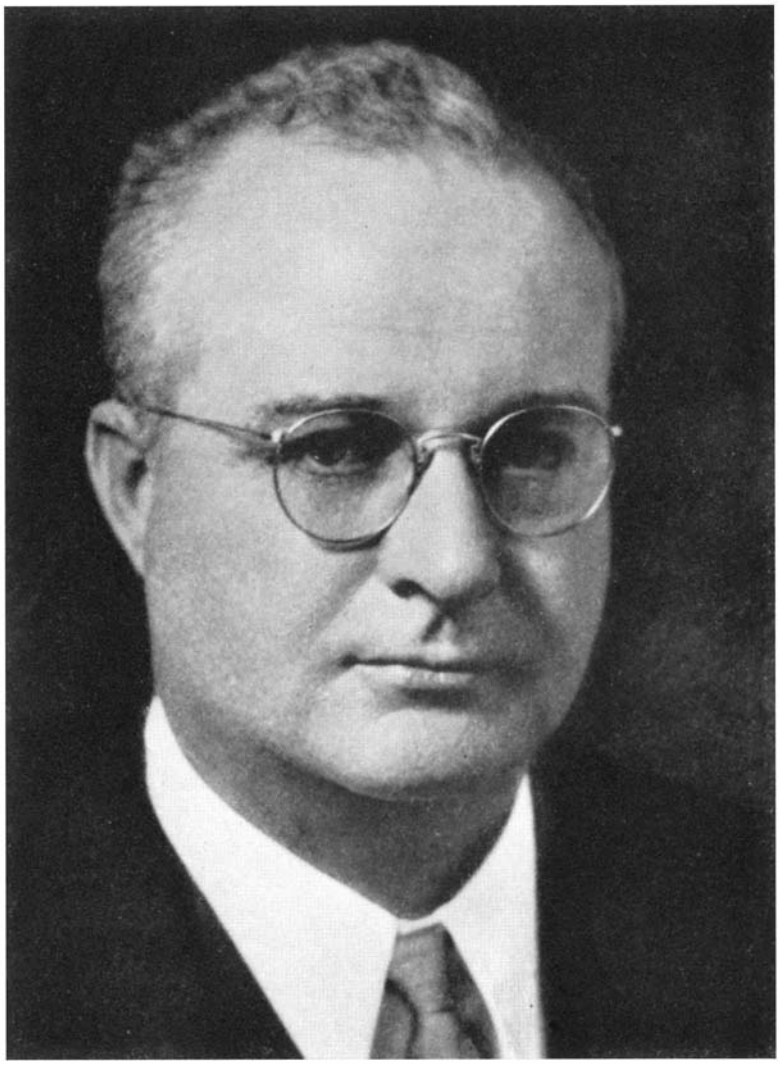
¶Unique constructional features of the Storström Bridge in Denmark, by R. G. Skerrett

¶Life frequently persists in spite of adverse circumstances, by T. Swann Harding

¶Speed a-wing—how fast can birds actually fly?, by S. F. Aaron

¶Another intriguing article on archeology, by Jotham Johnson

Personalities in Science



THOMAS MIDGELY, JR.

FOR distinguished work in applied chemistry, including the development of anti-knock motor fuels and of non-toxic, non-inflammable refrigerating fluids for household refrigerators and air conditioning, Thomas Midgely, Jr., vice-president of the Ethyl Gasoline Corporation, has been awarded the famous Perkin Medal.

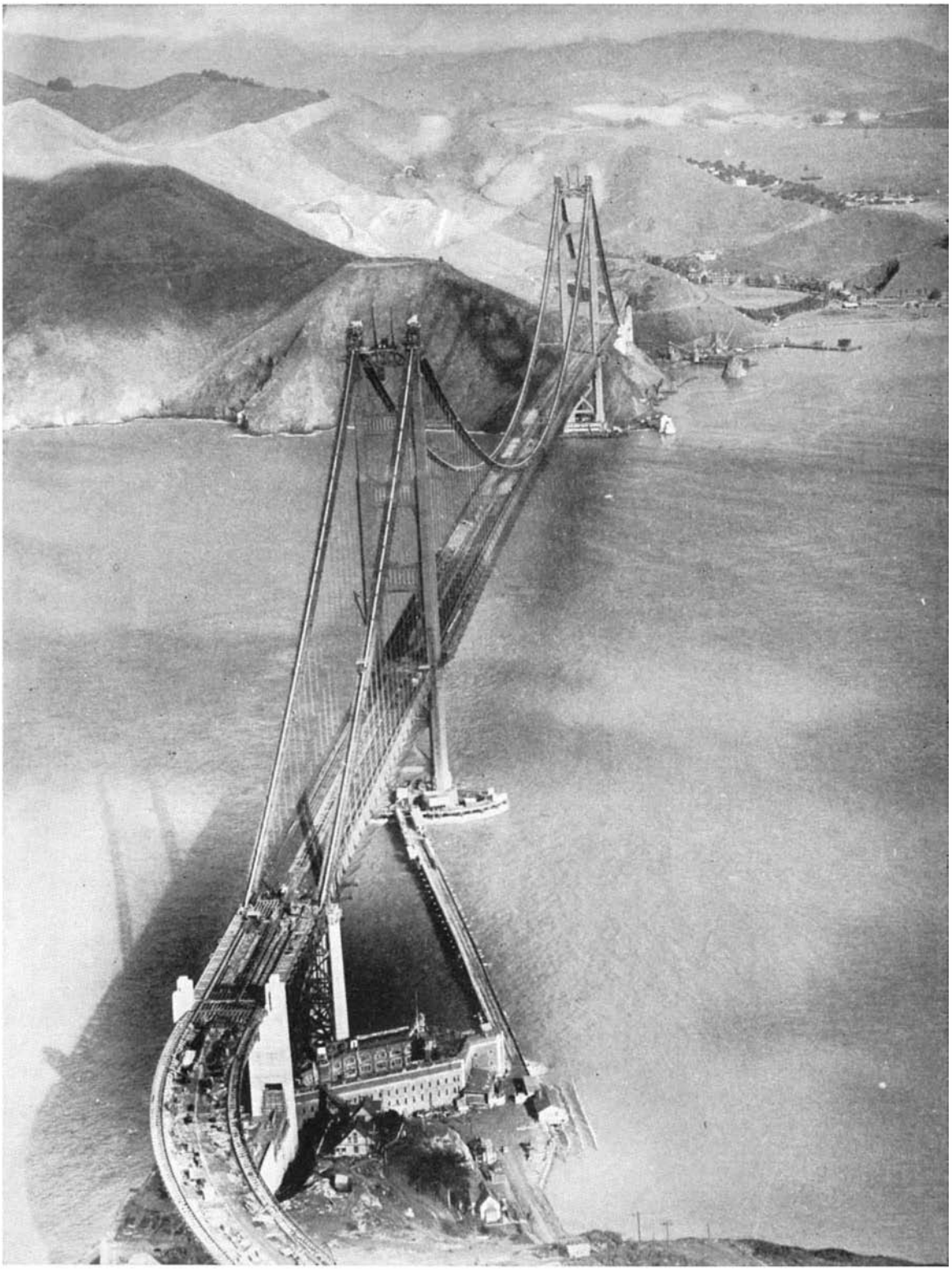
At a joint meeting of the American Section of the Society of Chemical Industry and the New York Section of the American Chemical Society, Robert E. Wilson, vice chairman of the Pan American Petroleum and Transport Company and since youth a personal friend of the medalist, spoke informally as follows:

"Midgely decided to take a course in mechanical engineering at Cornell University. I am sorry that I cannot report that he was an all 'A' student—in fact it appears from both his testimony and that of his professors that the ideal of efficiency which has always been uppermost in his mind demanded that he do the minimum amount of work with which he could get by in most of his courses, so that he could concentrate on a few things which were really of interest to him.

"Having heard much of the fame of Charles F. Kettering while still with the National Cash Register Company, he got a job with the Delco Light Company and thus began in 1916 his long and fruitful association with Mr. Kettering. It so happened that his first task was that of trying to get more power out of the small Delco Light units when they were operated on kerosene. It had been found that, operating on gasoline, the compression on these engines could be raised to a point where they gave fairly good power output and efficiency, but when an attempt was made to use these compressions with kerosene as fuel, severe knocking and even cracked cylinder heads resulted. Tom became much intrigued with this phenomenon, and, wanting to study it more closely, rigged up a high-speed indicator using a system of optical levers for magnifying and recording the shape of the pressure wave. This eventually led to the perfection of the Midgely indicator, which did so much to throw light on just what took place when engines knocked, indicating, among other things, that knocking and pre-ignition were two entirely different phenomena.

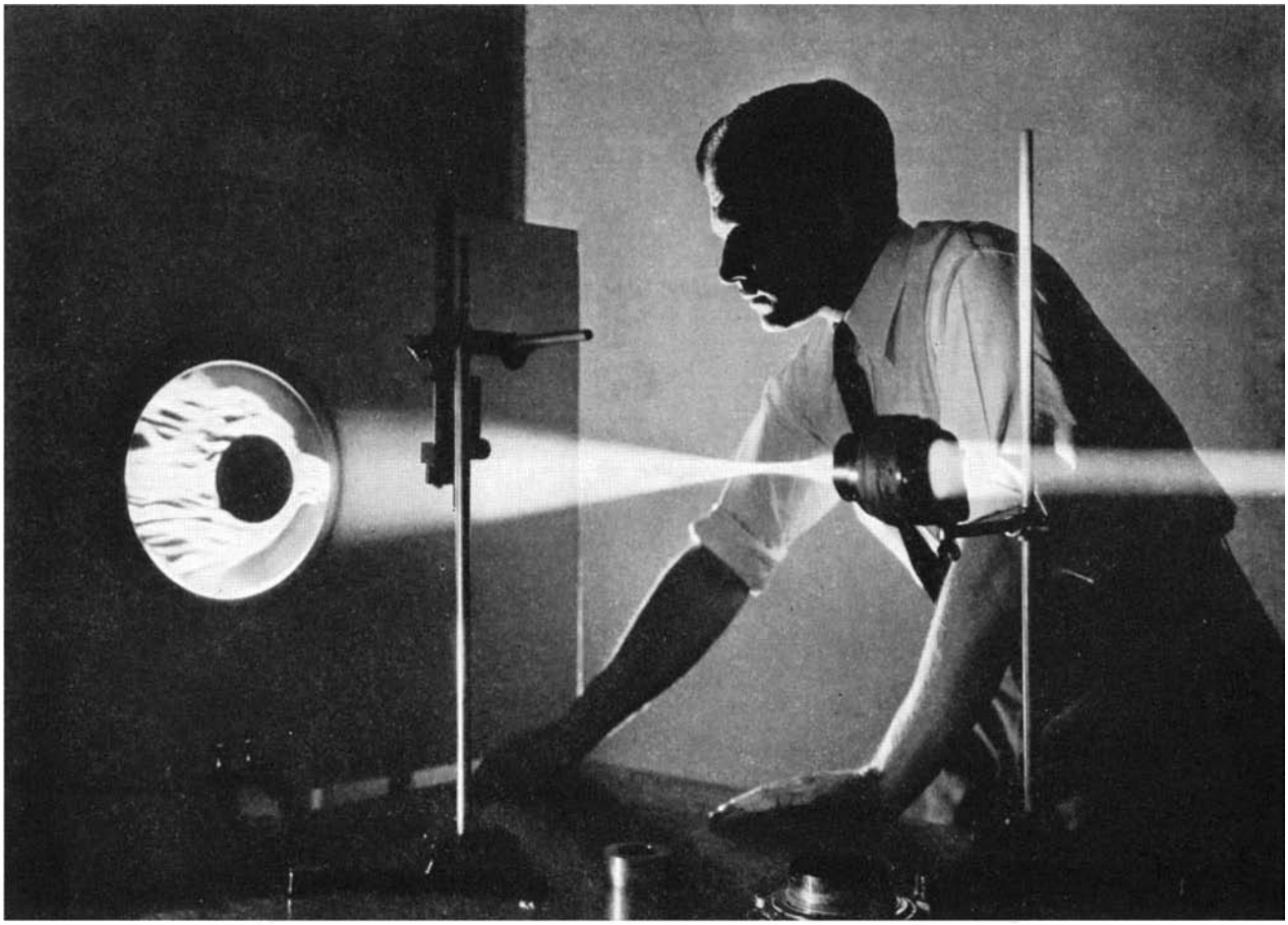
"The Midgely indicator showed clearly that the knock was due to a rapid rise in pressure after ignition and near top dead center. In attempting to theorize as to why kerosene knocked and gasoline did not, he first seized upon the most obvious difference between the two products—that of volatility—and thought that possibly the kerosene vaporized rather slowly until after combustion started and then vaporized very suddenly with a resultant too-rapid explosion. If this explanation were correct, he reasoned that by dyeing the kerosene it might be possible to make the droplets absorb radiant heat from the cylinder walls and hence vaporize sooner. While this theory proved to be entirely unfounded, it did lead to the discovery of the anti-knock properties of iodine, and started him on the trail of a whole series of anti-knock compounds culminating in tetraethyl lead. the basis of ethyl gasoline.

"Tom's other outstanding discovery was, of course, the development of certain organic chloro-fluorides as the only refrigerants which are at once stable, non-toxic, and non-inflammable. Again this particular discovery is merely a symbol of the many special problems for General Motors and its affiliated companies to the solution of which Tom has devoted his talents, and by which he has proved that neither the discovery of tetraethyl lead nor that of Freon was an accident but rather the result of real chemical ingenuity and intuition, plus a lot of hard work and horse sense. Who would have dared to imagine that a stable, non-toxic, non-inflammable refrigerant could be made in effect by combining a highly inflammable gas, methane, with two of the most toxic gases known, chlorine and fluorine, yet that is the accomplishment which has done more than any other one thing to make home cooling installations safe and popular."



LOOKING NORTH ACROSS THE GOLDEN GATE

THE Golden Gate Bridge (see also page 301) as a definite project dates back to 1919, when the San Francisco Board of Supervisors authorized a survey to determine its feasibility. Preliminary plans were prepared and the project was approved by the War Department in 1924, but it was not until six years later that the Golden Gate Bridge and Highway District was formed. The bridge has been built as a self-liquidating project, being financed by a $35,000,000 bond issue, guaranteed by the taxable property of six Californian counties—San Francisco, Marin, Sonoma, Napa, Mendocino, and Del Norte.



The Schlieren effect, used for studying streamlining, renders air flow visible

RESEARCH AND INDUSTRY

No Research Holiday . . . We Think Engineering is Ahead Because it is a Lap Behind . . . Has Much to Learn . . . Fallacies of Technological Critics

By CHARLES F. KETTERING

Vice President, General Motors Corporation, and Director
General Motors Research Laboratory

THERE has been a lot of talk in the last few years about research and scientific development, most of it of an extremely derogatory nature. When it wasn't derogatory, it was pitying. "We've reached the end of our rope in inventing new things. From now on we'll only improve the methods of making these things by machinery and throw more men out of work. We have come to a point in our civilization where research can only make things worse."

That is a theory I would hate to believe, even if there were truth in it. And I do not believe there is a word of truth in it. The facts seem to belie it.

We have been through some lean years recently, and it cannot be denied that unemployment is still a problem. The engineer is often blamed for this lack of jobs, this "technological unemployment," perhaps because there are not very many engineers to talk back. But I don't feel that the engineer is to blame for these conditions. At least, if there is any blame attached, it is for what the engineer did not do, not because he did too much.

A great many people apparently feel that industrial research has pushed forward too fast; as they phrase it, it has gotten ahead of our social absorption ability. To my mind, that is about like the man who went down to take the train at the scheduled time and found it had left an hour earlier. He was naturally quite irritated, but his protests availed nothing, as the railroad company's defense was that it was yesterday's train which had just pulled out, only 23 hours late. I think that may be the reason we think engineering is ahead—it is a lap behind.

With all the talk about the trouble created by technologists through the development of labor-saving machinery, it is peculiar that so few people have realized—or perhaps I should say, have expressed the realization—that a technological development may have much greater possibilities for labor-creating than for labor-saving. It is often asked if we would not be better off without some of this development which has taken work away from men and given it to machines. But how often do you hear anyone suggest that if we extended and multiplied this work of develop-

ment it might create new industries which would more than absorb any people who may have been thrown out of work due to it?

I am, of course, more familiar with the history of the automobile business than with any other, so let us take that as an example. Some thirty-odd years ago I had a canvass made of the number of people in the automobile industry. As closely as we could figure, it was about 1000. By the best figures we can get today, about 11,000,000 people are directly, or indirectly, dependent on this industry for their livelihood. These are certainly not all in the business of building automobiles, but that is not the motor-car industry. A large percentage of the steel produced goes into the automobile. A great deal of our glass, a still larger percentage of our rubber, and an extremely large percentage of our petroleum—all this added together is the motor-car industry.

NO one thought when he was making the old one-lung machine that he was beginning something which would some day be one of the leading industries of the world, would contribute to practically every industry known at that time, and directly or indirectly be responsible for the creation of many new industries and many drastic changes in the living habits of thousands of people. You can't tell what is going to happen to an idea, what it may lead to in the future. But we do know, if it serves a purpose, it will develop into an industry.

Let us take another example with which you are all familiar. The caveman knew how to make heat, even fire, by rubbing two sticks together. But it was a long time before man learned how to make cold. Finally, this was done in laboratories, and the first commercial use to which it was put was the manufacture of ice. This was a natural extension of an existing business, which brought the benefits of refrigeration to great numbers of people who previously could not afford them. Then somebody built a cold-storage plant, which was simply a large refrigeration unit. This was a new industry. Then this was changed around and produced in midget sizes, and began to appear in kitchens all over the world. Here is another new industry, a giant one.

Incidentally, it is interesting to note that these giant industries generally come into being as the result of someone taking a large mechanism and reducing it in size and price so that everybody can buy it. Doing exactly this is a very definite feature of American progress.

Then somebody, considering the sad state of the motion picture business during the summer season, when the theaters were either closed or doing a skimpy business hardly worth while, had the idea of installing a particular kind of refrigerating machinery for cooling the air coming into the building. This was just a particular adaptation of the same old discovery that man could control temperatures well enough to make ice. Making ice simply happened to be the first use to which it was put, principally because people already knew what ice was and what it could be used for. It would have been just as possible for air conditioning to come first, with refrigeration following afterward.

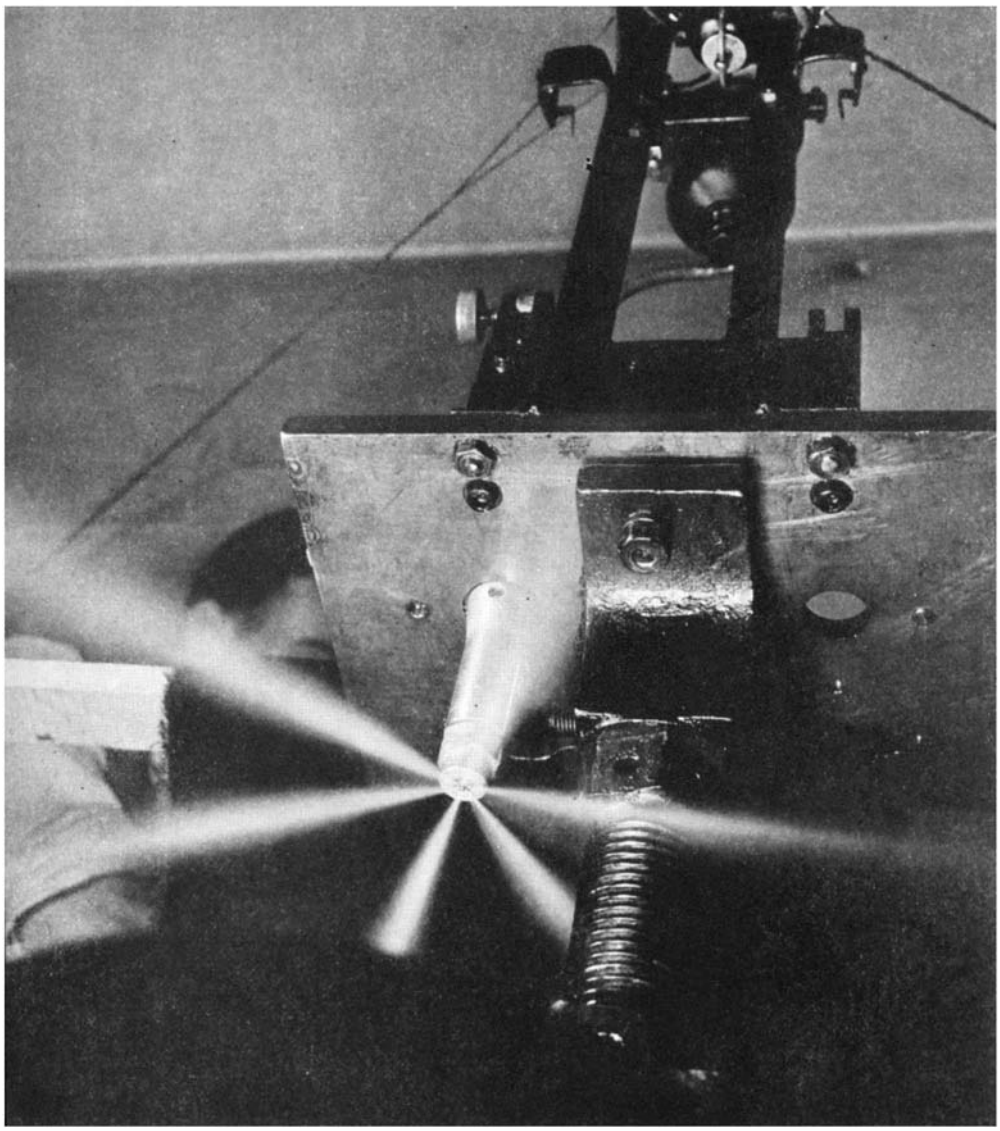
From the theaters, this air conditioning business spread to the department

Equipment for making photomicrographs

stores, creeping up floor by floor, and then into hotels and restaurants. Then some live engineer conceived the idea of putting such a mechanism on a train; and as this was rapidly taken up by various companies, it was possible to see a definite increase in rail travel. Formerly you couldn't have hired me to travel across the desert in the summer months by rail, but now this can be done with the utmost of ease and comfort. You may ask what the next step is going to be in the air conditioning business. I cannot help but think that it will follow the same path as refrigeration and numerous other developments. It will be turned out in midget sizes, the price will come down, and the comfort and benefits of air conditioning will be made available to great numbers of ordinary people throughout the world.

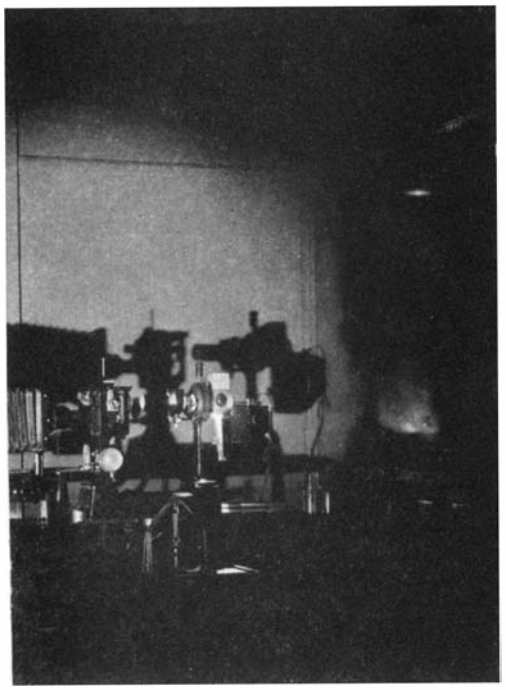
Of course, all industries do not grow

Much research is always being done on the important Diesel fuel injector. Here we see a fuel spray forced at 13 miles a minute from the small holes in an injector nozzle

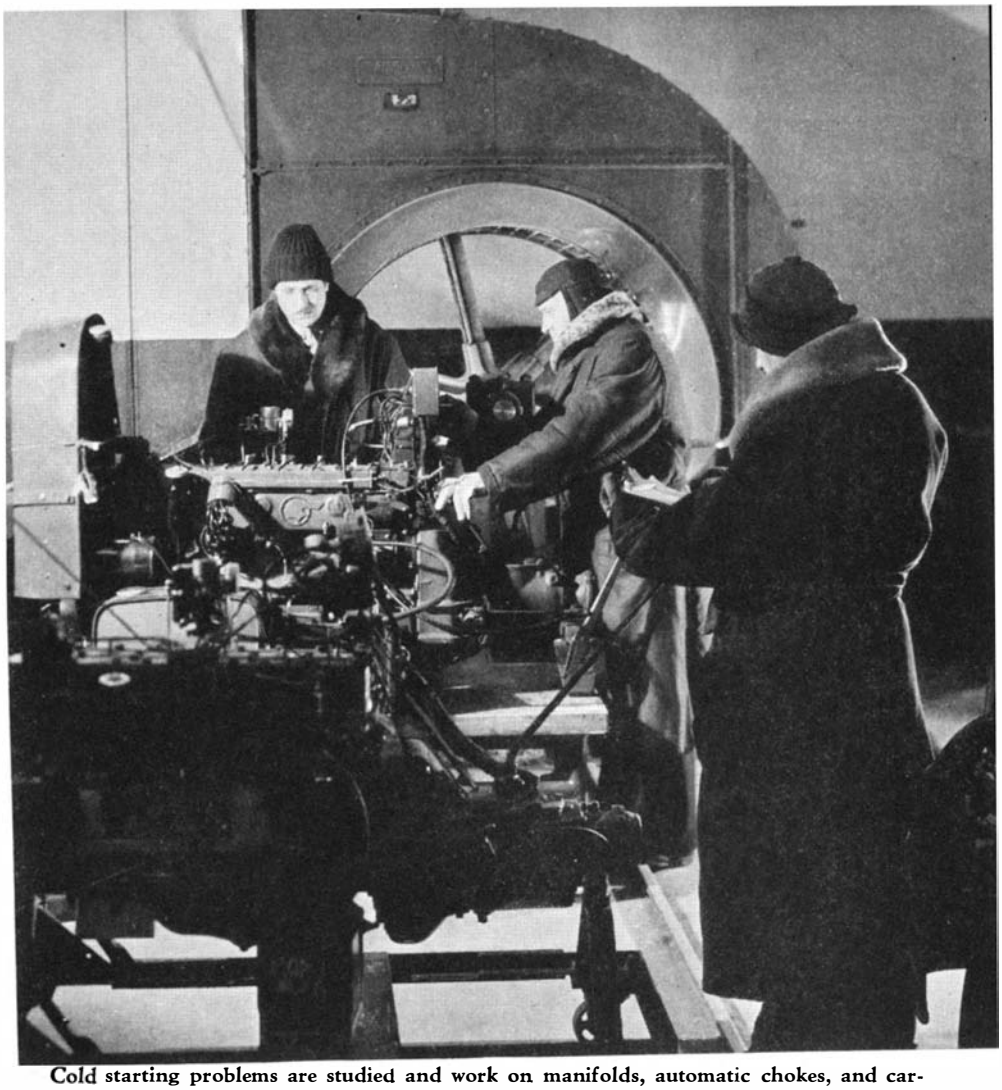


so fast, but on the other hand some are full grown almost before we realize there is such an industry. With all our past experience, it is impossible for us, even those intimately connected with a certain line of business, to forecast what developments will be forthcoming in the next few years. In the automobile business, highly organized as it is, I have never seen anyone successfully prophesy what was coming two years ahead. And when people ask, "What will the new great industries be?" the only possible answer is, "Nobody knows." You can't recognize a great industry when it starts, particularly as there may be some small detail lacking which will hold up its development until that is taken care of.

One important duty of the engineer at the present time is to give the man responsible for the financial end of the business a better picture of the workings of research and scientific development. I think perhaps we have become too expert bookkeepers. We do not know how to spend money without its being incorporated on the profit and loss statement. We do not know how to spend money wisely on the development of a new idea or principle. Ninety-nine percent of our business is set up on the books with the cost of each piece set down and every penny allocated to this or that item. Then when you come to something like a research laboratory, it is difficult to convince the accounting department that they cannot say, "Now this will cost so much. We will make a profit of X dollars on that project."



of the crystalline structure of metals



Cold starting problems are studied and work on manifolds, automatic chokes, and carbureters is carried out in this Cold Room, which can be cooled to 50 degrees below zero

Of course we don't object to an accounting system. It is a very necessary part of any business but research needs a different kind of a system. There is a gap between a fundamental idea and a commercial product, and the development during that period cannot be put in a profit and loss statement. A great deal of money has been spent in research on developments which never became commercial, and others have become the basis of whole new industries; and you never can tell from the looks of the project at the beginning what it may turn out to be.

The gap between the technologist and the management, or financier, seems to be widening. The engineer is becoming a better calculator, and consequently he doesn't carry his experimental work and model building as far as was customary in the past. On the other hand, industry has become more standardized, and a better model than before is wanted. So the gap is extending at both ends. That zone between the idea and the finished product I call, for want of a better name, the "shirt-losing" zone. That is the place where, if there is not proper management, proper engineering, and proper study, a great deal of money can be spent with no future profits to make it up. It is the fear of this zone that makes the management shy away from new developments. They would like such projects to jump directly from the initial conception of the idea to a money-making product. I sometimes think that if we tried to raise human children as industry tries to raise brain-children, they would be expected to earn their living at the age of about nine months.

THERE is another system of accounting, however, which is used by one of our largest businesses. This I call "actuarial" accounting. In the insurance business they do not worry about the individual items. They do not follow the individual policy-holder around and tell him what he can or cannot do. All they want is that the grand average of all these policy-holders comes out the way they figured. Therefore we must treat research as an insurance policy, insuring the company against ignorance of what is going on in the world and against lack of future profits. As I have often said, "Research is trying to find out what you are going to do when you cannot keep on doing what you are doing now." On that basis the company appropriates a certain amount of money for research. We agree to take that money and spend it with just as much carefulness and thrift as would be done in the manufacturing end of the business. We cannot guarantee just what, when, or how we will produce anything which means income, but we do claim, and so far experience has confirmed this decidedly, that in the long run the developments will be responsible for profits more than enough to pay the total cost of research.

Charles F. Kettering

Many developments which appear to be unsuccessful are merely awaiting progress in some other field to turn them into an over-night sensation. The first Diesel engine was built over 40 years ago. It could not be called an important development, however, until a very few years ago. Undoubtedly, various things were responsible for its ultimate success, but the progress in metallurgy alone is sufficient to account for a great deal of it. Just to give you an idea of how quickly these changes sometimes occur, I want to mention an incident in the office of Mr. Alfred P. Sloan in August, 1932. When I entered, I was greeted by the chairman of a great railroad, who held up a fat and impressive-looking report.

"This," he said, "will tell you why our engineers think the Diesel engine does not fit the work of railroads."

"Without reading the report, I'll sign it, too," I told him. "It isn't practical—the Diesel engine of today. But there will be new and lighter Diesels."

See how quickly that came true. In April, 1934, less than two years later, the Burlington *Zephyr* No. 1 Diesel-powered train was put into service and in May made its record run from Denver to Chicago. The thing which made this possible was not so much concentrated work on Diesel engines as it was the background of years of work on internal combustion engines in general, particularly some of the effort spent on the fundamentals of combustion.

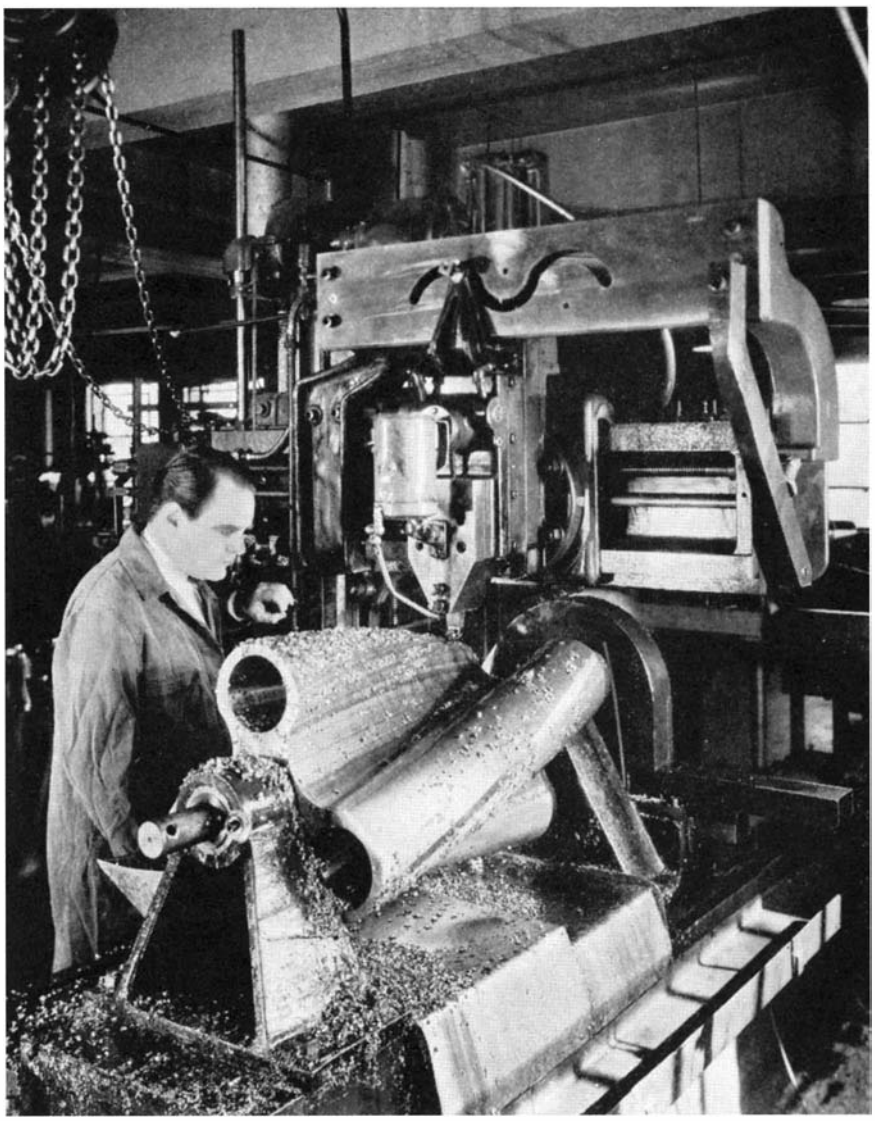
These various examples I have cited have all happened recently, and I could mention a great many more. Now why should these things stop occurring all at once? Just because we don't know what the future developments are going to be, is no reason for saying there aren't going to be any. We keep hearing of all the marvelous things we have learned, but there is very little talk about the things we don't know. A great many of the things we think we know turn out to be simply definitions that we have made up and attached to them. A scientist was asking me one day about some of our problems, and I said: "Here is one problem that has been bothering me a long time. Why can I see through a pane of glass?"

"Why, because it's transparent, of course."

So we looked at a dictionary, and found that something is transparent when you can see through it. Very simple, isn't it? But what does it mean? An old colored fellow summed it up pretty well. He said: "It ain't them things you don't know what gets you into trouble, it's them things you know for sure what ain't so."

Just about the most valuable thing I can imagine would be an analysis, or outline, of what we don't know. We brag about what we do know, but there is nothing with which to compare it. If we could just say, "Here is what we know. Over there is what we don't know," then we would have some idea of what the possibilities are for industrial progress in this country. And I think we would laugh at the tiny little pile of things over here that we know, in comparison with that great block of knowledge on the other side just waiting for someone to come along and hew into shapes useful to the world.

NEW scientific developments will continue to be born. If necessary, they will come out of barns or garrets, but they will appear. The only possible question is how often will they occur and how fast will they grow. That is where organized, or industrial, research comes in. It accelerates the pace of progress. Scientific problems are not solved by a fine new building and expensive equipment; but, with the many different phases of modern research work, there are definite advantages in a group attack on a project. One man can profit by the experience of others. There will always be opportunities to contribute to progress and human welfare, and the industrial research laboratories of the future I feel sure will do more than their share in this direction.



An end-result of research: a special type Root's air blower for a Diesel

OUR POINT OF VIEW

Excelsior!

FOR straight thinking, a clarifying vision of future progress, and the delivery of provocative bombshells of logic with which to shatter the delusions of technological defeatists, one strong voice can always be depended upon. That voice belongs to C. F. Kettering, esteemed Director of the General Motors Laboratories, whose article ends on the opposite page.

In recent years we have been treated to an amazing cloudburst of "social this" and "social that" backed by about as much empirical knowledge as a school-boy's first love affair. We have been told by those who have never been in (or near) a research laboratory, who have never sat behind a desk and met a pay roll, who apparently are mentally long-haired and van dyked, that science and engineering have out-stepped civilization. "Mankind must have time to catch up," they say. "The cloistered scientist must assume his responsibility to man and calculate the social consequences of his work." "Declare a moratorium on science." "Put some thought on sociological problems." And so on, *ad goosepimples!*

Why? Why should science even listen? There is no reason why it should but it has because these omniscient critics (of everything but their own theories) are so vociferous and often so highly placed as to lead astray many otherwise sensible people. That is the sorrow of a nation of too-many followers of someone else's thinking.

No need to repeat that science has contributed more to human progress than any other one thing. It will continue to do so despite derogatory remarks from the side lines. If social research is also necessary, let the ideologists perform it; that is their field. The scientist deals with objective facts, not subjective abstractions, though he is, finally, concerned with the subjective phases marked "human progress" and "profits." The sooner we stop giving ear to the talkers and learn to think with the performers, the sooner will those "sociological consequences" fall into their proper place in the pattern of a rapidly evolving civilization.

Whence Highway Funds?

THROUGH the medium of various forms of taxation the American motorist pays dearly for the privilege of using the highways. In New York State, for example, the average motor-car driver paid a total of $42.97 in taxes during 1935, the last year for which complete figures are available. It is generally assumed that the money collected by means of gasoline and registration taxes will be used for the benefit of the motorist who pays the money. The greatest need to which this money can be directed is better and safer highways. But what happens? To revert again to New York State—and the situation there is typical of that found in many other states—the taxes collected from the average motorist were spent as follows: state roads, $9.36; local roads $7.40; miscellaneous expenditures $1.09; *general purposes $25.12.* It is in this last figure that the injustice of the situation is to be found. We need more highways. We need safer highways. The money is available for both, but it is being diverted for "general purposes" that have nothing whatsoever to do with the motorist as such. Of these "general purposes" the less said the better—from the politician's point of view. One of the many purposes is for relief, and is it not strange that the motorist should be called upon to pay for this purpose a special tax that is levied on no one else?

The average motorist has no objection to paying his fair share of the cost of building and maintaining the highways, but he has, and very rightly, a decided objection to paying taxes that are diverted from the channels to which they have been pledged. He pays the same taxes in other brackets that are paid by the non-motorist, yet he is constantly called upon to dig down and contribute more than his fair share to "general purposes" under the impression that his money is to go for highway and allied expenses.

Ever since the beginning of the development of motor cars for personal transportation, legislators have looked upon the motor-car driver as fair game for purposes of taxation. Gradually taxes climbed—in New York State they increased from $25.34 in 1929 to $42.97 in 1935—but the highways did not increase in anything like the same ratio.

That specialized taxes of the type applied to motorists should be used for purposes other than those for which they were originally designed is one of the detestable features of our method of financing public developments. It is class taxation beyond a shadow of doubt. Only the motorist himself can do anything about the situation and he can act only by pressure brought to bear upon his local legislators. If he would have his specialized taxes reduced or if he would obtain his money's worth for the amount which he now spends, it is up to him to go to bat and fight for his own rights.

Happy Landing!

"SPECTACULAR" is hardly the word for it, though that word has been used in the announcements; it is that and more. Some might borrow from the circus-barker and call it superlative!, stupendous!, death-defying!, colossal!, but, along with the stark thrills it will furnish to a thrill-mad, gawking multitude, and its inevitable tragedies, it is also silly—silly and useless. We refer to the transatlantic air race scheduled for the month of August to commemorate the tenth anniversary of Colonel Lindbergh's historic flight from New York to Paris.

Briefly, the race will not be plane against plane; the pilot may take off at any time during August and race from New York to Paris against time. Only multi-motored planes equipped with two-way radios may enter. Prize money totalling 3,000,000 francs posted by Pierre Cot, French Air Minister, will reward the victors who may come from 35 countries affiliated with the Fédération Aéronautique Internationale.

There is no question that there will be numerous entries. But what does that prove? Also, numbers of the planes will doubtless reach Paris. Nor will that prove anything of particular importance. A fair percentage will reach Davy Jones' locker. This *will* prove something: that a stunt of this sort is dangerous and that those who participate are foolhardy.

Airplane design, from Pitot tube to rudder, has improved vastly in the years since Lindbergh's perfect achievement. But airplanes are not yet 100 percent trustworthy. These racing flights will not make them more so, will add nothing to our present knowledge of design or operation. They may add something of over-ocean flight knowledge to some of the pilots, for there are likely to be many entries who have had no previous experience over large bodies of water, but is such knowledge worth the great cost that will undoubtedly be the result of this race?

France's fine spirit in wishing to commemorate Colonel Lindbergh's flight with such a large appropriation for prize money (approximately 140,000 dollars) is indeed commendable, but just the same—well, we would prefer something a little less "spectacular" and more enduring.

BACKSTAGE AT THE ZOO

Captive Animals Live Longer . . . Fare Better . . . Pampered in Scientifically Designed Settings . . . Zoo Problems . . . Animal Instincts

By WILSON CHAMBERLAIN

RECENTLY an animal lover excitedly told the director of a large zoo that a polar bear had evidently gone mad. The creature was pacing up and down endlessly within a self-imposed limit of five or six feet, apparently too listless even to lift its great paws, which it kept sliding along. But the director only smiled.

"Don't worry," he said. "All polar bears do that from time to time. It's instinct. They think they're on a slippery ice-floe and are being careful not to go too near the edge."

The actions of other animals in captivity are similarly often misunderstood. When brown bears, for example, stand for hours just lifting one paw and then the other, they are merely following an age-old custom of padding down the snow. And it's not fleas that make the monkeys scour each other so intently but a passion for salt which they remove bit by bit from scaly skin, plus an innate vanity for grooming. Actually very few monkeys have parasites.

Don't think that the mere keeping of wild animals in captivity is cruel. The birds you pity in a two-foot cage live much longer than if they were free; and if their cages were larger, they might break their wings. The fox deprived of its freedom to run may make you indignant; but it runs primarily to track food and escape danger; when well-fed and at peace, the fox does not stray from its lair. The elephants you sometimes see tightly chained like that chain. It gives them a feeling of security; if you took it away, they'd trumpet all night in fear. Understanding this instinct, native keepers in India fashion a chain of straw for each of their charges rather than make them pass the night fearing lest their food be stolen and their bed (a source of particular pride) be destroyed by the other elephants.

Of course, in some of the backward commercial zoos, animals are sometimes cruelly mistreated. The remedy for this is regulatory legislation. Indeed, several states have enacted laws forbidding the keeping of animals in captivity without permission and supervision of the Conservation Department. This is doing much to get rid of the iniquitous roadside zoo and the mistreated bear-at-a-filling-station sort of menagerie.

But the well-run zoos have high standards of diet, comfort, and cleanliness. New zoos in Chicago, St. Louis, Toledo, San Francisco, Washington, Buffalo, and a score of other cities are doing startling things.

In Chicago, for example, the air in the lion house is changed every four minutes. The tropical plants you find in some houses are not merely attractive settings; their real purpose is to regulate the moisture. Some zoos go so far as to install electric humidifiers. To keep the penguin cool in hot weather requires 200 pounds of ice a day in their shelter. And when you see a hippopotamus with a baby, thank the zoo man for having built a large enough bath: the hippo breeds and gives birth under water—for security—while the baby nurses under water, going up for air and down for milk. Many zoos have a quarantine section where new arrivals are attended by white-coated doctors who wouldn't dream of not washing their hands before calling on the leopard, lest they infect it. These quarantine cages are deliberately small: after a long sea voyage, an animal's bones are brittle and it is nervous; in a large cage it might rush the bars and break its neck or legs.

COURTESIES to apes and monkeys could fill a book. To insure having strong adults, young chimpanzees in the Chicago zoo get nascent oxygen pumped into their cages to insure the pure air which their delicate lungs need. To make sure they sleep the full 12 hours they are accustomed to in the dark jungle, blinds have been put up outside their sleeping boxes in the zoo at Munich, probably the finest primate house in the world. There each ape has its own blanket, sent to the laundry every week. To check pyorrhea—common in apes—their teeth are brushed daily, while some zoos use concentrated vitamins B and D to combat it. In other zoos, sun lamps are used.

Personal attention is essential for apes. Frequently a chimp becomes listless because it is being tyrannized by the other apes. The leaders are apt to grab the favorite food, like tomatoes, leaving the potatoes to the weaker ones—a tyranny which can be ended only by a keeper's personal attention.

True of all animals, amusement is particularly important with apes. More and more, modern zoos are going to endless trouble to evolve swings, bars and trees to amuse the apes. But while such intelligent advances are being made in some zoos, their large scale adoption is held up by lack of cash.

Concrete, for example, is the bane of every conscientious zoo today. When originally installed, it was thought superior to wood. But it is cold, hard, and moisture retaining; the cats get callouses from walking on concrete unless keepers pare their pads frequently. It conduces to arthritis in foxes and tuberculosis in monkeys. Giraffes are apt to slip on it even though you roughen it; in Philadelphia, two fine specimens fell and died of broken pelvis. But to rip out concrete floors and install the sort of silica composition used in Chicago costs thousands of dollars, as do other improvements. In those zoos which have plate glass separating the apes from a coughing public, mortality rates fall phenomenally. But where to get the cash?

Zoos used to be the foible of Indian Princes and, later, of European kings; though the first zoo on record, in China about 2000 B.C., was state-financed, called the Intelligence Park, and run for scientific study. The modern zoo, however, is rarely endowed, and it is only as the public interest increases that municipalities or states can vote larger budgets. Only a few, like those in New York or London, have been fortunate enough to receive important private grants.

But even without much money, imagination can still accomplish a lot in zoos. You may have noticed in the elephant run of some zoos a formidable rough-surfaced pillar—it's a back-scratcher! In at least one zoo you'll find another bit of thoughtfulness: running water in the raccoon's cage, because the raccoon habitually likes to wash every bit of its food in a running brook! Brushwood in the fox's cage costs little, but gives the fox the pleasure of brushing against it and so stimulating his coat

to a beautiful sheen. Sometimes an animal is given a pet; a fox terrier is often strangely comforting to an elephant. In the 500-acre country zoo of the London Zoological Society, the wolves have two two-acre paddocks of timberland, used alternately. In each of these paddocks is a big platform like a feeding table; it is there because the wolves like to dig under it for mating, just as they burrow when living in the wild.

The greatest single advance in zoos is the principle of viewing animals, not behind bars, but across moats. Fifty years ago, when Carl Hagenbeck first envisioned natural habitats for animals and opened his zoo, people gasped with fright as they saw lions emerging from rock caves and heading straight for them. But a 17-foot water ditch separated the lions from the public; and lions will not cross water. It is strange that America has been so slow to adopt this idea which has swept all over Europe. Only in our most modern zoos do you find 60-foot high monkey mountains; crags for the barbary sheep; and great sand paddocks for the elephant, separated from the public by a narrow ditch hedged by a low row of iron spikes which the elephant will not tread upon, thus demonstrating another phase of the elephant's caution.

At the zoo in Balboa Park, San Diego, California, where the animals enjoy a pseudo freedom in huge pits dug in the hillside, with no visible bars or cages

IN such zoos, animals are actually more healthy than in the jungle. Lions bred in captivity are far superior to those running wild. Their size and coats are better because they get better food; their manes are more luxuriant because they're not torn by underbrush; and they live to a riper age in captivity. It is an odd fact that most animal lovers never think of old age in the jungle. But for wild beasts there is no graceful autumn of life; there is only a ghastly, inescapable disintegration or death dealt by more alert enemies. It is this senile loss of power—and usually only this—which drives a lion to man-killing. In freedom a lion rarely lives more than ten years. In captivity he lives to 25 and 30.

From the great museums of natural history, such as in New York, the modern zoos have borrowed the idea of having the three walls of the cage painted to represent the natural habitat—much more effective than just exhibiting animals in bare cages.

Zoo men are devoted to making their animals happy for their own sake and dramatic for your sake. They spend endless hours studying the latest dietary discoveries, such as, for example, a report that shrimps are preferable to cuttlebone in preserving the beautiful rose color of the flamingo. Or they may be up in the middle of the night to make sure the polar bear which had just had a cub—an anxious moment, as the cubs frequently die of pneumonia—was utilizing the straw put into its cage on the odd chance it would use it to keep the cub warm (and it did!). Or you catch them setting off on a journey half way around the world to settle some housing problem as to whether gorillas thrive outdoors during winter (as Philadelphia believes) or indoors (as London believes). Moreover, they constantly keep in touch with experiments in other zoos through correspondence, interchanging information that is frequently of mutual benefit.

In Munich, there are parrots on stands in front of the elephant pens. Their chattering, heightened by the tropical vegetation, gives a brilliant semblance of the jungle. In Leipzig, the polar bears have a diving board of green plate glass: with water slipping over it, it gives a wonderful illusion of ice. In a large zoo in London, the penguins are on different levels: now you're looking up at them; now you see them walking around a curve right next to you as they march in a stately trot down the ramp to their swimming pool. In Berlin, you see seals swimming not only on the surface, but there's a "lower level" where you see them under water. In Philadelphia, the beaver are given a full lake, wherein they can perform their miracles of building. Another idea which has proved very popular is to open the zoo on certain nights so visitors can see the vampire bats and other wild life that become active only during the night.

Labels are features often neglected by zoos; usually you find just *Panther, Felis Cericolor,* whereas, in Washington, for example, you learn interesting facts about the panther, such as that it is one of the most untameable of all animals, and so on.

A puzzling zoo problem is the peculiarly American habit of going to the zoo to torment the animals. In Washington, a taxi driver and his girl friend found some sort of release in letting dogs into a deer run; three fine animals were torn to pieces. In Philadelphia, stone-throwers killed several flamingos. In the few American zoos which have dared to have open-air snake pits, as is common in Europe, the results have been disastrous: brave young men jump into the pit and steal the snakes—for reasons best known to themselves.

What, the animal lover frequently asks when hearing of such isolated atrocities, is the point of keeping wild animals in captivity at all? Why spend millions of dollars to retain animals which may satisfy nothing more than curiosity? Fortunately, the average man values the zoo because it is the only glimpse of the jungle he will ever have. Beyond that, he gets from the zoo some realization of the world's past; some contact with nature; some humility that he seems to need and cling to in his present-day mechanized life.

THE SEARCH FOR

The Hunt for Stars that are Exceptionally Bright and For Those that are Exceptionally Faint is Not So Simple a Procedure as it at First Appears

By HENRY NORRIS RUSSELL, Ph. D.

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

THERE is always a certain interest in exceptional objects—those that set a record or come near it. Sometimes the record-breakers are easy to pick out—like Saul standing head and shoulders above the Israelites—but they are not always obvious.

It has long been known that the stars differ enormously in brightness. Some are known to exceed the sun a thousand-fold in brightness, and others to give less than a thousandth of the sun's light: but if we seek for those still brighter or fainter, we get into trouble.

A star ten thousand times as bright as the sun should be easy to see. At 500 light-years' distance it would appear to be of the first magnitude—at 5000 light-years it would still be visible to the naked eye. Even if it were a million light-years away it would appear to be of magnitude 17.5—easily observable with great telescopes.

If such objects exist in our own galaxy, we should find them among the naked-eye stars. The trouble comes in picking them out.

It is not much use to try to do this by direct measures of parallax, for even a first-magnitude star of this real brightness would have a parallax of only 0″.006. Despite the remarkable accuracy of modern photographic measures, this is about at the limit of detection—it corresponds to 1/50,000 of an inch on the best plates. A good series of observations suffices to fix the number of hundredths of a second of arc in the parallax with some assurance; but to get the thousandths accurately is still beyond our skill. We know that certain stars—for example, Alpha Cygni and Canopus—must be very luminous—much more than 1000 times as bright as the sun—but we cannot say just how much brighter they are.

The only isolated stars for which we can do better are a few novae, the distances of which can be found by studying the expanding nebulae ejected from them during the catastrophe. The distance of Nova Aquilae was thus found to be 1200 light-years, and its maximum luminosity 300,000 times that of the sun—but it held this for less than a day.

Otherwise, our best hope is to find the distance of a cluster or cloud of stars, and then pick out the brightest objects in it. The richest hunting grounds are in the Magellanic Clouds—which are now regarded not as scattered fragments of the Milky Way, but as the nearest of the independent galaxies. The distances of these clouds are accurately determined from observations of the numerous Cepheid variables in them, but are so great, about 100,000 light-years in each case, that a star 10,000 times as bright as the sun would look to us fainter than the 12th magnitude.

Now, between us and the Magellanic Cloud there is an extensive foreground of much nearer stars. By counting the number of stars per square degree in the surrounding regions of the sky, we can estimate about how many such intruders appear on our photographs—but how can we pick them out individually? This would be practically hopeless were it not that the Cloud, as a whole, is receding rapidly from the sun. The radial velocities of a number of gaseous nebulae in the large Cloud agree closely with a mean of 275 kilometers a second. Practically none of the field stars in the foreground will be moving as fast as this. So, if we can measure the radial velocities of the stars by wholesale, we can pick out those that belong to the Cloud. Observations with slit-spectroscopes would be exceedingly laborious, but a better way is open: Photograph the region with a prism before the telescope, so that each star shows as a spectrum, and place in front of the plate a cell containing a thin layer of a solution of neodymium chloride. This solution absorbs light in narrow bands—one of which is almost as sharp as the wider stellar lines. Its position in the spectrum is, of course, fixed, while those of the stellar lines will be shifted by the Doppler effect.

MEASURES on these spectra give the radial velocity with a probable error of about 10 kilometers a second. For stars belonging to the Cloud, the shift would be large enough to be detected by inspection, without measurement.

To get 12th-magnitude stars with this device should be practicable, though not easy, and it should thus be possible to get a complete list of the brightest members of the Cloud and far more information about the stars of very high luminosity than is now available. A few stars with peculiar spectra, showing bright lines, certainly belong to the Cloud—since no similar objects are found outside it. The brightest of these exceed 100,000 times the sun's light.

The search for faint stars is quite different. To begin with, there is probably a natural limit of some sort to the brightness of a star; but there is obviously no limit to its faintness, since we know that bodies, like the planets, exist which give out no light at all. The question is really: "What are the faintest objects which we can see (or photograph) at stellar distances?"

Here, evidently, we must look among the nearest stars. If we could make a complete list of these, the faintest among them would answer our question. So now we have to pick the nearest stars, among all apparent magnitudes. To do this by direct measures of parallax would be practically impossible, for there are millions of faint stars in the sky, and a good parallax determination demands accurate measures on a dozen plates or more. But it is possible to pick out the stars with considerable proper motions relative to their neighbors. If we have two plates, taken 20 years or so apart, and put them in a blink-microscope—such as was used to discover Pluto—the great mass of the faint stars will form a substantially unchanged background, against which the few stars with considerable motion will show obvious shifts. In this way a complete list of all the stars with motions faster than about 0″.2 per year may be made, and many slower motions detected when the plates are at their best. It is essential that the two plates should be taken with the same instrument, so that any small distortions of the images may be the same on both.

The earlier work of this sort was sporadic—on fields which happened to have been photographed years before, for one purpose or another. Various observers, notably the late Max Wolf at Heidelberg and Ross at the Yerkes, have discovered large numbers of proper-motion stars, some of them very interesting. A systematic and thorough survey has been

EXCEPTIONAL STARS

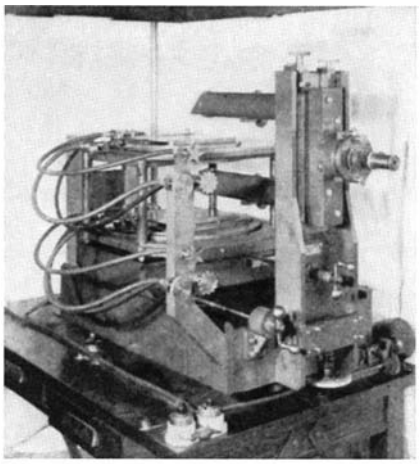
made by Luyten—formerly of the Harvard Observatory and now at the University of Minnesota—using plates taken about 30 years ago at the Harvard Station at Arequipa, Peru, and duplicated recently at the new station at Bloemfontein, South Africa—to which the same telescope had been moved.

More than a thousand pairs of plates are available, covering the entire southern half of the celestial sphere (except for a few regions which were missed at the earlier epoch) and showing stars to the 17th or 18th magnitudes. Dr. Luyten has "blinked" these (examining the images of about 25,000,000 stars!) and has found more than 80,000 stars with perceptible motion. It will be years yet before all these motions can be measured and worked up. Meanwhile, one important result has appeared. Among all these stars, not one has a motion exceeding 4″ per year, and no star fainter than the 17th magnitude has a motion as great as 1″ annually. This means that our lists of stars of really large proper motion must be nearly complete, and will be almost entirely so when a similar survey can be made for the northern half of the sky.

BY and large, the stars of large proper motion are the nearer stars. Now and then we get a star at a considerable distance, with very rapid actual motion; but these great space velocities are rare. Moreover, the proper motion list leaves out relatively few of the nearer stars. A star whose proper motion is less than twice its parallax must be moving at a speed less than 9 kilometers a second at right angles to the line joining it to the sun. As the average motion of a star in space, relative to the sun, is fully 30 kilometers a second, it is evident this can happen only when the star's motion is directed nearly toward the sun or away from it—which will happen in but a small percentage of cases.

The larger the proper motion, the nearer, on the average, the star will be —and, of course, the faster will be its actual "cross-motion." A recent study by van Maanen, using parallaxes of 651 stars of large proper motion, shows that for a tenfold increase in proper motion the average parallax increases by a factor of 6.6, leaving only a factor of 1.5 to represent the increase in real speed.

For stars of the same proper motion the average parallax changes very little with the apparent brightness. To decrease this by five magnitudes, or to 1/100 of the original value, diminishes the mean parallax to 78 percent of what it was before, showing that the second group of stars really averages only 1/60 as bright as the first.



A blink-microscope, an instrument mentioned in the text. Eyepiece at the right, connected by prisms with two round arms extending to left, each terminated by a right-angled prism and each having below it in its field of view one of the two nearly identical plates being compared in order to ascertain whether slight changes of position of any star have occurred. In the more common type, alternate views of the plates are had by mechanically moving an element from one to the other, but this particular comparator is one invented and constructed (optical parts by Fecker) by Prof. Heber D. Curtis, astronomer at the University of Michigan; it employs lamps to illuminate the plates, and blinks first one and then the other plate by means of a motor which controls the lamp circuits. Speeds from one blink every two seconds to four blinks a second are employed

The proper-motion surveys are therefore a very efficient method of picking out the nearer stars. Using these results, van Maanen concludes that within a distance of 13 light-years from the sun (corresponding to the large parallax 0″.251) there are 55 stars (of which 22 are already known). In the shell between 13 and 20.6 light-years' distance, he calculates that there should be 164 stars (of which 34 have so far been observed for parallax). This shell has three times the volume of the inner sphere, so that the estimated numbers of stars (which were derived independently) are in good agreement. It is evident that there is plenty still to do for the parallax observers—though only a few great telescopes can tackle the very faint stars which remain to be studied in the future.

Of these stars near the sun, van Maanen calculates that one quarter are brighter than the absolute magnitude 10.2 (1/140 of the sun's light). Another quarter are more than 1/1100 as bright as the sun; the third quarter exceed 1/7500, while about three percent of the whole give less than 1/100,000 of the sun's light.

The rapid falling off in the numbers of very faint stars is surprising. It should be remembered that these faint stars are very red (except for occasional white dwarfs) and of low temperature. With falling temperature the ratio of the visible light radiation to the infra-red radiant heat drops very rapidly, and it is probable that, if we could measure the temperatures of these very faint stars, and calculate their heat radiation, we might obtain results which looked very different.

The faintest star so far known is Wolf 359 (its number in Wolf's proper-motion list). This has a proper motion of 4″.84 and a parallax of 0″.413, according to van Maanen. Its photographic magnitude is 15.4, but since it is very red (spectrum M_4) it may be as bright as 13.5 visually. This would make its absolute magnitude 16.6, and its light 1/35000 of the sun's.

WE can hardly guess at its size, for the amount of light given out per square mile varies very rapidly with the temperature. At 3000 degrees it is about 1/50 as great as for the sun; at 2500 degrees 1/200, at 2000 degrees 1/2000 (making allowance for the fact that most of the light is red). With a temperature of 2000 degrees the diameter comes out less than one fourth of the sun's; with 2500 degrees, about that of Saturn. It looks as if this might be a small, dense body, part way on the road which ends in the white dwarfs. If the star's brightness could be measured in the infra-red, we might be able to say more.

Another very faint star has recently been announced by Luyten. It was discovered during his proper-motion survey, is of photographic magnitude 14.3, and has a proper motion of 3″.27 per year. Measures on six plates taken at the Harvard Station at Oak Ridge indicate a parallax of 0″.53. The probable error ±0″.13 is large, so that it cannot yet be certain whether this star is nearer than all but two others, but it is evidently among the nearest and faintest objects known.—*Princeton, New Jersey, March 5, 1937.*

Air Transport Looks Aloft

Flight in the Stratosphere Offers Many Advantages . . . Experimental Flights being Carried Out Systematically . . . Huge New Planes Designed

By REGINALD M. CLEVELAND

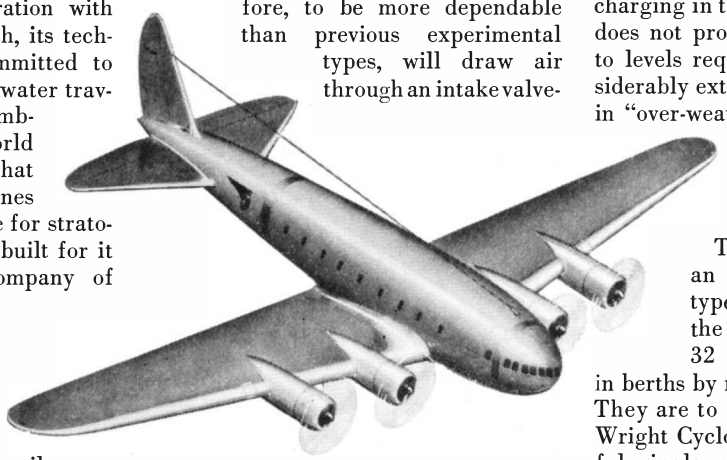
WITH almost startling suddenness, speculation as to when and how sealed, supercharged cabins would be used to transport air passengers at levels above the normal storm area has been translated into orders for airplanes provided with fuselages suitable for such supercharging. It is plainly evident that air transport, through some of its most responsible and dependable channels, is going "up stairs," at least in an experimental way. This raises many questions of interest as to operating efficiency and passenger comfort.

Pan American Airways, which, from the laying out of its immensely long over-water routes in co-operation with Colonel Charles A. Lindbergh, its technical adviser, has been committed to water-going aircraft for over-water travel, threw something of a bombshell into the aeronautical world recently by announcing that four-engine, land monoplanes with pressure cabins, suitable for stratospheric operation, would be built for it by the Boeing Aircraft Company of Seattle. Before the New York alumni of the Massachusetts Institute of Technology, Juan T. Trippe, President of the international airline system, revealed a number of details as to these revolutionary aircraft which have been under development for many months by engineers of the manufacturer and of the operator, working together.

They are to be 42,000-pound airplanes with cylindrical, wholly streamlined fuselages, powered with specially supercharged engines developing a total of about 5000 horsepower. Although Mr. Trippe did not specifically say that they would be used in transatlantic service, he did say that, as mail and express planes, they would have a range of 4000 miles and would be able to cross the Atlantic in 10 hours.

THIS range is more than ample for the Great Circle course between Newfoundland and Ireland, which will be one of the routes operated jointly by Pan American and Imperial Airways, and it is, perhaps, significant that the great new airport development at Botwood, Newfoundland, some 40 miles northeast of St. Johns, includes a land airport with a main runway a mile long and 1200 feet wide.

For night service, the pressure cabin Boeings are to have accommodations for 18 passengers in commodious berths and 8 more in comfortable sleeping chairs. By day they will accommodate 32 passengers in lounge seats. A new type of supercharger for the cabin, mechanical throughout and believed, therefore, to be more dependable than previous experimental types, will draw air through an intake valve-well cut along the wing. The air will be pumped inside the wing, through a miniature air-conditioning plant at the inboard engine, and from there into the sealed cabin where ducts will distribute it uniformly from the control compartment through the passenger compartments and thence into an anti-pressure chamber aft where the exhaust valves are located. These superchargers are said to require only a small fraction of the power of one engine and a complete set of dual mechanisms will be built into each plane.



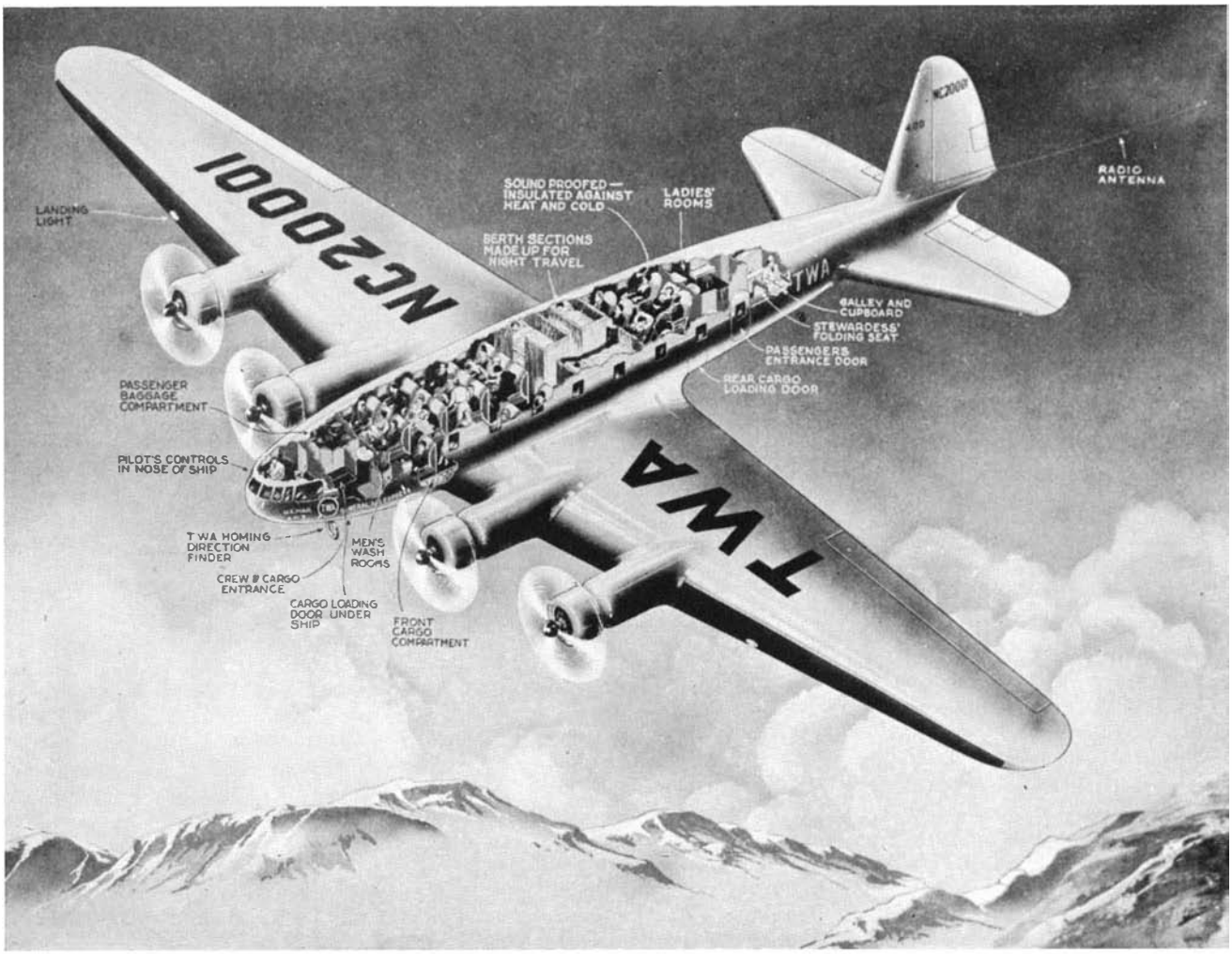
How the Pan American Airways stratosphere plane will look when in flight. The details are given in text

The cabins are designed to withstand an internal pressure of six pounds to the square inch above that of the surrounding atmosphere. This is expected to provide, at 20,000 to 25,000 feet, cabin conditions now usual at flight levels of 8000 to 12,000 feet. Without additional engine supercharging, the planes are expected to be able to operate up to an altitude of 36,000 feet and to have cruising speeds at the high levels of better than 260 miles an hour, using only half the available engine horsepower.

Just prior to the announcement of these planes, Transcontinental and Western Air revealed that it had signed a contract with the Boeing Company for six quite similar airplanes of the four-engine type, also designed to take supercharging in the cabins, although the line does not propose to use pressure or go to levels requiring it until after a considerably extended period of experiment in "over-weather" flying which is being pushed continuously for it by Lt. Commander D. W. Tomlinson, assistant to President Jack Frye.

The airplanes ordered—and an option for 17 more of the type has been announced by the company—are also to carry 32 passengers by day and 18 in berths by night, with four in the crew. They are to be powered with the G-100 Wright Cyclone engine, the most powerful single-row radial yet put in production, which has a rating of 1220 horsepower for emergency and 1000 horsepower for cruising.

THESE Boeings for TWA are of a type known as No. 307. This is the basic design upon which the 307-S, the stratospheric plane for Pan American, has been projected. As one result of upper air research, Boeing developed means by which the standard 307 could be stressed for pressure. That is to say, this plane can be converted into a pressure cabin type with the addition of some 400 pounds of structural changes. Pan American requires 500 hours of pre-service testing for any new type of airplane which it purchases. After these tests have been made, the results can be made available to any purchaser. The first two of the 307 class to be delivered will be the stratosphere jobs and then the six standard planes. By that time it is expected the 500-hour tests will have been made and, at TWA's option, the rest of their craft of the type may be stratospheric jobs. It is also understood that the Royal Dutch Airlines (K.L.M.) plans to order similar craft.



Scale drawing of the high-altitude plane being built for Transcontinental and Western Air, Inc.

The "over weather" work which Commander Tomlinson has been doing with a specially equipped Northrop Gamma laboratory plane has provided him with more actual experience of conditions at 30,000 feet and above than any other living man. He has discovered by practical experience what the scientists hold, namely, that there is no definite level which is fixed at all times and at all places where the stratosphere begins. The air gets colder the higher you go, until a certain height is reached. After that no matter how high you go it remains constant at about 70 degrees below zero, Fahrenheit, and that "certain" height varies from about 25,000 feet to 48,000 feet.

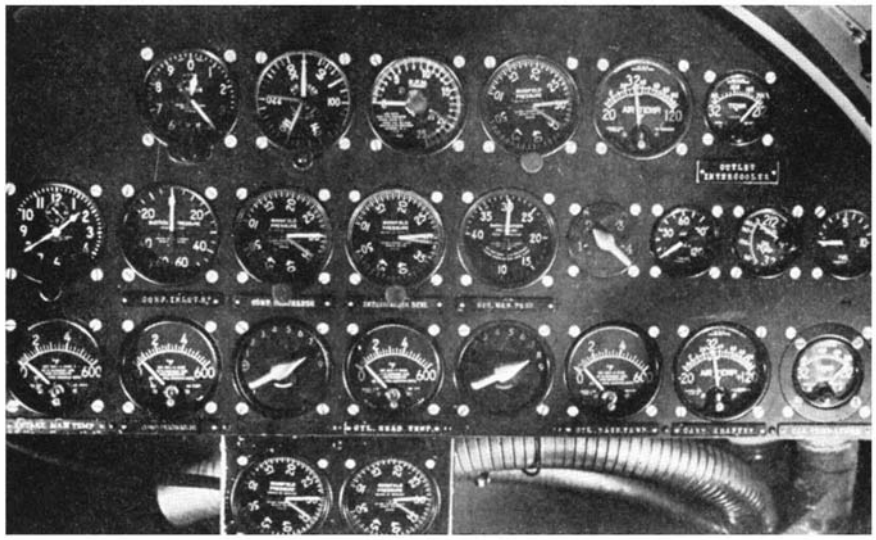
Not long ago Tomlinson made a 7½ hour flight during which he was unable to get over cloud formations even at the ceiling of his airplane, which was 36,000 feet. Normally, however, conditions from 20,000 to 25,000 feet provide clear vision "over the top" and smooth, bumpless air free from turbulence.

Tomlinson also found, almost to his cost, the dread potential effects of oxygen deficiency. With his beam radio out and his two-way voice radio very noisy from static, he flew his ship with the stick between his knees and alternately talked into his transmitting mouthpiece and took a whiff of oxygen from a tube. Once he became so absorbed in the radio conversation that he neglected to take a whiff for something more than 15 seconds. He almost passed out and had to breathe the raw oxygen for several minutes before his senses cleared.

INTENSIVE studies of the effect of oxygen deficiency have been made of late by another of the great transport systems, United Air Lines. Taking a doctor aloft and a number of volunteers to act as "guinea pigs," the effects of too little oxygen were observed at various levels from 14,000 to 22,000 feet by giving the human "guinea pigs" simple problems in arithmetic and simple manual tasks to do. Without additional oxygen, their writing was scrawly, their answers to simple problems incorrect and their motion reactions slow and blurred. With oxygen, they promptly returned to normal functioning, both mental and physical.

A broad field, only touched upon thus far, remains for exploration as to the physiological effects of altitude, quite aside from the question of oxygen deficiency. Dr. Emanuel Esrati, who has spent a number of years in research on pilot reaction at various levels above the 8000 or 10,000 feet that might be considered normal, both in Palestine and in Germany for Lufthansa, holds that temporary desiccation of some of the human organs is a common effect upon certain individuals when they reach abnormal altitudes. Such drying of the gall bladder, he finds, produces immediate symptoms of melancholia. Should wider and more intensive experiment bear out the general application of this and similar theories, it can be readily understood that problems will surround high-altitude flight—both as to pilots and as to passengers—more complicated than mere matters of pressure and oxygen supply.

There are also aircraft engineers of established reputation who hold that, except for extremely long ranges, the technical difficulties of stratosphere operation, admittedly both many and great, outweigh the advantages. For use in the continental United States, for example, a stratosphere airplane in transport service entails, they consider, compromises which, although certainly not insurmountable, raise technical and economic problems which are discouraging. Such an airplane must be able not merely to fly at 40,000 feet efficiently with the



"Candid" photographs are taken at short intervals of the instrument board of an experimental stratosphere plane, relieving the test pilot of a recording chore

special aerodynamic, engine, and propeller characteristics there demanded, but must be able to fly efficiently in the lower levels of the climb and descent and probably also of the westward trip.

This is not a "one way" country, insofar as stratospheric conditions are known at present. Commander Tomlinson has encountered winds of considerably more than 100 miles an hour velocity from the north and northwest at from 30,000 to 35,000 feet. It is believed that at 40,000 to 45,000 feet there is an almost constant westerly wind, averaging from 60 to 70 miles an hour. This would be a splendid advantage on the trip from California to New York, but how about the return journey? The theory is widely held, although by no means is the fact as yet established, that at 50,000 to 55,000 feet there is comparatively still air. So the transcontinental stratosphere airplane must move towards the setting sun either at this enormous altitude or well below stratospheric levels.

MUCH will doubtless be learned about these conditions from a wider use of the radio meteorograph, a device in which the Weather Bureau places much hope. This consists of a simple radio transmitting set carried aloft to very high altitudes by an ordinary sounding balloon. Its advantage lies in the fact that it can continue to send its radio signals of temperature, humidity, and wind conditions even though it go out of sight of a theodolite or be entirely lost. Dr. Karl O. Lange, of the Bluehill Observatory of Harvard University, has recently installed a high-altitude observation apparatus at the new gliding site of the Soaring Society of America at Harriss Hill near Elmira, and from its recorded observations much further light on upper air conditions is expected this year.

Some of the difficulties which confront the designer of high-altitude commercial aircraft have been the subject of a study by Michael E. Gluhareff, chief engineer of the Sikorsky Aircraft Corporation, who has presented a paper on the subject before the Institute of the Aeronautical Sciences. Mr. Gluhareff, who, with Mr. Sikorsky, has shown in the Clipper and super-Clipper designs, and in the plans for far larger flying boats, that he is not afraid of unexplored fields, finds these difficulties no minor ones.

Among them he notes the cooling of the engines and the oil, as it appears that cooling depends on the density of the cooling medium, and not on its velocity; that ordinary fuels would probably boil in the tanks if there were not sufficient pressure; that insulation of the electrical system would have to vary from that used at present, due also to low pressure, while batteries would have to be used instead of magnetoes; that propellers would have to be especially designed, as tip speed velocities increase with altitude, and that possibly propellers of four or more blades would be needed, or propellers of variable diameter, or several gear ratios on the engine.

When it comes to passenger comfort and safety, he holds that the cabin must be supercharged, preferably to sea-level condition; that oxygen equipment can only be used to about 20,000 feet unless sufficient pressure is present in the cabin, and that when it comes to oxygen spraying, it would be necessary to deliver 5200 cubic feet of oxygen for 20 passengers during a period of 10 hours, and that equipment for this would weigh in the vicinity of 2500 pounds.

UNDER structural problems, Mr. Gluhareff, who has made a study of six hypothetical airplanes for the stratosphere, finds that in a cabin measuring 11 feet by 37½ feet an additional weight of 250 pounds would be required if the cabin were supercharged from 10,000 feet to 25,000 feet altitude. For 40,000 feet altitude, the additional weight would be about twice this figure.

The doors, windows, and hatches would have to be very strong and small. For example, he holds that at 40,000 feet altitude a small door, five feet by two feet, would have to withstand a constant negative pressure of 17,200 pounds. This means heavy locks and hinges also and, for the pilot's cockpit, probably a double windshield. Controls would have to be electrically or hydraulically transmitted to the surfaces, as direct controls would entail leakage.

It is plain, however, that the high levels so gallantly and significantly pioneered by the late Wiley Post when he flew the 190-mile an hour Winnie Mae about 270 miles an hour between Los Angeles and Cleveland by supercharging its Wasp engine and sealing himself into a pressure suit and helmet, are to be thoroughly explored and levels of 20,000 feet flown much sooner than had been expected.

The rotor (background) of this "turbo" supercharger makes 30,000 revolutions per minute at full speed. It maintains the full engine power up to 30,000 feet

Amateur Astronomers Active in Philadelphia

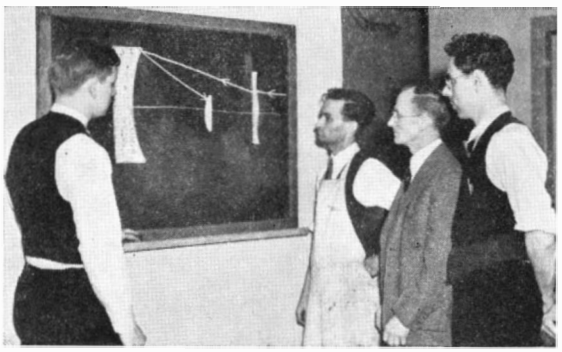
CLUBS of amateur telescope makers and astronomers are now flourishing in at least 40 cities in the nation, and three of these clubs have shops actually within the local planetarium buildings. The Chicago Amateur Astronomers, formerly the Amateur Telescope Makers of Chicago, are housed in basement rooms in the Adler Planetarium in that city. The Optical Division of the Amateur Astronomers' Association, formerly the Amateur Telescope Makers of New York, similarly have shops in the basement of the Hayden Planetarium at the American Museum of Natural History in New York, and now the Amateur Telescope Makers' Section of the Franklin Institute meets and perspires over raw disks of glass in a shop above the dome of the Fels Planetarium of the Franklin Institute in Philadelphia. We show several photographs of activities in these shops.

While thousands of amateur telescope makers work alone, either by preference or the circumstances of their isolation, the gregarious instinct leads many more to flock together, thus adding sociability to science. If two heads are better than one, three heads may be better than two, and 30 perhaps better than three. Half of the zest in constructing anything is contained in the knowledge that other hobbyists of the same kind are working alongside, but it is also true that optical work of the finest grade has been done by many entirely isolated amateurs. Seldom, however, does this last long, for friends soon become inoculated by the "bug."

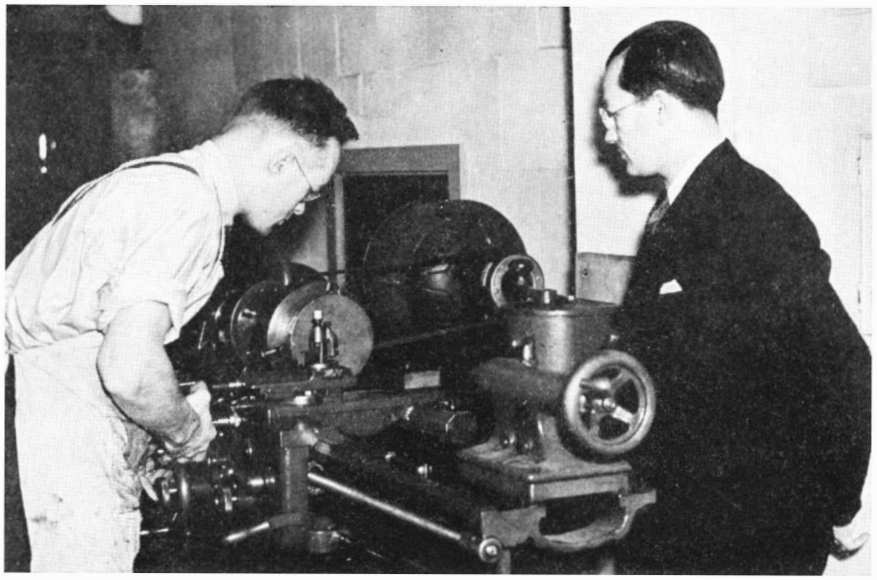
A typical Thursday night session. The photograph shows half of the available pedestals around which the concave glass mirror disks of reflecting telescopes are ground and polished by hand, using the fine abrasives shown in the bottles and shakers on the shelves

Above: **Dr. Rodrich Boehmke (left), a Philadelphia optical manufacturer who has assisted the club with advice, and a machine on which telescope mirrors may also be made if the worker so desires**

Right: **Telescope making leads to "all-night" arguments about optical theory, hence a small blackboard is conveniently ready for those who like to think**



Below: **A member of the club doing the heavy looking on while another member faces a tool used on the grinding machine preferred by certain workers**



HIGHWAY FREIGHTERS

A Half-Billion Dollar Industry . . . Furnishes Flexible Transportation for a Wide Variety of Products . . . Sturdy Pneumatic Tires a Vital Factor

By PHILIP H. SMITH

MOTOR truck manufacture is a half-billion dollar industry. Add to this wholesale value of product the value of business done by companies and individuals engaged in truck transportation and you get a major industry centered around a product a little more than 30 years old.

Today the motor truck moves 2 percent of the ton-miles and 5.5 percent of the nation's carload tonnage. If these percentages seem small it is only because the total movement of merchandise is so enormous. In actual figures the ton-miles for trucks are 2,164,000,000 and the carload tonnage 16,145,000.

To trace the development of this giant, one need go back no more than 15 years. Truck production had already reached a high figure 15 years ago, but the balloon tire made its appearance in the early 'twenties and that was the real beginning of the high speed transportation of heavy loads. Long distance, interstate trucking which captures the imagination could hardly have become feasible had the pneumatic tire not been perfected to take cruel punishment.

The human factor in truck transportation was also affected by balloon tires. Many can recall the stories about the short driving-life of truck drivers because of the incessant jar as the solid-tired vehicles pounded over the pavements. It is fact that driving was a gruelling occupation, fit only for young men and for limited periods. The balloon tire banished that difficulty, and it did something else. As a result of the cushioned ride, it was no longer necessary to use magneto ignition, acetylene gas for headlights, and hand cranks for starting the engine. Storage batteries, unable to take the punishment inflicted by riding on solid tires, became feasible and thereby provided adequate and safe lighting, while self-starters gave driver relief.

The advent of the pneumatic for heavy trucks may seem a small matter, but its significance can hardly be overemphasized. Speed is a vital element in truck transportation and to the extent that heavy loads can be moved quickly, by so much does trucking become competitively desirable.

A second development of great import was the switch from four- to six-cylinder engines. This is a highly controversial statement with which many authorities will disagree. However, high speed became practical when power was increased without a corresponding increase in engine weight, made possible by the lightening of reciprocating parts and stepping up of engine revolutions. This development of motor-truck engines is akin to advances made in passenger-car engine design.

With its engine placed under the driver's cab, this 215-inch wheelbase, stake-body motor truck carries 107 bags of wool

Within the period of 15 years have come advances in metallurgy which, applied to truck engineering, give a chassis capable of carrying heavy loads at high speeds. If it were not for the knowledge of alloying metals to increase strength of steels, the present-day motor truck would be a very cumbersome vehicle, toting around a deal of excess weight. Almost every part of a truck instances the use of metallurgical advances. Consider, for example, the size and weight of axles and axle housings, in relation to the stress and strains they must undergo.

Given an excellent vehicle as the product of engineering research of a most painstaking variety, what improvements are likely to be forthcoming? Is the motor truck on the eve of any radical change?

The objective of engineering work is toward achieving greater economies in operation and maintenance. Every step toward this objective gives greater justification for truck use. Motor-truck transportation is competitive, and competition forces these economies. Then there is the added incentive given by hampering legislation and taxation. All-over design and motive force are the two points at which the problem is being attacked.

ALTHOUGH the science of metals has accomplished wonders with the modern truck, continual research aims to find ways and means for lightening vehicles without impairing their load-carrying capacity. The objective might be described as an attempt to make the vehicle weight smaller in proportion to the total loaded weight, which is tantamount to increasing payloads, given any specific vehicle dimension. It would occasion no surprise if, very shortly, we found trucks being built without frames, the body serving as the structural member.

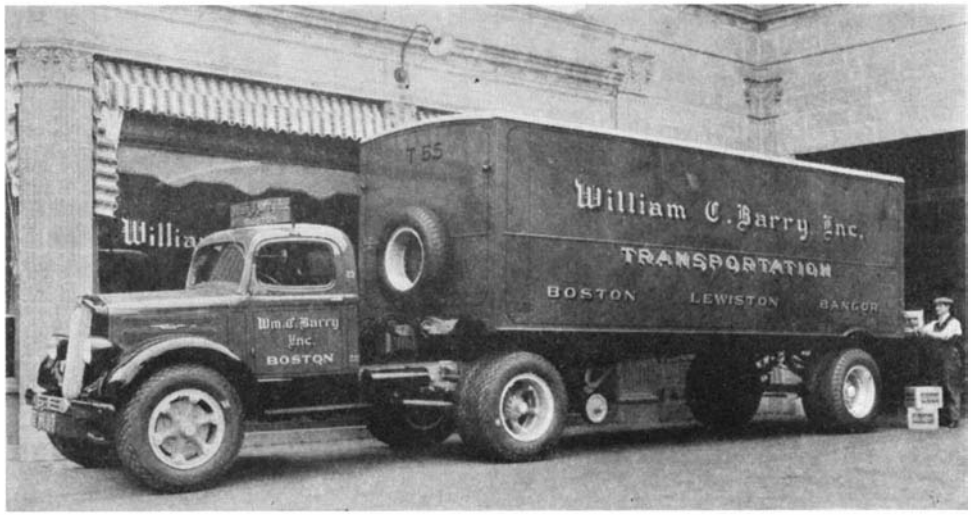
There has been a great deal of experimental work and corresponding progress in the development of lighter weight bodies. Aluminum is coming into wider use, while high-strength, lightweight steels are entering into body construction as never before. If a ton can be cut from the weight of a vehicle in this manner, an extra ton of merchandise can be carried without increasing the power or the over-all weight of the vehicle and the economies are obvious. Savings of this sort are now common and in the long run they outweigh the higher initial cost of the equipment.

There are engineers who believe that economies in motive power will be brought about by adoption of the Diesel engine. This is still a moot question. Steady progress has been made in rendering the Diesel suitable for trucks and about 2500 vehicles so powered are

in commercial operation, demonstrating surprising fuel economy. On the Pacific Coast, for example, where Diesels are most widely used, there are several companies operating large fleets and finding them quite satisfactory. On the average, fuel consumption is only about 50 percent that of the orthodox gasoline engine.

There is no possibility that Diesels will capture the truck overnight. As now constituted. the Diesel engine is more costly and requires more frequent overhauling than the gasoline engine. These obstacles must be overcome before the advantages stack heavily in its favor. Furthermore, there is not the great differential saving in fuel that is commonly supposed. Less fuel is burned and the fuel is of a cheaper grade, but that's only part of the story. All but 13 states have imposed a tax on Diesel fuel and this is usually as high as the gasoline tax. There is even talk of higher fees for Diesel-powered trucks, which would reduce the possible savings. Another fact, not widely appreciated, is that improvement in the Diesel has been an accompaniment, if not the result, of improvement in the fuel. Diesels do not burn fuel just as it comes from the well. Today's fuel as used in the truck is a refined product. In a sense, therefore, the Diesel and the gasoline engine have been moving nearer together and there are many capable engineers who believe that the Diesel's major contribution may be the spurring of research to make the gasoline engine more efficient.

It would be extremely unwise to state that the Diesel is not the coming motive power for trucks. Posing the drawbacks is simply one way of indicating that progress will be slow and the outcome uncertain. In view of what has been accomplished in taking a cumbersome, stationary engine and adapting it to a moving vehicle, there is reason to believe that equally great advances can still be made, but relative costs will be the deciding factor in ultimate usefulness.



Tractor-trailer combinations, such as the long-distance trucking unit shown above, have had a tremendous influence on highway transportation. With such combinations, the tractor units may be kept in active service while the trailer units are being loaded or unloaded

Outside the field of transportation there is little appreciation of the immense influence that legislation has had both in design of trucks and the growth of trucking. All authorities will say that legislation has retarded the use of motor trucks, either by the imposition of penalizing taxes, or the promulgation of weight and dimensional rulings. This has made for added difficulties, but trucks and trucking have forged ahead in spite of it.

The purpose of legislation is manifold. It is prompted by a desire to make trucks pay for the cost of highways; to prevent them from injuring the paved surfaces; to get revenue which cannot be derived as easily from other sources; and finally, to force the shipment of merchandise back to the railroads. A discussion of the merit or demerit of such legislation does not fall within the scope of this article, but we need to tell the effects upon design and growth.

Privately operated trucks pay about 2⅕ times as high a tax as passenger cars; common carrier motor trucks pay six times the car rate. The grand total of 354,000,000 dollars to which the annual tax on trucks has soared comprises registration fees, gasoline, state and municipal taxes, as well as any special local taxes. In certain states, the purchaser of a pneumatic tired, three-ton truck, must pay close to 1000 dollars in taxes before he can begin to operate. This means that motor vehicles which compete as common carriers must be able to earn high fixed charges as well as pay their way before they can be regarded as money-making investments. That they succeed is evidenced by the sustained growth of truck transportation.

Length, height, width, and load restrictions also impose a burden, the greater because these restrictions are not uniform throughout the 48 states. Where the most rigid rulings prevail, bottle-necks are created which mean virtually that interstate haulers must comply with these minimums and lower the efficiency of operation for the entire run.

Into the woods goes the motor truck to haul out loads of logs, economically as well as speedily

TRUCK design reflects state legislation because limitations have spurred manufacturers to devise ways and means of surmounting them. Curtailment of length, for example, has given rise to placing of the engine under the driver's seat; thus more space is made available for the load. Weight limitations have forced attention to spreading the weight over a larger pavement area, as accomplished by multi-wheels. Lightening the weight of bodies also exemplifies this effort to make transportation efficient in the face of laws which were not drawn up with payloads in mind.

Payload is the factor of motor-truck transportation upon which all eyes focus, irrespective of the type of service to be performed; that is, whether it is private, intrastate, or interstate hauling. Payload is the talking point in design and operation because economy, rather than gadgets or beauty of line, is what sells and keeps trucks running.

Legislation is going to continue to

On the farm the motor truck has many and varied applications, from harvesting certain crops to transporting produce at high speeds from the farm to market

have influence over trucking, but its power may be more beneficial than heretofore from the industry's standpoint. Greater uniformity of laws is coming about as the result of persistent labor on the part of national associations, safety groups, and other interested parties. Of much greater significance is the Federal Motor Carrier Act of 1935 which is being administered by the Interstate Commerce Commission. This Act puts common and contract motor-carrier transportation under a co-ordinated control.

The possibilities for good which are within this Act can hardly be understood without reference to the motor-truck transport industry as it has grown and is today. One of the major complaints of soundly operated companies has been that any individual could engage in the enterprise by the mere purchase of a truck and without due provision for amortization, safety, decent hours or wages for drivers, or any of the many requisites which are the mark of good business. The ranks of trucking have been filled with small operators who thus came into being and then disappeared through bankruptcy, but not before they had undercut rates and seriously demoralized the business.

MOTOR-truck transportation is still primarily a business of small operators, although concentration in fewer hands is proceeding rapidly. It is a business in which the vast majority gain little more than a livelihood and the minority get the volume and make the money. The most recent Government census, which covers the year 1935, bears this out in figures which show 1.5 percent of operators getting nearly half the total revenue, while on an income basis 81 percent earned less than 5000 dollars for their year's work. This census also relates that local operators received 38.4 percent of revenue, interstate concerns 36.9 percent, and intrastate 24.7 percent.

Transportation officials believe that this picture is about to undergo a rapid change because the Carrier Act specifies safety equipment, qualification of drivers, and publication of rate schedules. Once rates are set, they cannot be shaded. The outcome, officials believe, will be the elimination of the fly-by-night, or marginal, operator who lacks necessary capital. For the first time in its history, therefore, motor-truck transportation becomes a legitimate, well-recognized industry—a respectable part of our national transportation system. While some individuals may be heavily penalized, the I.C.C. regulations should help to put operations on a sounder basis.

There are over 4,000,000 motor trucks in use in this country and millions of dollars in capital are employed. The drivers constitute an army of some 3,000,000, and the service rendered extends into nearly 50,000 communities where no other form of transportation is available. Growth to this stupendous proportion means that truck transportation is something more than an upstart or the gad-fly of the railroads.

Motor-truck production follows very closely the trend of general business and future expansion promises to tie with prosperity. Specialized equipment constantly broadens the market so that new industries can use the truck to advantage. Refrigerated trucks exemplify this. With the practical employment of dry-ice as a refrigerant, it has become more feasible to ship perishables; and the growth of such shipments is steady. The motor truck is now the predominant carrier of such commodities as milk, fruit, and vegetables, and comes very close to being the leader in transport of live stock.

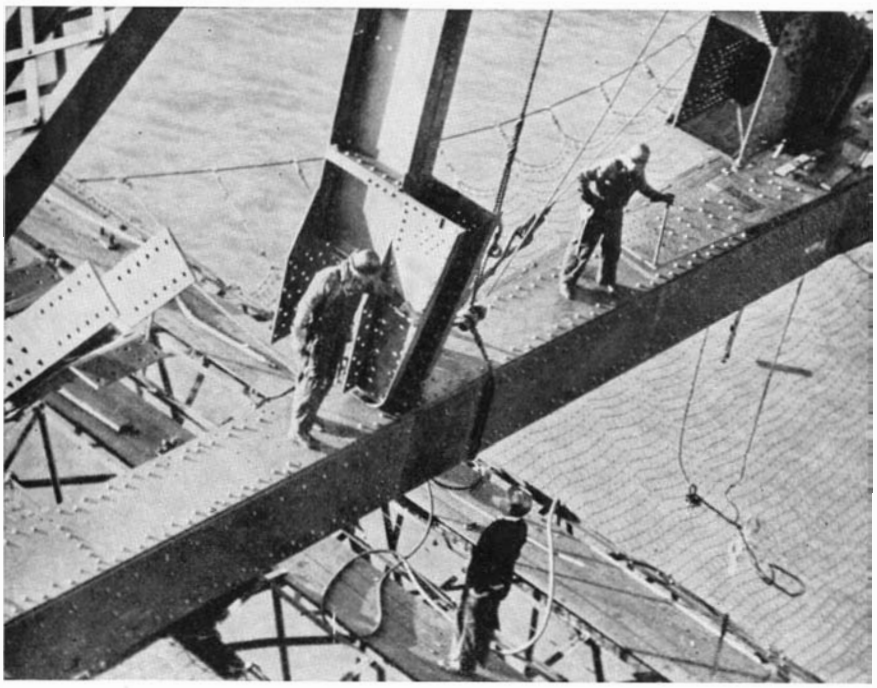
There is no mystery about the development of the motor truck, nor its use as a vehicle of transportation. It came about because flexible transportation was a need and no other agency could supply it as well. Economy, speed, door-to-door delivery, shipping facilities when and as needed—all this is provided by the motor truck and modern living depends upon it. With intelligent regulation, with greater stability, and with the continued betterment of design in the vehicles themselves, trucks and trucking have a long way to go.

Photographs courtesy Autocar Company, International Harvester Company, and White Motor Company.

Coal loaded on trucks at the mine may be delivered directly to the distributor with a minimum loss of time and with no costly trans-shipping to cut into profits

Recent air view of the Golden Gate Bridge, with Marin hills in the background and Mt. Tamalpais at upper left

How Big is a Bridge?



Placing the last girder of the Golden Gate Bridge. Note safety net

UPON the question in the title of this page depends the answer whether the Golden Gate Bridge at San Francisco, to be completed in early May, will assume first place among the world's suspension bridges, or whether the George Washington Bridge at New York will retain this distinction. Determination of "bigness" in bridges depends largely upon what measuring stick is used. Considering length of span, the Golden Gate Bridge, with a 4200-foot main span, is the world's longest suspension-type bridge. The George Washington Bridge, however, is designed to carry a heavier load, although its main span is 700 feet shorter and its cable length 2482 feet shorter than the western structure. On the other hand, diameter of the two cables supporting the Golden Gate Bridge is 36½ inches as against 36 inches for the George Washington structure, which has four cables providing a total supporting strength of 350,000 tons, as against 193,004 tons for the Golden Gate Bridge.

Paris Prepares For Gas

Gas Masks for Civilians . . . Gas-Proof Shelters and Cellars . . . Emergency Squads Equipped With Gas-Proof Clothing and Steel Helmets

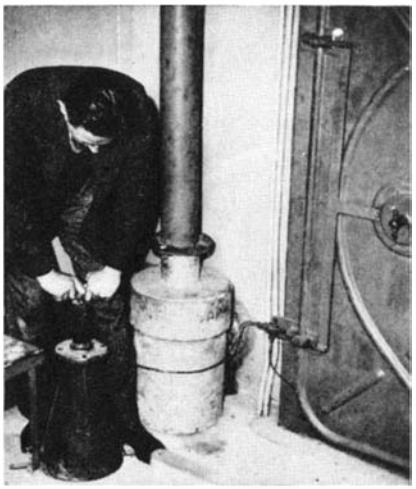
THE cry "*Aux abris*" ("To the gas shelter"), together with the screeching of sirens, galvanizes the civilians of present-day Paris into instant action. Wrought up to a point verging on hysteria by unceasing threats of war in Europe, French authorities are taking steps to protect the population of the country from gas attacks by an enemy. A vital part of these preparatory measures is the intensive education of civilians in the proper methods of saving themselves from the disastrous effects of poison gas. Regardless of what may be said about the use of such gas in any future warfare, it cannot be denied that it has a great psychological effect on non-combatants and that the morale of a whole country can be vastly strengthened by education conducted along proper lines.

The work being done in Paris today is typical of the precautions being taken throughout France. Approved types of gas masks can be purchased for approximately three and a half dollars and are available in drug and department stores, as well as in every police station. If the purchaser is inclined to be fastidious he can have a special mask made to order for about 20 dollars. Training schools have been established throughout the city to instruct civilians in the proper method of donning a gas mask and in other precautions that must be taken in case of a gas attack.

But gas masks are not the only means of protection being developed in Paris. Experiments are being carried on with small concrete gas-proof shelters, housing three persons and provided with a cone-shaped top which is said to be capable of diverting shells and thereby rendering the structure less liable to damage. Another type of gas shelter being developed consists of a double-walled collapsible tent, equipped with an entrance that can be made completely gas-tight. These tents have no supports other than air; when one is to be used, compressed air from a motor-driven blower is forced into the space between the double walls, thereby inflating the tent like a balloon and providing a

In a school recently organized in Paris, professional nurses teach civilians the proper use of newly developed gas masks

Right: **Members of a first-aid team, clad in gas-proof uniforms, being disinfected after entering a gas shelter**



Cracks around the door of a gas-proof cellar being sealed by a soft rubber tube inflated by a pump

Left: **Two Parisian motorcycle policemen fully equipped for carrying on their work during a heavy gas attack**

Women and children in one of the temporary gas shelters which consists of a double wall of gas-proof fabric with a gas-proof entrance. These shelters may be quickly set up for protection of civilians or to provide emergency first-aid stations

Close-up of a completely protected volunteer of the first-aid gas squad in his gas-proof uniform

shelter for a number of civilians.

In every branch of building construction the fear of war gas is having its effect. Apartment house owners find that their rooms can be rented more easily if gas-proof cellars are available for the tenants. Hotels have more guests if similar protection is afforded. Even the subways are equipped with gas-proof cubicles. In fact, it is reported that the French Municipal Council recently passed a law making it obligatory for every new building to be equipped with gas-proof shelters which meet with the approval of army engineers.

It is said that throughout France nearly 10,000,000 gas masks are now available for the civilian population. In Paris alone 80,000 masks are ready for immediate service. But, Parisians say, 80,000 masks is a mere drop in the bucket! To supply the whole population of Paris alone the government must spend 300,000,000 francs.

Below: Inside a large permanent gas shelter. The nurse is operating the air purifying apparatus. The cycle-driven generator supplies current for electric lights

Photographs from Mirzaoff

Leaving a concrete shelter, capable of housing three persons. Note the conical shell- and bomb-deflecting top of shelter

To all this agitation for gas masks and shelters, sirens and gas drills, add the fact that the Police and Fire Departments are fully equipped for operating under gas attacks, that special gas patrols are available for dispatch to all sections of the city by motorcycle and automobile, and that ambulances are available on a moment's notice with nurses and doctors trained especially to fight poison gas, and you have a picture of what happens when the entire population of a country is so imbued with the idea of impending war that even the lowliest citizen is instructed in the procedure to be followed when and if the dreaded blow falls.

The photographs on these two pages, taken recently in Paris, tell their own dramatic story of the extent to which the authorities and private citizens have gone in their endeavor to be ready to fight successfully the insidious, invisible foe which, they seem to feel, may strike at any moment.

THE SMOOTH SLIDE

By BARCLAY MOON NEWMAN

EVERY mystery of science has two aspects, the practical and the theoretical. No exception is the supreme mystery of modern research, the nature of life—what it means to be a live thing.

On the practical side, the investigation of cancer may well come first to mind. In this disease, the tiny units of living material, the cells, are not only alive but too much alive. They carry on the life reactions, grow, and multiply at far too great a rate. The excess growths which they thus produce are injurious, later painful, and finally lethal. As the efforts toward determining the secret of cancer and of its control have become greater and greater, yet ever end in failure, bioscientists in general have become more and more convinced that the cause of this disease is bound up with the enigma of life itself. For, the regulation of cellular metabolism (rate of biochemical activity), of increase in size, and of reproduction must now, more definitely than ever, be regarded as among the most profound phenomena of animate existence.

Figure 1: **Very greatly magnified photograph of chromosomes containing subdivisions believed either to be genes or to contain the genes which seem to be the captains of life. From the genes each cell in the body is bossed. What *is* this boss?**

The search for the germs of influenza, infantile paralysis, sleeping sickness (encephalitis), and yellow fever has also penetrated to the obscure borderland between the living and the non-living. Each of these germs is a virus, that is, a parasite so minute and so simple in structure that biologists have been unable to decide whether or not it is alive. Here, again, the mystery of the difference between an animate and an inanimate being has practical bearing upon the conquest of disease. And a related problem is that of the phage, which is no bigger and no more complex than the virus, and which is capable of devouring bacteria, including some that infect man.

Furthermore, nothing is more practical than enzymes, the promoters of biochemical reaction which abound perhaps numberless within the body: like ptyalin of saliva and amylase of pancreatic juice which stimulate the digestion of starch into sugar; or like many another substance whose rôle is not the promotion of destructive reactions (such as digestion), but of constructive ones, such as the building up of intricate, living protoplasm out of absorbed nutrients. The possession of a specific enzyme permits yeast to ferment sugar to alcohol and use for its life activities the energy thus released. Recent research in Russia has shown that azotobacter, a distant relative of common yeast, has an enzyme which enables the organism to take free or uncombined nitrogen from the air and fix it, that is, synthesize nitrogen compounds, especially ammonia. An extract from crushed azotobacter has the same power, and therefore must contain the enzyme still active. This line of work may lead to the devising of less expensive methods of nitrogen fixation, essential for the making of explosives and fertilizers. Precisely what is an enzyme? An extraordinarily large and intricate molecule, straddling, as it were, the boundary between life and non-life.

In the last analysis, it is impossible to separate the practical from the theoretical, for it always happens that a worthwhile theory turns into a significant portion of human knowledge and is eventually put to some practical use. Today, it may seem impractical to speculate concerning the basic causes of aging and death, and concerning the basic factors of heredity and their suggested application to racial improvement, eugenics. Yet a Nobel Prize in *medicine* has been awarded to T. H. Morgan for his theoretical studies of inheritance in the fruit fly. And as we grow older, somehow the problems of adding to the years during which our minds are profitably active, and of lengthening the life span itself, do not appear so speculative as we once thought. Moreover, if we are thoroughly familiar with the tragedy of human weaknesses, such as crime, feeblemindedness, low mentality in general, and bodily defect, amid a giant civilization constantly threatening to get out of control, must we not regard eugenics as a field which it will pay to cultivate? Then, too, is it not excellent psychology to relax every now and then, and for a moment philosophize upon the wonders of the universe and even upon the meaning of life, the greatest of these wonders?

THUS, it may be that the theoretical aspect of the deepest mystery of organic nature can merit the notice of the busiest, the most practical, of men. For, thanks to the developing conception of the gene (Figure 1), it is now believed that the origin and meaning of life's physical chemistry, the processes of aging and dying, and the mechanism whereby the offspring reproduces the living pattern of the parent, constitute, all of them, only a single, grand consideration—the fundamental nature of life.

The gene, the unit of heredity, apparently belongs with the virus, the phage, and the enzyme within the twilight zone where the non-living world shades into the world of life. This does not mean that any of these four entities are ever found physically associated together in the same environment. Rather it means that they have so many properties in common as to make it logical to place them in the same category: of threshold beings, whose vital state is exceedingly doubtful. That is, the newer discoveries concerning these odd organizations of matter have demonstrated that there is no great chasm separating the organic

Up to Life

Discoveries now Being Revealed, in the Twilight Zone between Life and Non-life, have Astonished the Scientific World . . . Their Practical Bearing

MANY men of science believe the revelations concerning the nature of life—the same ones described so ably in the accompanying survey—are destined to make the present time famous or classic in the future annals of science. Few scientists had been so optimistic as to predict, for our times, the solution of the major mystery and problem of all science—what life is—yet many signs seem now to point toward success. Better still, they point toward the simultaneous solution of several other baffling mysteries. The reader is urged to ponder well the solid content of this article.—*The Editor.*

from the inorganic. Each one of these four types of gigantic molecules is evidence that there is a gentle gradation of organizations ascending from inanimate to animate nature. There is a smooth slide up to life.

Thus there is, from electron to man, a hierarchy of combinations of particles. Electrons, protons, and neutrons unite to form atoms, which, in turn, join to produce molecules. The compounds so produced may be simple, as in the case of a water molecule, or exceedingly complex, as in the case of the proteins, like albumin whose molecules make up the largest part of egg white. And with increasing intricacy along certain lines of molecular architecture, there is steadily closer approximation to that group of properties which, all together, signify a living thing.

NO single activity of life is not characteristic of some example of non-life. Even an atom can grow: the heavier atoms have arisen from the lighter ones. Even an atom can repair an injury: if it has been mutilated by the loss of an electron, the loss can be made good. A crystal of table salt not only can grow but also can reproduce itself—of course in the proper solution, salt water. Certain oils, such as linseed oil, definitely exhibit respiration. They "breathe in" oxygen, carry on a slow oxidation, and "breathe out" carbon dioxide; meanwhile, the process releases, as in the body, a small quantity of heat. A copper wire shows memory: twist it back and forth, the twists are remembered, and finally the wire breaks. For that matter, an adding machine has greater powers of recollection (for figures) than a human being. Therefore, there is no simple test for life. Therefore, it is exceedingly difficult to say whether or not a borderline form, such as a molecule of a virus, is actually alive.

In 1857, a certain tobacco pestilence was first described. It was noted that the infected plants were stunted and that the leaves had a mottled appearance. This appearance of the leaves gave the disease its name: mosaic disease. In 1892, Iwanowski, in Russia, proved that the causative organism must be a virus, because he could pass an extract from the stricken plants through a filter with pores fine enough to hold back the smallest bacterium, and still the extract was infectious. What is the nature of a virus? What are its reactions? Does it consist of several molecules or only one? These questions became more and more important to medical pathology as the number of known virus diseases steadily increased.

Figure 2: **Dr. Wendell M. Stanley, to whom the American Association for the Advancement of Science has awarded its 1000-dollar prize for his noteworthy paper on virus research. He is 32 years of age**

In 1932, Stanley (Figure 2), of the Rockefeller Institute, set out to solve these problems. He chose to work with the tobacco-mosaic virus, since it is the easiest to deal with (especially as it is a *plant* infection), since more was known about it than about any other virus, and since it has long been regarded as a typical member of its class of parasites.

Pepsin is an enzyme (ferment) which is a specific digester of proteins. Stanley discovered that the infectious extract from diseased plants lost its infective power after being digested with pepsin. Hence it seemed likely that the virus is a protein. Certain salts are known to precipitate proteins. He tried out these precipitants on more of the fresh extract. Sure enough, the mixture clouded up and rained out some of its dissolved substances—the protein fraction. The extract, minus this fraction, again was no longer infective. The virus must be in the protein fraction, must almost certainly be a protein. Stanley then found a neutral solvent for the protein precipitate, made a solution, and again brought about precipitation, this time with an ammonium salt which caused the precipitate to emerge in the form of crystals. Repeated solution and crystallization ultimately gave a pure product, whose extreme virulence made it practically certain that he had isolated the virus. This parasite, then, shows up in the pure state as needle-like, transparent crystals (Figure 3). Each one of the millions of molecules constituting a single crystal turns out to be a germ of the disease.

IT has astonished the scientific world that a single molecule can be the causative organism of a disease. How can a crystal be made up of living molecules? Hitherto crystalline substances had been regarded, and for good reason, as inanimate—perhaps portions of animate beings, but not themselves alive. Yet there is no doubt that an almost infinitesimal bit of this dead-or-alive material, when placed in the living tobacco plant, soon shows its activity and "life," for the leaves wilt and die—while the virus feeds upon the living tissues and reproduces itself indefinitely.

In bulk, as thin glassy needles, the virus does not seem alive. It is presumably an inanimate protein, consisting of the elements carbon, hydrogen, oxygen, nitrogen, and chlorine. In the absence of other life, it is quiescent, does not breathe, and requires no food. It apparently is but an enormous molecule, highly intricate, certainly, but just a molecule, having a definite molecular weight, 17,000,000 times that of the hydrogen atom. Still, it is only biding its time, for it exhibits many activities of life once it has come into contact with life—the protoplasm of the tobacco plant. Decidedly, it must be thought of as a being from the borderland of animate exis-

tence, an organization just at the threshold of life. In it we discover how the stages of increasing complexity of atomic combination have at last scaled up to the realm of life.

Like the genes, which organize and direct the development of the tissues and organs in the embryonic animal or plant, the virus is able to master the reactions occurring in its host and turn them to its own account: that is, to make the substances of its host help in producing more of the very thing which is literally devouring the protoplasm of the tobacco plant, as in this case, or of man, as in the case of sleeping sickness and influenza. A morbid molecule can overshadow the life processes of the diseased organism and dominate them.

A gene can dominate the life processes of the cell which fabricates it, but to a happier, more constructive end. In every cell of every living thing, there is the central, spherical mass of regulative protoplasm, the nucleus. And in each nucleus, there are the deeply-staining, sausage-shaped chromosomes (Figure 1)—pure, concentrated, regulatory material, no more and no less than aggregations of genes—the building units of the chromosomes and the units determining the heredity of the individual. Now the chromosome is believed to be a chain of genes, each gene being a giant protein molecule probably somewhat similar in constitution to the virus.

IS the gene the sole seat of actual life within the body? We do not know, but there is much evidence in favor of this view. The gene is a protein, and only where we find proteins do we find life. Furthermore, there is no doubt that the gene is the unit of control of the bodily activities, from fertilized egg on until the death of the many-celled adult. The genes of the parents, except for an insignificant quantity of nutrient and protective substance, are the entire legacy to the offspring. Like enzymes, genes not only stimulate the biochemical reactions of the cell, and therefore of the body as a whole, but also control the direction in which a reaction travels; that is, the manufacture of the products, and the rate of these activities. Hence, according to the chemical structure of its genes, so goes the organism's structure. Our architecture is like that of our parents because each parental type of gene was able to make a copy of itself, or a near copy, and to hand down to us, by way of the chromosomal mechanism of the germ cells, certain of these duplicates, or near duplicates, of parental genes.

It is essential to mention that the delicacy and intricacy of molecules as high in the scale as the proteins are such that it is not always possible for one of these atomic groups to fabricate an exact likeness of itself. Such molecules are susceptible to the slightest alterations in their environment. A very minor shift in the position of an atom or two in a complex molecule means a new molecule, and sometimes a new creature. The tobacco-mosaic virus can readily mutate, or undergo a structural change, which gives rise to a different sort of infective agent, a novel variety. The bombardment of fruit flies with X rays alters the

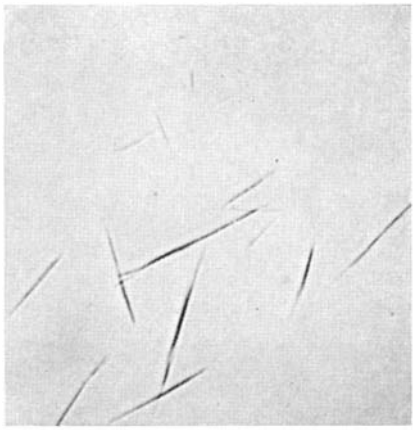


Figure 3: **Photomicrograph of the crystalline tobacco mosaic virus protein, magnified 675 diameters**

parental genes so that the offspring have a far greater proportion of white eyes, for example, than of the more common red eyes. A gene mutation causes the mutation, white eyes. Evolutionists believe that such mutations, or chance variations, have been the raw material for evolution—Nature selecting the fittest of these variations or mutations for survival. In the twilight zone between non-life and life, many a great secret lies.

How smooth is the slide up to life? An inanimate virus molecule becomes animate when it touches live protoplasm. A living gene may suffer a slight transformation and become a lethal agent; some investigators think that this is what gives rise to cancer. Can a definitely inactive molecule—in its particular scheme of atomic arrangement always doomed to the avital or non-living state—can such a molecule be transformed to a very closely related structure, but one capable of a higher existence, on the plane of life? There is evidence that even this sort of modification can and does occur. Certain enzymes are autocatalytic; that is, they are capable of producing *themselves* out of completely inert substances, but ones quite similar to themselves. This is a kind of spontaneous generation. For example, a comparatively slight modification may automatically occur within the molecule of an inactive protein, which has no digestive power, and thus make out of itself an active enzyme, with the ability to effect a definite fermentation. Within a molecule, an atom leaps from here to there, an infinitesimal distance. Yet this insignificant leap is across a significant boundary, the one between death and life.

A BACTERIOPHAGE is either an enzyme or a gene on the loose, or a living thing as small as a virus. It too is considered to be a midway molecule, poised between life and non-life. As in the case of its three related forms, the most powerful lens fails to reveal it. Its outstanding characteristic is its ability to devour bacteria and perhaps other very minute organisms. Phages were discovered independently by Twort and d'Herelle in 1917, when these investigators noted that certain bacteria (which they had been growing in cultures) strangely disappeared, seemingly because of the attack of an invisible parasite. Like a virus or an enzyme, the phage can reproduce. A very minute quantity of bacteriophage, when placed into a bacteria culture of the appropriate variety, increases and therefore can kill a very large number of microbes. Also like a virus or an enzyme, they are specific in their action: a certain bacteriophage can destroy only certain kinds of microbes. Again, they are unable to multiply unless in the presence of living protoplasm, that is, the particular sorts of bacteria upon which they feed. It is possible that they are produced by the bacteria themselves, and may be true enzymes—non-living but able to dissolve the protoplasm which gives rise to them, perhaps as the result of some peculiar diseased condition among the bacteria. Northrop, of the Rockefeller Institute, has recently secured a bacteriophage in apparently pure form. It has been obtained as a sticky protein, similar to egg white. This particular phage attacks pus-forming bacteria known as staphylococci. A mere speck, once in a staphylococcus culture, can rapidly undergo propagation and finally annihilate the whole culture. Now that a phage has been for the first time isolated as a pure sample, we cannot fail to learn more about these fascinating entities of the realm wherein molecular organizations gradually take on the functions of an animate creature.

Thus, again we discover that Nature does not do things by big jumps. There is today a smooth slide up to life. We are reminded of the ascending process of cosmic evolution, in which matter and energy, at least on the earth, have cooperated in strange ways so as to produce gangs of atoms which live, move, and even feel and think. Now, man, who believes himself to be the highest of these products, is pondering the physical and chemical secrets which enable unorganized stuff to rise to the order of life. And the universe seems more than ever a unified cosmos—a place of infinite orderliness, however infinite in extent and wonder.

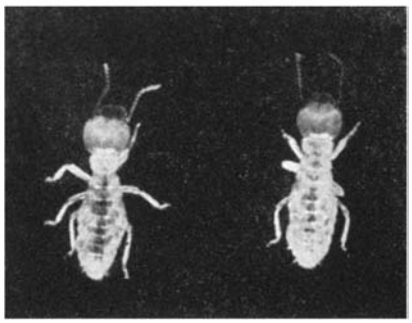
YOUR HOUSE MAY HAVE TERMITES

By ALBERT G. INGALLS

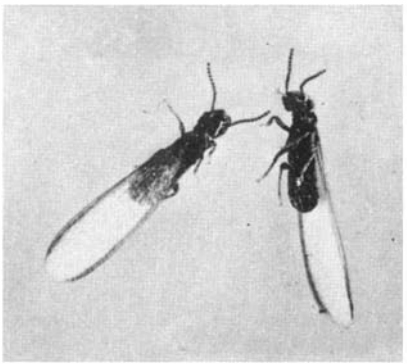
THE writer had read here and there, including this magazine, articles on termites, emphasizing merely their beautiful home life without giving definite, practical information on finding them. He did not once suspect they were at the same moments lunching on his house. After going all through the work of getting rid of them, which required an expense of something under 200 dollars, he offers a few practical, preliminary hints for ascertaining whether a house is infested.

If termites are at work on your sills, studs, joists and floor, they will not announce themselves, for they are strictly inside workers. They are blind and highly light-sensitive, even to weak light. Just once do they come to the light, when a part of them grow wings and swarm, usually in spring or fall. Then they come out for a few hours as winged adults, fly a short distance, lose their wings and re-enter the earth. The earth is the termites' natural home. They lurk and drink below-ground, and in their natural state they go above-ground to lunch on available wood. To them, therefore, your house is simply a nice big dead tree. From earth to house and back again they run frequently and over definite, inside highways. If there is a gap between soil and wood, as is likely in the case of a house, this is where they may be detected, for they will not run across this gap without an artificial tube. Accordingly, the homeowner should systematically examine both outside and inside (flashlamp) of the foundation wall for things that look like narrow streaks of brown paint drizzling down. When broken, the streak will be found to have a hollow interior of perhaps the diameter of a pencil lead. It is a termite shelter tube. Now he knows he is "in for it." Other tubes may be located. These are termite trunk highways. While termites may be poisoned, such treatments are generally less satisfactory than methods which prevent termites from bridging the gap between earth and wood with these highways. This demands close attention to fine details.

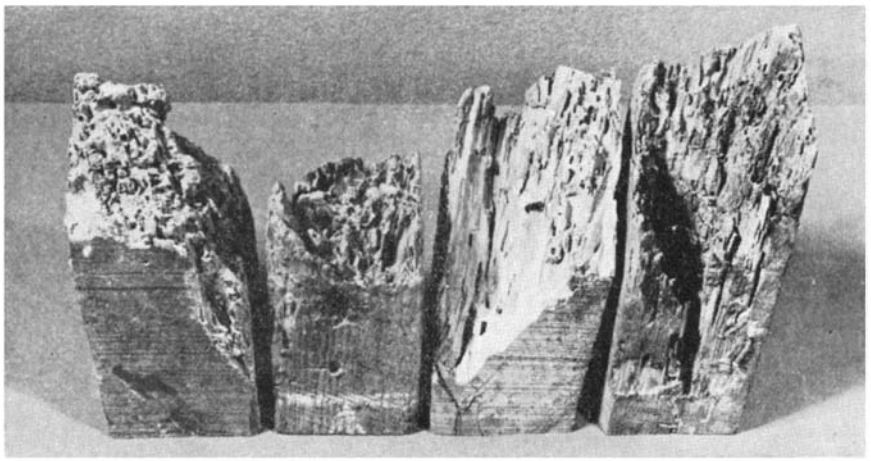
Sills, joists and other parts may now be sounded for honeycombed interiors with a small bit.



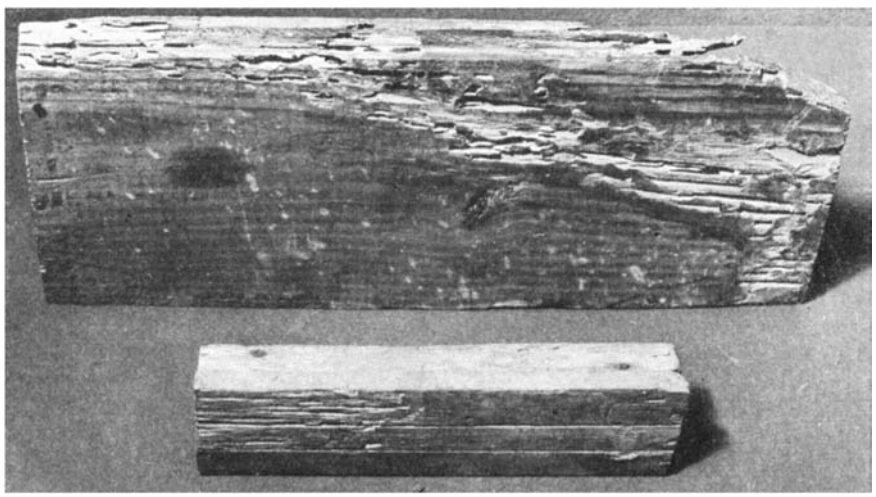
Workers, six times enlarged



Winged adults, five times size



Bottoms of coal-bin partition studs after some years of termite eating



Board from coal-bin partition. *Below:* An experiment. Two pieces of pine and one piece of cypress (at bottom) buried several months. Termites do not prefer cypress

It is bad medicine to become excited on discovering termites, or to let scare-you-all advertising stampede you. This writer's experience indicates strongly that the best immediate thing to do is to take ten days' time without doing anything except learning all about the manners and customs of termites. Then, when the professional exterminator comes, you will not be in the dark but able to look at the matter intelligently, know what he is doing, and why. Your house is extremely unlikely to "tumble down" in the meantime, even if someone says so. The Government publishes excellent termite literature: United States Department of Agriculture Leaflet 101 and Farmer's Bulletin 1472, obtainable from the Superintendent of Documents, Washington, D. C.

ARCHEOLOGICAL OUTLINES

Painted pottery made by an as yet unnamed race which lived on the site of Tepe Hissar 6000 years ago

By JOTHAM JOHNSON
University Museum, Philadelphia

DAMGHAN is a placid town with a ruined citadel and a long covered bazar, lying perhaps a hundred miles southeast of the Caspian Sea, and separated from it by the massive Elburz range. From the foothills the spring of Cheshmeh Ali provides a small stream which, flowing past Damghan, wanders for a few miles to vanish in Iran's central desert.

Somewhere here lay Hekatompylos of the hundred gates, a capital of the Parthian kingdom—perhaps at Tepe Hissar, a group of mounds lying two miles east of the town, where also Ernst Herzfeld had picked up surface sherds of prehistoric pottery. It was inevitable that the University Museum would dig this promised land; with the Pennsylvania Museum of Art as co-sponsor, and Dr. Erich Schmidt as Field Director, the mounds of Tepe Hissar have been thoroughly investigated.

At the bottom of all things lay the poor remains of a nameless race. Where they came from, and what language they spoke, wait for a future miracle to solve. Yet we are not totally at sea. Their houses were made of a material more humble than sun-dried brick—layers of mud bound together with straw. The size of the town and its substantial buildings indicate that these people were permanently settled agriculturists, as is confirmed by their elaborate and therefore not readily transported pottery vessels, their small grindstones, their figurines representing sheep and cattle. We do not know that they had domesticated beasts of burden. They hunted ibexes in the mountains and gazelles in the plain, for food and skins. And by painting their pottery they won immortality.

As their most typical product this pottery has been intensively studied and elaborately classified. It was made on the wheel. In brown or dark grey on a red or brown ground, most of the designs are geometrical, hatched triangles, comb, wave and ladder patterns; a few specially prized show conventional ibexes and gazelles, birds, and even cats. The shapes also are standardized: cups, graceful bowls, jars, and broad-mouthed storage vessels. A few hand-made vessels survived from the most primitive occupation level.

Pottery figurines of domestic and wild animals in remarkable profusion were magical in purpose, to increase the flocks and lead the hunter to game. Spindle whorls for yarn spinning show knowledge of weaving, hence the earliest residents of Tepe Hissar were not limited to skins—or fig leaves. The bracelets, necklaces, and belts of the dead yielded 200,000 colored beads.

PRIVATE seals, of stone or terra-cotta, had geometric or wave patterns like the pottery, but one unique specimen seems to show two human beings engaged in some act of worship. Burial customs disclose belief in immortality. The dead were interred right in the town, under the house floors, without coffins, their legs bent up to save digging. With them were placed the seals and bead ornaments they had worn in life, pins to hold their celestial robes together, and bowls and cups of painted pottery for Elysian banquets.

A little copper was found even in the lowest deposit—garment pins with conical or pyramidal heads, daggers and arrow or light spear points; enough to lift them out of the neolithic into the transitional chalcolithic period, but by no means superseding stone for hammers, grinders, scrapers, mortars, and other heavy tools. Weapons, however, were few and there is no trace of a town wall.

This, then, was a typical settlement in northern Iran of the Painted Pottery Peoples, the first great migrating race of western Asia, now suddenly encountered at a number of sites. Strata equivalent to Hissar level I*B* (level I of this mound is at the bottom) occur at Rayy, Murteza Gert and Tepe Sialk, and similar or older strata are found from Mohenjo-Daro in India and Anau in Russian Turkestan to Susa in Elam, al Ubaid and Jemdet Nasr in Babylonia, Tepe Gawra, Arpachiyah and Tell Halaf in northern Mesopotamia, and Alishar in Anatolia; in the current number of *Iraq* Sir Aurel Stein tells of his survey of ancient Pars in the winter of 1934-5, during which he discovered a score or more of new chalcolithic sites with painted pottery.

Dr. Schmidt observes that a proto-Elamite culture datable from parallels in Susa and Sumer overlies the Tepe Sialk stratum corresponding to Hissar I*B*; that would date it and its homogeneous cultures to about 3800 B.C., comparing well with the closing phases of the Painted Pottery Peoples at Tepe Gawra as dated by independent comparisons; Hissar I*A* must reach back long before. [Excavations at the great mound of Tepe Gawra were described by the author in SCIENTIFIC AMERICAN, October, 1935, pages 178-179.—*Ed.*]

We would expect to have passed below the chalcolithic period into the neolithic, but copper now proves to occur to such astonishing depths that it becomes risky to apply the term "neo-

IN PREHISTORIC PERSIA

The Excavation of Sites in Iran (Persia) Makes it Possible for the First Time to Piece Together a Partial Outline of Persian Archeological History. Tepe Hissar, an Ancient City Mound at Least Six Thousand Years Old, Was Once Inhabited by the Painted Pottery People of Unknown Identity

lithic" to any culture yet known in western Asia. Nowhere in Iran or Mesopotamia, in any case, has any New Stone civilization turned up beneath remains of the Painted Pottery Peoples, though paleolithic cultures—Mousterian and Aurignacian—have been found.

In time newcomers introduced a new scale of living and a wheel-made burnished grey pottery by which to be recognized forever. For a few years the two types are found side by side; then painted pottery disappears. Thus are Hissar II*A* and II*B* differentiated. The familiar Hissar I shapes, however, survive practically without change throughout Hissar II, implying that the new culture was assimilated peacefully to the old. And, in fact, nowhere is there a sign of struggle or of the torch.

Walls were straighter and cleaner, living quarters improved by the introduction of large sun-dried bricks of mud and straw. The tombs supply more elaborate jewelry, now with lapis lazuli. Before the close of II, copper seals begin to appear, together with numerous daggers, fine garment pins, bracelets, and other ornaments; also a mace head beautifully worked with an engraved zigzag design, as well as objects of silver and lead. Hissar II's great step forward was in metal-working, and, considering how long it lasted, we may be surprised that it was not greater.

Hissar III is also characterized by grey pottery. Probably there was a peaceful invasion and the improvements over period II—the new series of pottery shapes and the wealth of metal objects and alabaster furniture—are to be credited to new and wider relations between Tepe Hissar and neighboring cultural centers; but we are at some embarrassment to explain the amazing disappearance of the potter's wheel, probably the only record of a race which experienced its benefits only to abandon them. Wheel or no wheel, each vase is a ceramic masterpiece, and the axiom that hand-made pottery is more expensive to own is borne out by the frequent discovery of bottles broken and repaired with string. Here appear also a few painted vessels, perhaps for ritual use, surviving from Hissar I.

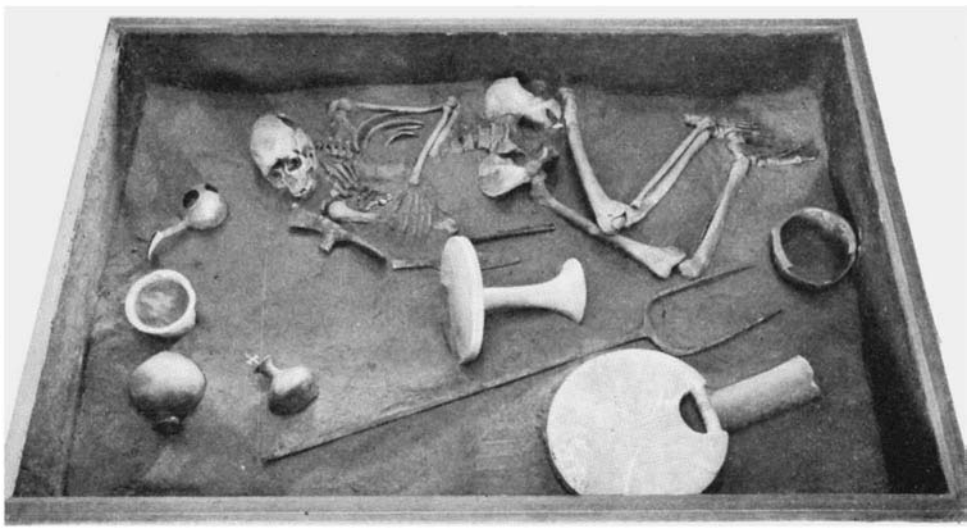
MOST of the bronze objects come from an extensive cemetery on the main mound of Tepe Hissar. A tomb set up in the University Museum shows the typical gear of a warrior: a "bident," or two-pronged copper spear wrought in one piece with its handle, a spear and helmet, his farm tools, mattock and chisel, a wand, a string of beads, and prized possessions to furnish his house in the other world; a spouted bowl of silver, two bottles of grey pottery and a jar, a small table, top and pedestal in one piece, and a portable table, the top cut out to make a hand-grip, the pedestal separate, all of alabaster. In another grave were arrow-heads of chalcedony. In some graves bidents, copper bowls, and other objects had been "killed" by twisting and breaking to make sure they would really go with the deceased.

The grave of a little girl had six silver cups and pitchers, crushed by the weight of earth above them. Lead was a precious metal; cups were made of it. And finally a little gold appears. Seals tend to be of copper or alabaster, but a number of cylinder seals in Hissar III are probably importations from Mesopotamia. Human figurines in silver, copper, and alabaster are found.

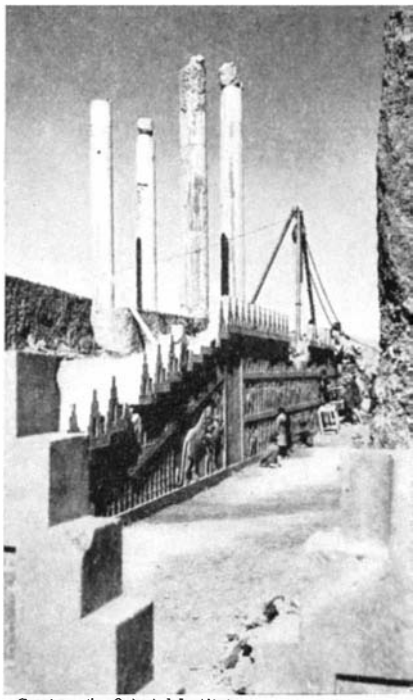
Dr. Schmidt has divided Hissar III into three sub-levels, *A*, *B* and *C*. Of these, *B* ended in fire and the sword. One room contained the skeletons of a dozen people who had tried to escape by way of a stairway to the roof, but had been beaten back and perished in the flames. Communal burials imply further details of this somber story. Yet enough survivors returned to rebuild and continue Tepe Hissar's cultural development.

At this point the philologists deserve a brief hearing. They now generally agree that the first "center of diffusion" of the Indo-European languages, which include the Iranian and Indic groups, was off to the northeast of the Caspian Sea; that about 3500—3000 B.C. their advance guard swung around the east and south coasts of the Caspian to settle in what later was known as Iran.

It would be interesting to connect these migrants—highlight of linguistic studies—with one of the epochs of Tepe Hissar. The Painted Pottery Peoples, who had been known in these regions since a far earlier time, could not qualify; but the Grey-Ware Peoples of His-



A tomb found in the third layer of superposed cities in the "layer cake" at Tepe Hissar



Courtesy the Oriental Institute

Wing of staircase recently discovered by the Oriental Institute in the palace of Darius at Persepolis

sar II might, and attempts to confirm this identification will be made (over countless dead bodies) in the years to come.

THE systematic exploration of key mounds along the supposed highway of migration, to catch this race in motion if possible, has begun at two sites. Tureng Tepe, near Asterabad north of Tepe Hissar, was dug by Frederick R. Wulsin for the University Museum in 1931; he found a grey-ware culture perfectly comparable to Hissar II and III. Dr. Schmidt's excavations at Ragha or Rayy—more famous as Rhages, source of some of the world's loveliest pottery—are now in course and no report is available, but it is understood that, in addition to the primitive village of the Painted Pottery Peoples mentioned above, he has discovered a well-defined stratum of the Grey-Ware Peoples, superior in culture to Hissar II, as we might expect, and inferior to Hissar III.

If further exploration brings final proof identifying a migrating Indo-European tribe with a given copper-age culture, the combined resources of linguistic science and archeology will be pooled to work on this typical Aryan[1] problem.

After Hissar III*C*, which closes soon after 2000 B.C., the mound was deserted. At this time Iranian culture seems to have lost its distinguishing features, and to have entered a long period of dependence on Elam.

Elam was not part of the Iranian plateau, but was the wide mountain range between it and Babylonia. The Elamites spoke a non-Iranian—not even Indo-European—language and belonged to a different racial stock entirely. But they knew writing at a remote period; by 2400 B.C. they figure prominently in history, and have often (for example, in George G. Cameron's misleadingly titled new "History of Early Iran") been made to pose as spokesmen for the Iranians.

One of their chief cities, Shushan, exhaustively dug by a French mission, is the greatest scientific site in the world; in some opinions Susa I goes back to 5000 B.C.—almost as old as Tepe Gawra's still untouched level 20. Still its records are by no means consecutive and during the second millenium B.C. we are permitted only occasional glimpses at a tug of war with Babylonia. Elam never quite became an empire, and when Agamemnon's Achaeans were parading before dusty Troy, Susa seemed also on the road to oblivion.

YET in the time of the last Assyrian empire there was a last rival monarchy in Susa, extinguished with the city's destruction about 640 B.C. To these centuries belong the highly decorative bronze bits, chariot pole and hub ornaments, adzes and axes, daggers, pins, and bracelets which, dug from the tombs of Luristan by native tomb robbers, came on the market in thousands a few years ago and received wide attention, several American museums securing representative collections.

The sporadic discoveries there of bronze objects engraved with the names of early kings of Babylonia—like the bowl of Shargali-sharri who ruled at Agade about 2600 B.C., now in the University Museum—do not prove that the Luristan bronzes run back to that date, as some have thought. They may rather be taken to show that Elam was not always unsuccessful in her wars with Babylonia, or that in 700 B.C. Babylonia maintained a lively trade in her own antiques among visiting hillmen.

Erich Schmidt's official report on Tepe Hissar will appear this month (May), and for next winter are scheduled his account of archeological exploration by airplane in Iran and the sumptuous "Survey of Persian Art" edited by Arthur Upham Pope. In 1938 will appear Neilson C. Debevoise's "Political History of Parthia" and Schmidt's preliminary report on Rayy: five works of first importance.

It is a great moment in the archeology of the Iranians, and it's about time. After all, they occupy the most fascinating zone left for the new generation to explore. They have sponsored a series of artistic peaks which have never been dull and often Olympian. They hold the key to the problem of Indo-Iranian migrations, the solution of which will advance the study of Indo-European origins by a generation. And in the absence of written testimony, which makes them prehistoric right down to the Neo-Babylonian period, they become a field laboratory without peer. The history of early Iran will be written with the spade alone, a monument to archeological method or its lasting disgrace.

The start of excavation of a mound at Rayy, which is in progress. A Parthian temple, a Painted Pottery village, and a Grey-Ware level have been found

[1]The name "Aryan," was not coined for Hitler's personal use nor has it any more to do with blond Nordics than has the swastika. When the historical Iranians or Erani needed a distinct name they spoke of themselves as the *Aryanam Khshathram* "Empire of the Aryans." In the 3rd Century B.C. the Alexandrian geographer Eratosthenes comprised under Ariana those parts of the old empire which had then regained independence. But this is a far cry from 3000 B.C. If Hitler is aiming at an Aryan ideal he would derive profit but little comfort from a trip in Iran.

GLUED ARCHES

For Building Construction Stand Rigorous Tests

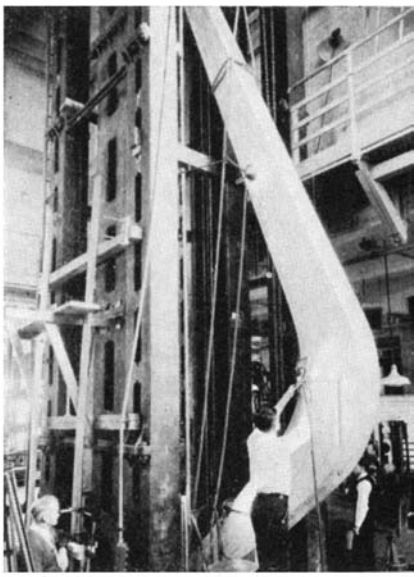
By MARY BRANDEL HOPKINS

AS a test of glued-arch building construction, of which economy of cost and space are the outstanding merits, the United States Forest Products Laboratory at Madison, Wisconsin, has during the past year subjected one of the arches in a large service and storage building to a constant weight of 31,500 pounds from 315 sandbags on its roof. This weight, 50 percent in excess of that which would have to be borne by the arch were the roof blanketed with a drift of snow weighing 30 pounds per square foot, has deflected the roof peak, in all those months, the remarkably slight amount of only one and one tenth inch. The outward spreading at each shoulder of the arch is only about one-quarter of an inch.

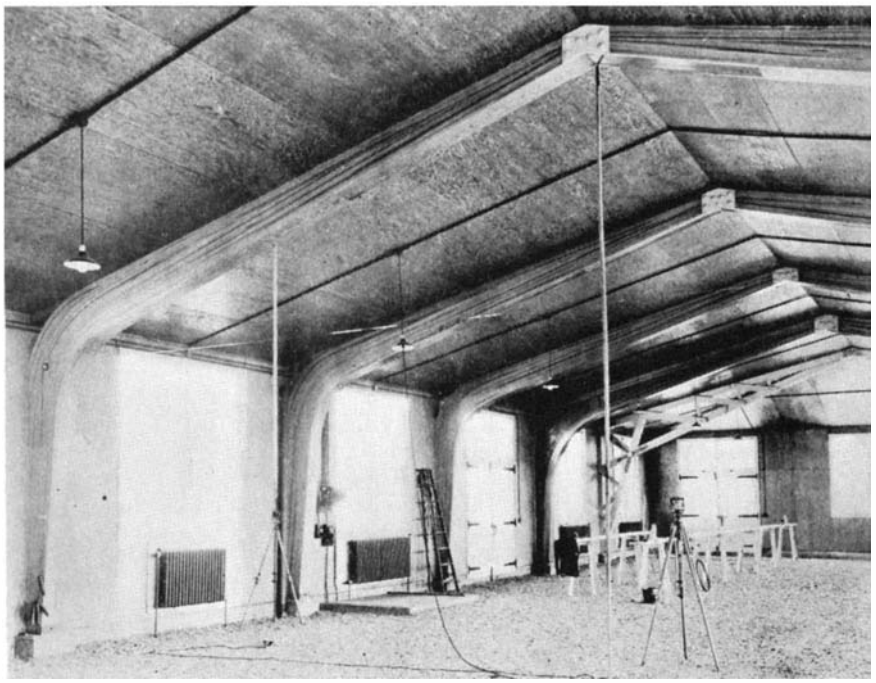
While tests made in the laboratory's million-pound testing machine before the arches were built into the structure left no question as to their ability to carry the load that would come normally, the sandbag experiment is being conducted to measure the deflection from an extra load.

The arch supporting the burden is one of five used in the 160- by 46-foot building, which is 12 feet high at the walls and 19 feet high in the center. The arch was formed by assembling a group of thin boards with water-resistant casein glue and bending them against a form of required curvature, where the assembly remained clamped until the glue had set. Similar groups of laminations of 9/16 inch material were added to increase the width to 11½ inches and the thickness to 12 inches at the base, 24 inches at the knee, and 8 inches at the apex.

The advantages of construction with the laminated glued arch are many. Seasoning of small pieces of material such as are utilized in the construction avoids the checking and warping involved in drying larger pieces. Larger and longer members than are generally available as single pieces are made possible. Members of any desired curvature may be provided. Material produced from small trees can be utilized. Laminations can be so arranged as to minimize the results of defects. Striking economy of material results from tapering members so that their cross sections at various points in the length are no greater than required by the imposed loads. More artistic appearance is possible than with some types of construction. Lower, and consequently in some instances thinner, side walls, together with reduction of waste overhead space and resultant saving in heating and air conditioning are other advantages.



A glued laminated wooden arch in the million-pound testing machine



Interior of building, showing instruments for checking deflections of the glued wooden arch under load. *Above:* The sandbags piled on the roof during the test

Twenty-eight buildings in Wisconsin, Michigan, Minnesota, and North Dakota employing glued-arch construction already have been erected or are in process of construction. They include the gymnasium with its wooden arches of 60-foot span in the new 350,000-dollar high school in Racine, Wisconsin; the gymnasium with arches of 58-foot span in the high school at Fish Creek, Wisconsin; the high-school gymnasium at Peshtigo, Wisconsin, with 63-foot span; and the high-school gymnasium at Ashley, North Dakota, with 68-foot span.

Animal Technicians

By S. F. AARON
Drawings by the author

THE statement that expert artisans existed long before the advent of mankind has often been truthfully repeated. It is also very probable that human discoverers and inventors have been very largely imitators, having as examples principally the work of birds and insects.

Thus we have been given lessons in masonry, pottery, pulp compounds and paper making, combinations of clays and vegetables, spinning of threads, bridge construction and framing, tunneling, underground dwellings, carpentry; and, with limitations, weatherproofing, weaving, kite-flying and airplaning, stitching or sewing, diving and underwater work, even dredging. And, above all, cementing or gluing.

But this last—the uses of adhesive material—seems to have largely escaped the observations of students and, while its proficiency results from inherited development and the materials are of the various artisans' own secretions, they have an advantage over those which man must compound for his uses.

The only reference that can be made to this use of cements and glues involves the secretions of saliva peculiar to the birds and insects that employ it with such remarkable results, and without which many species could not have existed.

It seems odd that, when having numerous examples of construction before him, of birds, beasts, and bugs, very primitive man did not generally adopt the evident methods that could have been most needful and which was later done.

GLUE-LIKE, stoutly adhesive, hardening, waterproof, and plentiful as an admixture for building material, the saliva as secreted by many insects and a few birds is without its equal in the inventions of mankind, or in anything that can be employed by the four-legged relatives of mice and men. The use of saliva as a glue has reached its highest development by the edible nest-making swallow of the Orient, by the silkworm, and by the web-building spiders. As far as the chemists have ascertained—and specific analyses have been made—there is very little difference between the various salivas used by a few birds and many insects as an adhesive material. It is probable that the robin and other thrushes employ a very limited amount to aid the mud and clay to adhere to the twigs and grasses of their

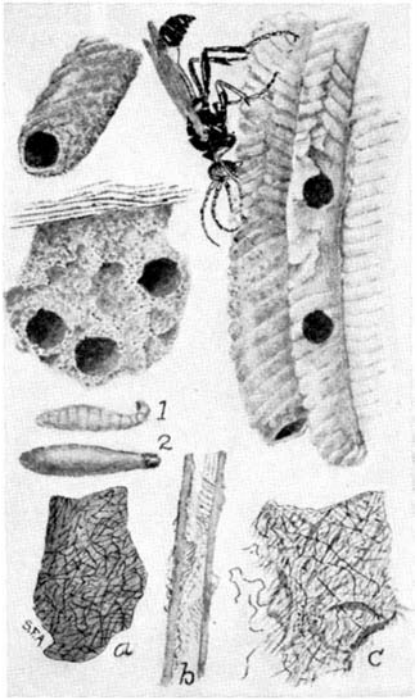


Figure 1: **Three types of the mason wasp nests and the mason at work. *1:* Larva, maker of the silken cocoon. *2:* The cocoon, about half size. *a:* Sericin lining of cocoon. *b:* Human hair in comparison. *c.* Outer silk cover of the cocoon, magnified about 13 diameters**

nests, and that it differs not at all from that which the longicorn beetle larva mixes with its gnawings of wood to form the powder post plugs to its burrows. The caddis-fly puts twigs together under water with a material of the same nature and composition as is used by the chimney swift to make its twigs stick to each other and to the inner sooty wall of chimneys.

The paper nest hornets and wasps mix with their wood fiber pulp a material that is the exact counterpart of that employed by the mud mason wasps and their larvae to form their cocoons within the mud cells. So also do the bag-worms fabricate their conical, movable, twig-encrusted domiciles, the caterpillars of many moths make their silken cocoons, and the tiny parasitic ichneumon maggots surround their delicate bodies with an envelope having the precise shape and character of the silkworm cocoon from which commercial silk is spun. And the basic material does not differ from the delicate web strands of the ever-busy spiders and the evenly distributed saliva that permits the barn and eaves swallows to fasten their bulky nests to vertical surfaces.

But there is a variation in the manner in which this saliva is applied. Silkworms condition it into threads so delicate that many are required to make a strand as heavy as a human hair. It is emitted through spinneret tubes in figure eight form by motion of the caterpillar's head and from the outside of the cocoon wall inward. But first there is spun an indiscriminate mass that has been termed floss. When the wall of the cocoon is finished, the saliva is spread in a varnish-like sheet over this inner surface. The term sericin is applied to this gummy material, also to the excess saliva that sticks the spun threads together.

THE larval cases of the mud mason wasps (Figure 1) are made up outwardly of a very fine silk and are lined with a coating of sericin through which fine fibers are spun, much as hair or jute is mixed with plaster to give it strength. The cocoons of certain tropical moths allied to the silkworm consist of a continuous, thick, solid wall becoming exceedingly hard in order to withstand enemies.

The edible nest of the Asiatic swallow is of the character of sericin and the Chinese think it no more out of the way to eat it than we do to partake of predigested honey.

The spiders reach the perfection of a varied development in producing their webs of a material, from abdominal spinnerets, that has the elements of salivaceous exudations. But while all others are of a sticky nature only when applied, and dry hard and smooth, some of the web strands of spiders are also of a viscid character for the purpose of holding victims that come into contact with them.

This sticky web is employed by the orb weavers; the snares of other species depend on the tangle of cross strands to hold those insects that chance to leap or fall into them.

The amount of sericin expended in nest building varies with the needs of the various species. The quantity seems not in the least to be influenced by temperature, but is governed by the enemies that threaten, or the necessity for extreme adhesion. Thus the cocoon builders guard against birds, mice, lizards, ants, and insect parasites, the mason wasps against such inquilins as the an-

threnids (which include generally those small beetles, the larvæ of which feed upon dead insect matter and occasionally on their living relatives) and various fly larvæ that devour helpless grubs and pupæ, also getting their living from dead insects and such matter as wood, feathers, and skins. The amount of saliva expended by the chimney swift is far greater than that necessary for the swallows and other birds that use mud, and the potter wasps (Figure 2) have reason to reinforce more strongly the thin walls of their delicate jug-like larval homes than do the mud masons with their much heavier construction that might be supported without cement.

The anatomy of birds other than the swifts does not disclose more than a normal development of the salivary glands, nor have any of these species been seen actually to emit saliva as an aid to nest building; but that it is made use of is beyond doubt, because of the adherence of the earthen material to the face of wooden timbers and rock cliffs, also by tests of strength: If a piece of wet clay from which the robin gathers its mud be tested it breaks easily, but an equal piece from the nest containing no grass or other fiber is much stronger and more adhesive to any surface. The same experiment, with like result, may be made with clay from the cells of mason wasps.

IT is most illuminating to the nature student and fabricator to watch the nest building of those birds that put together structures calling for extreme skill—acquired most largely by heredity, of course, and bolstered also by individual application and ingenuity. The orioles and the vireos are extreme instances and it has been my privilege, by both chance and special effort, to make close observation of several constructions from within a window where my presence was unsuspected.

As weavers the vireos take second place, but with the application of combined materials they attain equal results, making more compact and stronger nests that better outlast severe weather. I cannot discover that the orioles of our eastern states' species (the Baltimore and the orchard orioles), or that near relative of the southwest, Bullock's oriole, ever employ saliva, or anything in the nature of a cement or mucilage. They depend solely on a most admirable although irregular interweaving, and the manner in which this is done is by simply thrusting a loop—rarely an end—of the grass or other fiber used, into and through the mass; going inside the nest and pulling it through. The beginnings I have not witnessed, though I have seen the orchard oriole add fibers of long grass to the attachments on the twigs, first threading the strand into the nest bulk, then with admirable precision passing it twice around the branch.

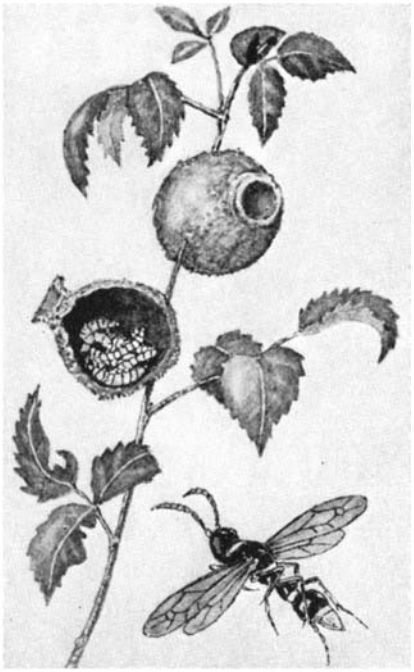


Figure 2: **The jugmaker wasp and her pottery. One jug cut open to show the paralyzed caterpillar food of the baby wasps (1⅛ diameters)**

Once I watched an orchard oriole twist a stalk of grass around a pear tree limb within a dozen feet of my study window, then discard the situation for one lower down that I discovered many days later. But I have watched at intervals a red-eyed vireo build its fine, pensile nest from start to finish not eight feet from a window and, from this and an examination of many nests, there can be no doubt that saliva is used. I did not see the bird actually produce the slightly gummy substance; that must be nearly invisible. But I did see the little mechanic almost mysteriously attach the ends of short strands of grape vine bark to the sides of the already thickening nest wall, and I afterward found the exact spot and many others in that and other nests, with bits of leaves and twigs on the external surface adhering thus. This process is no more peculiar than the employment of saliva to aid the adhesion of particles of earth and mud used by the robin, woodthrush, phoebe, and the barn and eaves swallows.

Figure 3: **The harvest mouse and its nest. No glue used here: only extreme quadrupedal manipulation**

The entire process is of the utmost painstaking, and so diligent was the bird that the nest was completed in the long daylight hours of two days. This included the gathering of materials, in which she was absent sometimes for half an hour. The male took no part in this labor. There was little interweaving, but principally a laying on from without, the external wall steadily growing thicker and higher from a well begun foundation of platform-like construction suspended by two-inch cables of grass, weed bark, and rootlets. The softer lining was placed at the last.

VERY similarly constructed to that of the orchard oriole is the bulkier, globular nest (Figure 3) of the harvest mouse, a little beastie most common in the south and southwest. It is not known how these master builders among the mammalia go about the work of construction, but they make the job a comparatively short one, using long grass and slender weed stalks that are less interwoven than simply overlaid and wound around and about the supporting weed stalks, or the twigs of bushes. There are several entrances, and the interior is further made cozy with such soft materials as milkweed down—this mouse having learned the value of those materials that the birds use.

The geometrical webs of the orb-weaving spiders have been too often and minutely described to require repetition. They equal or surpass in some respects, especially in the methods of approach or beginnings, anything that man has done. Those webs of other species are but multiplied strands to suit the spaces chosen. But all spiders can do better than these webs, by making stout silk bags to hold their eggs and young. These roughly globular containers have well defined openings for the escape of the little ones.

We have something yet to learn from nature's methods. Some of our imitations have been inferior; for example, rayon, the preservation of foods, cements and varnishes as previously explained. If we could devise a material as good as chitine (the exo-skeleton of insects) and make it bug-proof and not too expensive, we should have obtained a valuable commodity for many uses.

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

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

D. H. KILLEFFER
Chemical Engineer

70,000 Clocks Adjusted Free

A DOUBLE file of giant transmission lines carrying 275,000 volts marches across desert and mountains—from the great power plants at Boulder Dam to the City of Los Angeles.

The 266-mile line brings vast reserves of low-cost power to serve the homes and industries of Los Angeles, delivered at a frequency of 60 cycles, replacing the former 50-cycle electricity serving the quarter million meters on the lines of the city-owned Bureau of Power and Light.

One of the results of bringing Boulder Dam power to Los Angeles was the hiring of 75 clock experts

With the delivery of Boulder Dam power to Los Angeles the citizen-owned utility faced the problem of adapting consumers' equipment for satisfactory operation on the higher frequency.

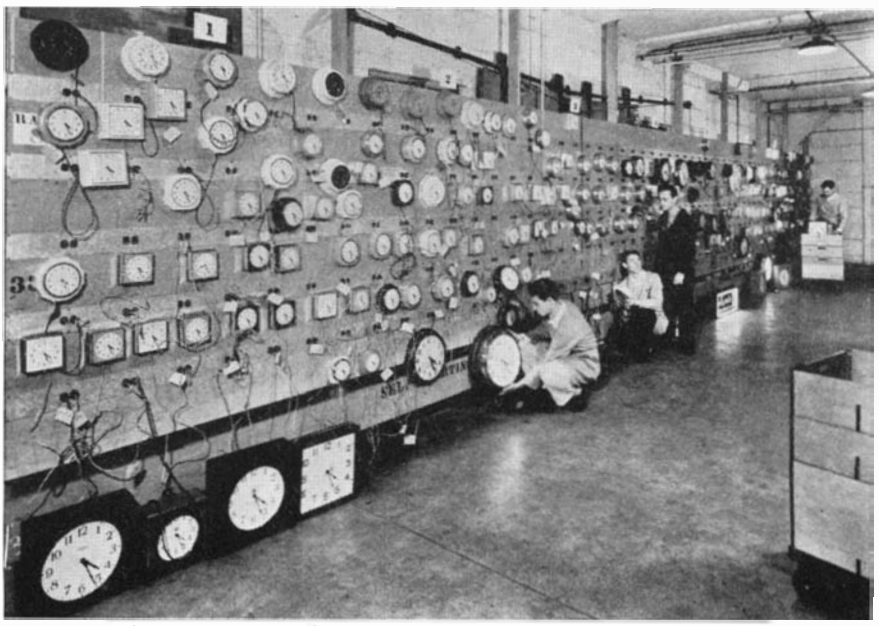
The job is now completed and stands as one of the year's outstanding examples of efficiency. Without cost for adjustment and without major inconvenience to consumers, the change in frequency has been completed. Thousands of different items of household and industrial electrical equipment, ranging from barber poles and hair clippers to 750-horsepower motors in industrial plants, have been adapted for operation on Boulder Dam's 60-cycle power.

Chief among the many complex problems now smoothly solved, and most interesting from the standpoint of the man on the street, was the job of caring for more than 100,000 synchronous electric clocks. Los Angeles' clocks kept time on 50-cycle electricity, but with the change to 60 cycles each 50-cycle clock would speed up, gaining 12 minutes in each hour.

After careful study of the situation, the city's Bureau of Power and Light announced that it would be its policy that no one should be allowed to suffer because of the change. The Bureau, therefore, began a survey of its 285,000 meters to check up on the number of appliances on its lines that would be affected. The company found that its consumers owned nearly 125,000 electric clocks that based their time-telling on a frequency of 50 cycles.

The Bureau of Power and Light proceeded to make preparations for the job of readjusting the 125,000 electric clocks. The problem was made especially complex by the fact that the utility discovered more than 250 makes of electric clocks with almost as many methods of construction and gearing. It was also learned that the manufacturers of almost 200 brands were no longer making clock parts and had abandoned the business entirely. For many of the obsolete models it was impossible to find substitute parts. The Bureau contracted with a leading firm of clock experts, the E. W. Reynolds Company, for the making of clock adjustments. So immense was the task that it was necessary to equip a special three-story building containing over 80,000 square feet of space for the extensive job of collecting, inspecting, and repairing all clocks.

The Los Angeles territory was divided into twelve districts, each with nine to nineteen district depots. Owners of synchronous electric appliances were notified and requested to bring their clocks and motors to the neighborhood depot. There the clocks were carefully checked as to condition and then sent to the central depot. From there the readjusted clocks, cleaned by compressed air, given a special oiling, tested



The testing room where 70,000 clocks were checked for accuracy

and guaranteed to run satisfactorily for 60 days, would be returned to the householder within five days. It was soon found that the task of resynchronizing the clocks was in a great many cases so difficult that the only solution was the substitution of an entirely new rotor. The Bureau, therefore, contracted with the pioneer Warren Telechron Company for approximately 50,000 clock rotors designed to operate on 60-cycle current. These units in most cases were connected with the works in the consumer's clock with a minimum of effort.

One of the results of the operation has been the hiring of 75 special clock repair experts and many other men to handle stock room detail.

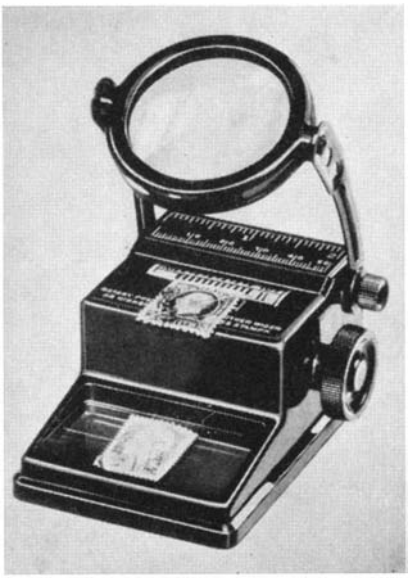
STRONG

GLASS fibers have been made having a strength of approximately 2,000,000 pounds per square inch, although the typical strength of glass in rods is only about 20,000 pounds per square inch.

For Stamp Collectors

WHILE stamp collecting is a most interesting and instructive hobby, its devotees have a complicated job of measuring exact sizes of stamps, counting perforations, and detecting watermarks. This can be a very tedious job.

An accompanying illustration shows a new device designed to make this hobby an ideal relaxation. It is provided with an adjustable magnifier, a scale, and, perhaps most important, a perforation counter. This latter feature consists of a hand-operated drum, on which are marked bars to match the perforations of stamps being examined. This drum is rotated until a set of bars exactly matching the perforations falls beneath the edge of the stamp. The number of perforations are read at one end. The watermark tray in front of the device keeps its rich jet color permanently, an important requisite in identifying faded watermarks. The complete unit is produced in black Bakelite molded.



Relaxation for stamp collectors

Saving Our Wilderness from Ourselves

"THE fight to save the wilderness has grown during the past ten years from the personal hobby of a few fanatics to an important, nation-wide movement. All over the country," according to Robert Marshall Dobbins and Althea Dobbins in *The Living Wilderness*, organ of the Wilderness Society with headquarters in Washington, D. C., "people are beginning to protest in a concerted manner against the invasion of roadless tracts by routes of modern transportation. Encouragingly enough, a number of these protests have been heeded, and several splendid roadless areas have thus been saved. Others have been preserved by federal and state officials before any protest had to be launched. Yet others, unfortunately, have been invaded either because nobody happened to realize that invasion was imminent, or because no one was aware that there was a significant area to be saved.

"The accompanying map indicates those forest areas in the United States of 300,000 acres or more and those desert areas of 500,000 acres or more which are not yet accessible to mechanized transportation."

The following is the platform of the Wilderness Society:

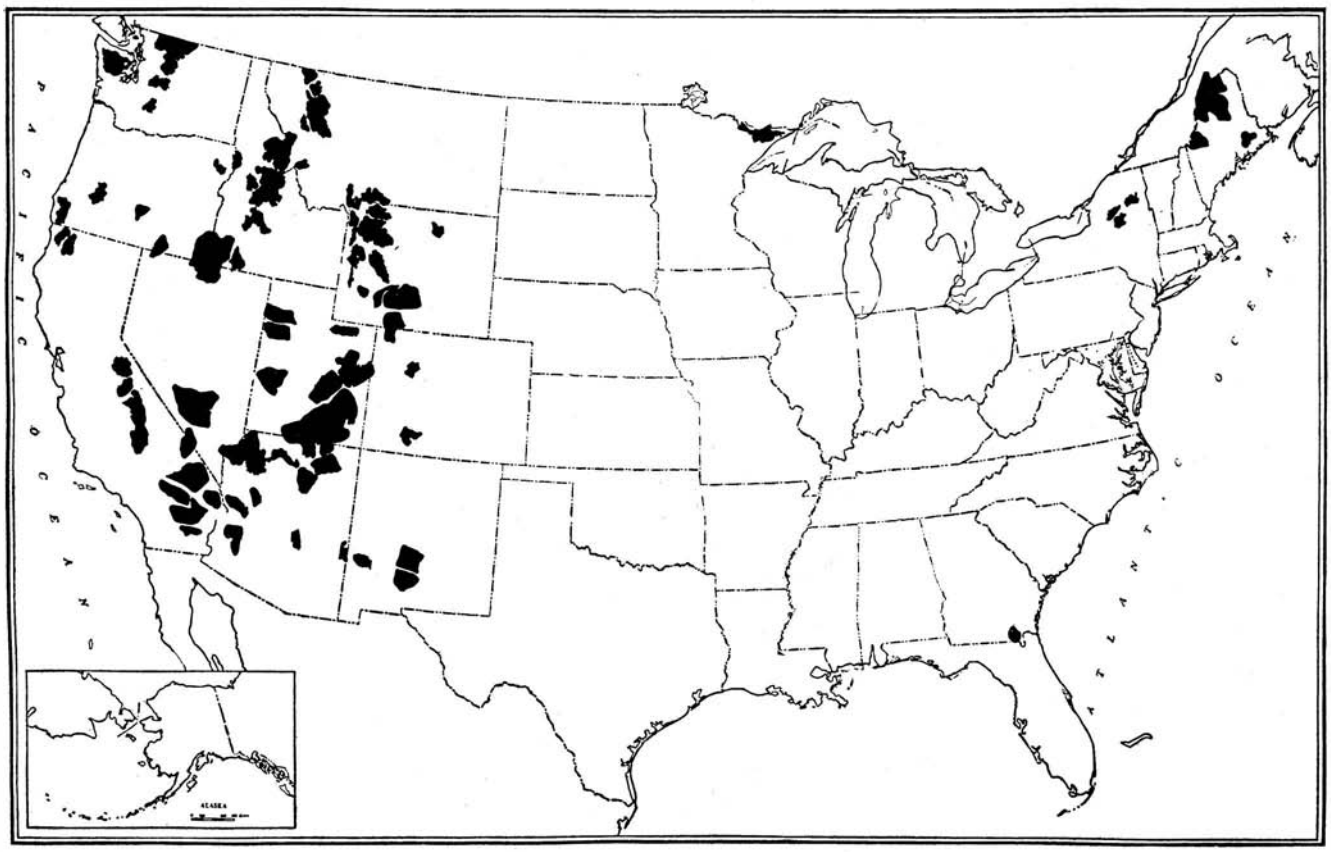
That the wilderness (the environment of solitude) is a natural mental resource having the same basic relation to man's ultimate thought and culture as coal, timber, and other physical resources have to his material needs.

That the use of this resource should be considered a public utility and therefore its commercialization should not be tolerated.

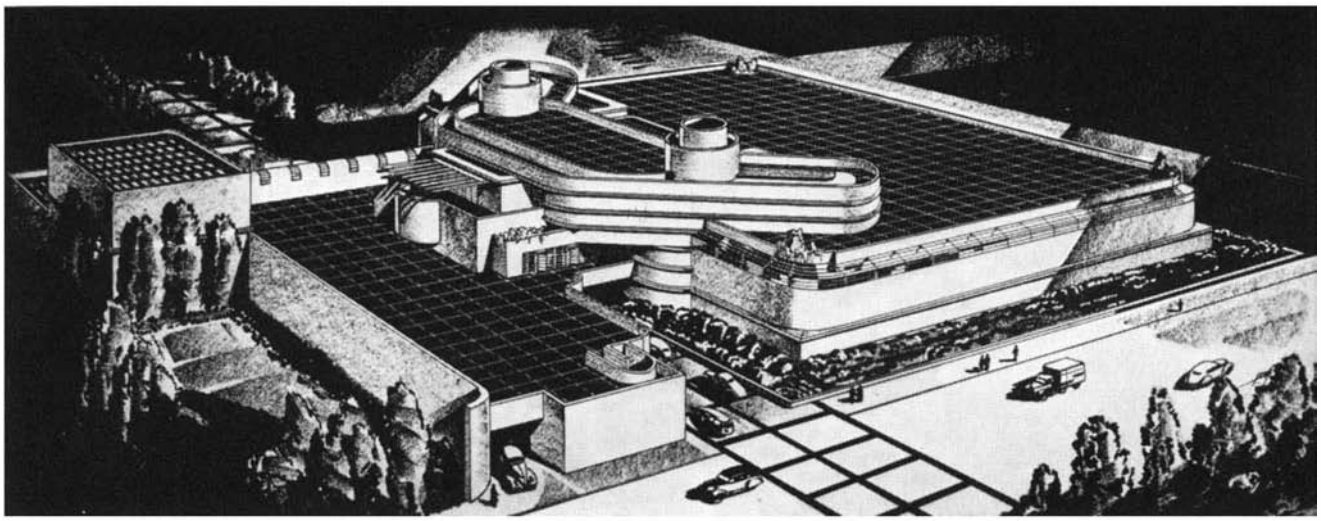
That the time has come, with the brutal-

DOCTORED

AMONG the flavoring agents added to cigarettes are cocoa, chocolate, licorice, ginger, cinnamon, tonka, vanilla, coumarin, molasses, rum, brandy, maple syrup, angelica, oil of anise, oil of juniper, oil of cloves, honey, sugar, and organic esters.



Forest and desert areas in the United States which are inaccessible to mechanized transportation



Exterior of an unusual office building, designed for utilitarian purposes. Note the "nostrils"

izing pressure of a spreading metropolitan civilization, to recognize wilderness environment as a human need rather than a luxury and plaything.

That this need is being sacrificed to the mechanical invasion in its various killing forms.

That scenery and solitude are intrinsically separate things, that the motorist is entitled to his full share of scenery, but that motorway and solitude together constitute a contradiction.

That outing areas in which people may enjoy the non-primitive forest are highly desirable for many pent-up city people who have no desire for solitude, but that such areas should not be confused in mental conception or administration with those reserved for the wilderness.

That, since primeval succession can never return once continuity has been severed, it is manifestly the duty of this generation to preserve under scientific care, for the observation, study, and appreciation of generations to come, as many, as large, and as varied examples of the remaining primitive as possible.

That the wilderness remaining in America has shrunk to such a small remnant of the country's total territory, that what area does remain is all-precious and its preservation a vital need.

That encroachment upon our remnant American wilderness in any one locality is an attack upon the whole and creates an issue of national moment and not for local action alone.

That since the invasion of wilderness areas is generally boosted by powerful, country-wide organizations, it is essential that individuals and groups who desire to preserve the wilderness must unite in a country-wide defense.

The editors of this magazine, agreeing with the aims of the Wilderness Society, have joined it, and urge others to do the same. "Except in communities living by the axe," the Society organ states, "newspapers are all with us."

Gas Wells for the Florist

LOOKING for one thing only to be disappointed by finding another is the lot of man. Seldom is the thing found of more value than that sought, although there are exceptions. The history of the oil industry is full of incidents where wells were drilled in search of "black gold" only to find water. This process was reversed the other day when a St. Louis war veteran dug a water well with a post-hole digger on the bank of the Mississippi River and brought in a gas well. Driving down a pipe and capping it with an old inner tube and using the valve as an outlet, he is now cooking with this fuel and using it to heat his home.

A trip through the gas and oil fields will reveal many other houses with small gas wells on the premises. Instead of utilizing the gas, the owner allows it to burn as a torch which gives forth a weird light by night and visible smoke clouds by day. Not so C. B. Mershon of Pittsburgh, Pennsylvania, assistant manager of the Industrial Department, Manufacturers Light & Heat Company.

In Mr. Mershon's backyard is a small gas well and there is considerable pressure back of the gas so that it flows readily. Not only does the Mershon family cook, heat water, and heat their home with this fuel; they do other things with it. The most unusual of these is to mature a vegetable and flower garden long prior to the regular planting season. To accomplish this, a copper pipe is looped back and forth just below the surface of the ground where the seeds are to be planted. This is attached to an ordinary gas-fired water heater. The water is heated to the proper temperature and then circulated through the underground coil. The proper temperature is maintained continuously and automatically by a thermostat. Seeds are planted and quickly sprout under this heat treatment. Of course, they are kept under glass so that the young plants will not be nipped during the cold nights. —*J. B. Nealey.*

Mr. Mershon's backyard gas well

COPPER

THE American nickel contains three times as much copper as nickel. Nearly 3,000,000 pounds of copper are used annually in minting U. S. coins, including gold and silver pieces. The familiar penny, or "copper," is really made of bronze, containing 95 percent copper and 5 percent tin and zinc.

Unique Office Structure

SOME recent buildings have been designed to achieve bizarre effects, while certain others have turned into oddities largely because of the demands of modern improvements incorporated in the structures. A building of the latter sort, designed by Frank Lloyd Wright, famous for his architectural creations, which will be ready for occupancy this summer, will house the main office of S. C. Johnson & Son, Inc., makers of Johnson's wax polishes.

The plan centers around one large workroom, measuring 210 by 130 feet, to house several hundred employees. Girdling this room, which has a ceiling 20 feet high, is a mezzanine gallery close to the first floor on which are located the offices of department heads and junior executives. Above this hall is a kind of pent-house on the roof, in the shape of three ellipsoidal links, containing the offices of the chief executives.

No windows of the accepted form will pierce the walls of this building, but a band of tubular glass encircles the building six feet above the floor, while a second band follows the rim of the ceiling. There will be no exterior openings in the building except the chambered entrance doors.

Perhaps the oddest features of the building are the two "nostrils" projecting above the pent-house offices. These are circular breathing stacks reaching from the basement to a point well above the roof and con-

stituting a part of the air-conditioning system, which will be of the "true" type—that is, it will be in operation both in summer and in winter.

Of the many other unique features, we might mention that the building is fireproof, 'quake-proof, and sound-proof.

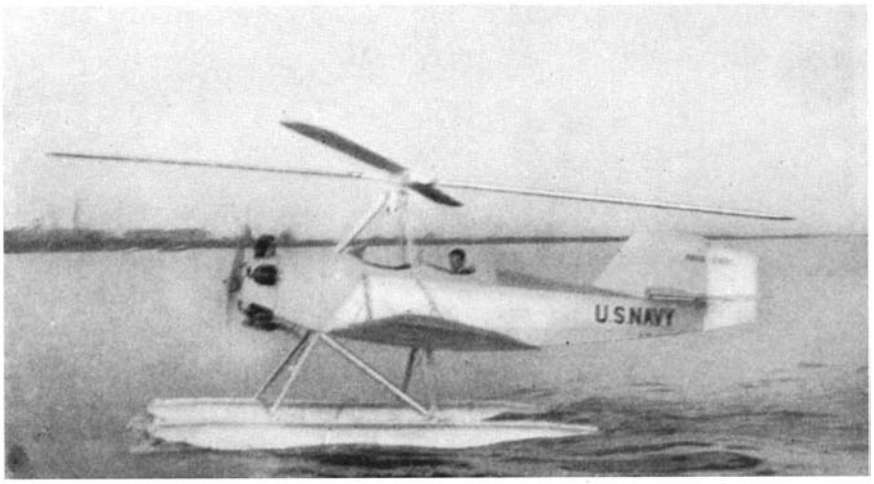
A Versatile Training Plane

A WORLD'S record for speed between New York City and Miami has been set by Major Alexander P. de Seversky, who is now planning another record flight between Miami and Havana. The Major flies machines of his own construction; besides the well known Seversky Amphibian, he has a very fine advanced training plane to his credit. It is the policy of our Army Air Corps, just as it is the policy of air services in other countries, to order airplanes which are capable of rendering a number of tactical or training services. Thus a multi-place fighter may serve as a light bomber, a two-seater fighter as a photographic reconnaissance type, and so on. The advantages of such versatility in time of war are obvious.

The SEV-X-BT is a fine example of such versatility. With its 550-horsepower Wasp engine "choked" to 450 horsepower, with landing gear fixed in position and with a large set of wing panels, it has the low landing speed and relatively moderate performance of a primary trainer. With smaller wing panels but wheels still fixed, it becomes a useful "basic" trainer. With wheels retracted and smaller wing panels it becomes an "advanced" trainer for combat and tactical work, with the full power of the engine in use. There is great advantage in training Army officers through elementary and advanced stages on a machine having the same general characteristics but with graduation in speed. The fourth classification of the Seversky is as a staff plane for cross-country work. A commodious baggage compartment is included, together with other equipment for long cross-country flights.

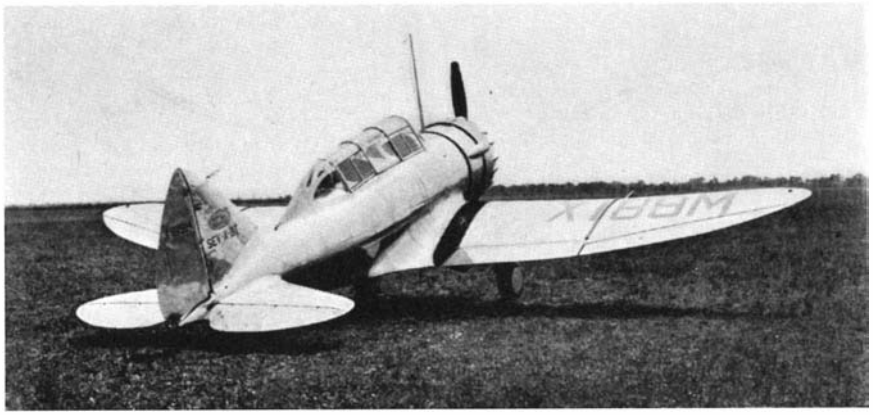
Airplane design is one of the most fascinating of the engineering arts. In military design, the engineer has, however, a large number of things to look after. Thus, in designing the SEV-X-BT, Chief Engineer Kartveli had to provide all-metal construction, multi-box wings, monocoque fuselage, crash protector, and so on, and at the same time take care of an immense number of accessories as specified by various branches of the Matériel Division of the Army Air Corps. For example, the plane has to carry all kinds of instruments including those for blind flying and blind landing. Blind flying hoods for both cockpits have to be supplied.

An ingenious device on the SEV-X-BT makes it possible to use the same fuel tank with a capacity of 70 gallons or a capacity of 150 gallons at the will of the pilot and according to the duty to be performed. For combat practice a machine gun camera forward, and for reconnaissance work a photographic camera aft are available. Since the engineer has to provide all this, and more, give great structural strength yet keep within rigid weight limits, the design work is apt to cause many a headache.



The Gyroplane takes to the water

The photographs indicate some interesting aerodynamic features. Thus there is a double cowling with two openings so that the air flow over the fuselage is smoothed out as much as possible. Since the rudder is close to the cabin, it is made rather high to retain effectiveness. Flaps are used over the center of the wing. Tail surfaces are built smoothly and integrally with the fuselage.—*A. K.*



Above and below at right: **Two views of the Seversky training plane**

Gyroplane on Floats

JUST as Harold F. Pitcairn is *the* exponent of the Autogiro in the United States, so E. Burke Wilford of Philadelphia is the leading worker in the Gyroplane field. The Gyroplane is a rotary airfoil craft, in which the blades rotate freely in the windstream, with propulsion effected by the conventional propeller. But instead of the blades being hinged about a horizontal pin and moving up and down, as in the Autogiro, the blades of the Gyroplane are hinged about an axis substantially parallel to the span, and feather or oscillate about this axis.

Now the Gyroplane, for the first time, has been built on two floats. Our photograph shows the XOZ-1 float Gyroplane, which has been built for the Navy Department, and is undergoing tests at the seaplane base at Essington, Pennsylvania. It will be noticed that the Gyroplane is provided with a fixed wing, which carries an important proportion of the load in cruising. At landing it is the rotor which takes up the

major portion of the burden. The specifications of the XOZ-1 are as follows: Rotor diameter, 32 feet; rotor disk area, 800 square feet; span of the fixed wing, 28 feet; fixed wing area, 100 square feet; engine, Kinner R-5 of 155 horsepower; gross weight, 2000 pounds.—*A. K.*

World's First Extra-Fare Planes

UNITED Air Lines, notable pioneers in American air transport, have now in service the world's first extra-fare planes. The company has recently purchased a fleet of 28 Douglas DC-3 type, twin-engined machines at a total cost of 3,000,000 dollars. Ten of these splendid ships are standard 21-passenger day planes, eight are to be sleepers, and ten "Skylounge Mainliners" have been put into non-stop service between New York and Chicago, with an extra fare of $2.05. The extra fare is no doubt fully justified because instead of seating 21 passengers, the extra-fare ships will provide accommodation for only 14 passengers, which makes a very substantial difference in payload.

One of our photographs shows the very comfortable interior arrangement with swiveling chairs—reminiscent of Pullman practice, but better adapted to the human anatomy. Other cabin features include china, silver, and linen for hot meal service, air-conditioning, steam-heating, sound-proofing, intra-plane telephone, and so on.

The Mainliners have also considerable technical interest. They are the first airplanes to put into air-transport service the twin-row, 14-cylinder Wasps which develop 1150 horsepower. American air transport derives many advantages from military and naval aviation developments. The expense of developing new engines of such high power is enormous, but this is taken care of in experimental contracts for the Army and Navy air services, and eventually the more peaceful branches of aviation profit thereby.

It may be asked why constructors and operators always grasp at higher engine power when high speeds are already available? The answer is not only in the insatiable desire for higher speed on the part of the public, but also in the fact that higher engine power adds to safety. With only one engine in commission, the Mainliners can climb to 9500 feet and sustain flight comfortably at this altitude. This means that the transports are immune to the effects of failure of one of the two engines except in certain sections of the Rockies.

The new machines are equipped for multiple radio navigation and have constant-speed propellers, de-icers on wings and propellers, and all other accessories available today. The following is an extract from the latest specifications: high speed, 212 miles per hour; cruising speed, 190 miles per hour; cruising range, 1500 miles without refueling; wing span, 95 feet; length, 64½ feet; gross weight, 12 tons; cabin 27¾ feet long, 6½ feet high, 7¾ feet wide.—*A. K.*

Synthetic Rubber Balloons

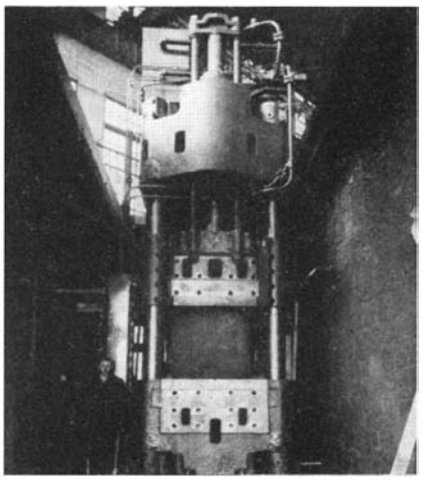
IT would appear that Nazi Germany is not the only country seeking self-sufficiency for war purposes. Our own Army Air Corps is not forgetful of the necessity of *Ersatz* materials to replace those which might conceivably be cut off from the United States in a time of universal upheaval. Rubber is an imported material, and so we read without surprise that the Army Observation Balloon, Type C-3, which is undergoing service tests at Fort Sill, Oklahoma, is constructed of synthetic rubber for the first time in lighter-than-air history.

In making conventional balloon fabric, two plies of fabric—generally cotton—laid at oblique angles are "doubled" or made homogeneous by the interposition of rubber. This method was not changed in the building of the new balloon except that the synthetic product was substituted for natural rubber. Extensive laboratory and exposure-rack tests were made with the new covering. After eight months of testing it was shown that the synthetic compound remained stronger in tension. Also, the gas leakage, which is 15 to 19 liters per square meter of surface in 24 hours for ordinary rubberized cloth, was only one to three liters with the synthetic material. Considering the price of helium, gas leakage is often an expensive item. Furthermore, a definite increase in life is expected of the synthetic balloon. It would not be surprising if the *Ersatz* cover replaced natural rubber in all our balloons, war or no war.—*A. K.*

Left: **The Douglas Mainliner in service on United Air Lines.** ***Below:*** **Interior of the plane.** ***At left below:*** **A telephone line permits communication between the stewardess' kitchen and the pilots' compartment 30 feet away**

Giant Press for Aircraft Construction

WHEN Glenn Curtiss, the famous aviation pioneer, built his first airplanes he used a hacksaw and hammer as his main equipment—or so the legend runs. For many years airplane construction was mainly a matter of skilled craftsmanship. Today, all-metal construction and larger dimensions of the aircraft have brought into play almost every device of the manufacturing or production arts. For example, the Lockheed Aircraft Corporation has recently put into service one of the largest hydraulic presses ever built. The press, which will be used for forming parts of metal fuselages and wings in strong aluminum alloy, was built by the Farrel-Birmingham Company, and required five railroad cars for its transportation to California. The press stands near-



". . . a pressure of 2000 tons . . ."

ly 26 feet high and weighs 175 tons. With its one 38-inch ram and two 20-inch rams it can exercise a pressure of 2000 tons on the parts to be formed, while the hydraulic pressure in the rams is 2300 pounds per square inch. From the photograph it can be seen what a large clear space is available for operations. The stroke is 36 inches, the closing speed is 130 inches per minute, and the pressing speed is from one to ten inches per minute. The control is remarkably simple. There are hydraulically controlled operating valves, a push button for starting or stopping the motor, and two gages to indicate the pressure on the rams.—*A. K.*

Aeronautical Research

THE Annual Report of the National Advisory Committee for Aeronautics summarizes splendid achievements in aeronautical research and looks forward to even greater activity in the future. Langley Field, the Committee's experimental station, is at present undoubtedly the best equipped aircraft research center in the world. But moving pictures recently exhibited by the Institute of Aeronautical Sciences indicate that Great Britain, France, Italy, and Germany are following our lead energetically and in some respects are even ahead of us. We should not rest too complacently on our laurels!—*A. K.*

BRASS

A MODERN 40-foot motor boat, or cruiser, contains over one million brass screws, mostly in the hull.

More Light-Weight Trains

AN order for 52 light-weight, stainless steel passenger cars for the Atchison, Topeka and Santa Fe Railroad was recently announced by the Edward G. Budd Manufacturing Company.

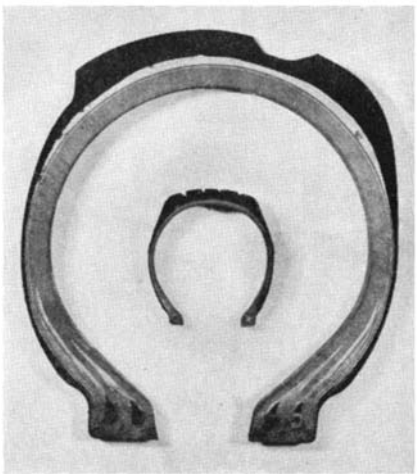
The 52 cars, which will embody the newest designs in railroad passenger equipment, will include 30 passenger coaches, 10 dining cars, six club lounges and six club baggage cars.

This order is in addition to the de luxe nine-car train which the Budd Company now is building for the Santa Fe in its Philadelphia shops. This train will go into service soon as the "Super Chief" of the Santa Fe's Chicago-Los Angeles run, drawn by the powerful Diesel locomotive shown in the photograph on this page.

TRANSPORTATION SECTION

Super Tires

TRUCK tires designed for heavy service in the mining and construction fields where motorized equipment is used to move large quantities of soil and rock, have been announced by The B. F. Goodrich Company.



A six-inch passenger-car tire compared with a giant "earth mover"

The large tires, known as "earth movers," will carry a maximum of 15,740 pounds per casing, or nearly eight tons; are mounted on 13-inch rims; weigh 449 pounds; and are available in 12, 16, and 20 plies. The inner tubes for these tires weigh more than 53 pounds and the flaps 12 pounds.

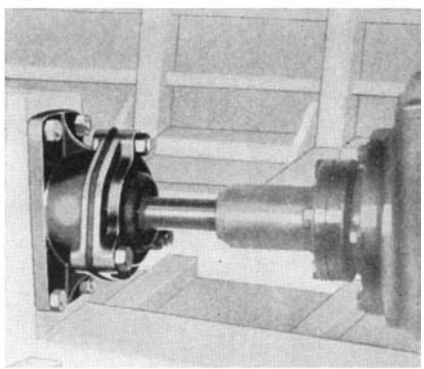
The new tire is now in use on various government projects, including the California All-American Canal, the Mohawk Dam in Ohio, Mississippi flood control, and in several strip-mining enterprises.

Four of the Goodrich tires mounted on one axle will carry 60,000 pounds. The tires may be obtained with two types of tread, one for trailer uses on free moving wheels, and the other incorporating a super-traction tread for use in mud and soft ground.

Marine Stuffing Box

AN entirely new type of rubber lined stuffing box for motor boat transmissions, free from the maintenance or service problems of rigid or semi-rigid types, and giving greater shaft protection, smoother operation, and requiring no service or attention during the life of the installation, has been announced by the Federal-Mogul Corporation. It is shown in our accompanying illustration.

The Equi-Flex cushion stuffing box, the manufacturer states, is completely flexible, full-floating, self-adjusting, and self-lubricating. It reduces friction, minimizes shift wear and breakage, conserves power, muffles noise, cushions whip, absorbs shock, dampens vibration, and is silent and trouble-free, it is claimed.



Smoother operation for motor boats

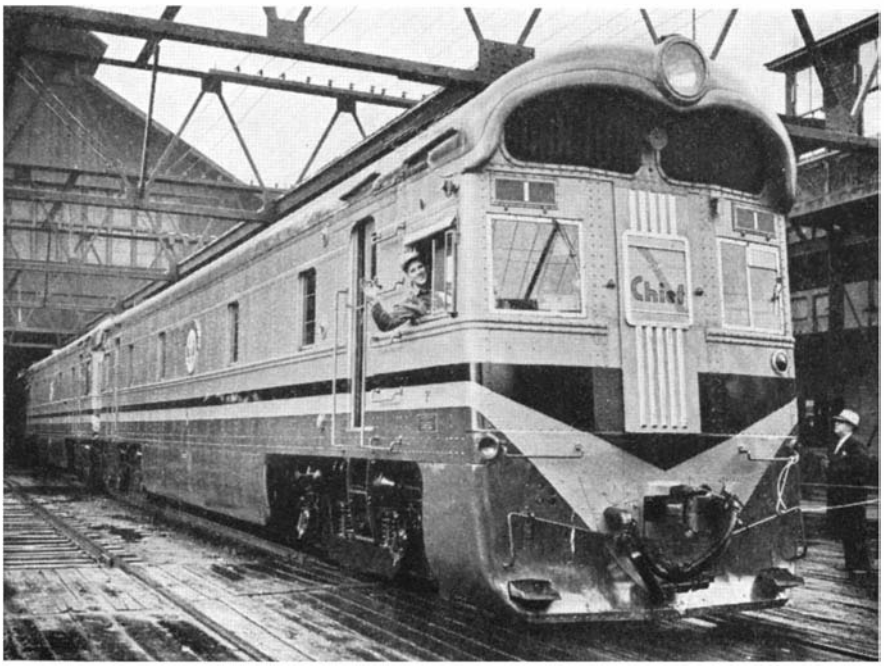
It automatically compensates for all shaft misalignments, accommodates a total of 20 degrees angularity and from 3/16 to 3/8 of an inch eccentricity without binding or excessive wear.

The Federal-Mogul Corporation states that the new stuffing box is particularly suited to closely-coupled, flexibly-mounted marine engines, and is interchangeable with all standard inboard stuffing boxes and shaft logs.

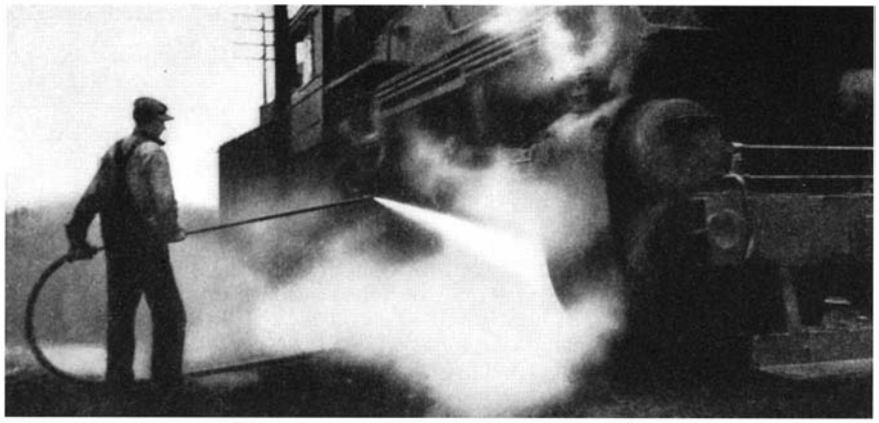
Five Thousand Crossings Safer

SINCE the summer of 1933, a total of 3125 grade crossings have been constructed or are scheduled for immediate construction with federal funds administered by the Bureau of Public Roads. In addition, standard protection signals have been or will be installed at 1872 crossings.

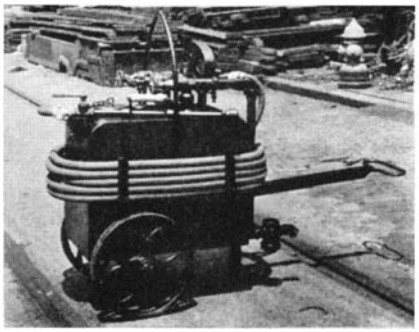
This combined elimination and protection program totals 4997 railroad crossings and



The locomotive for the Santa Fe "Super Chief," newest of the "streamliners"



Above: **Cleaning a locomotive with a high-pressure jet.** *Below:* **The cleaning unit in a portable form**



does not include an additional number from which travel has been removed by relocating highways. Construction costs, in large measure, have been paid with federal funds, but the states and railroads have provided the rights-of-way and paid other incidental costs.

Bureau traffic experts say these improvements afford daily protection from the hazards of crossings to several millions of people.

High Pressure Washing

LOCOMOTIVE cleaning must be thorough to permit proper inspection, to facilitate repairs and prevent deterioration. Also, proper cleaning improves locomotive appearance. But—cleaning must be done efficiently and economically.

A device for this work must primarily be flexible, permitting a wide range of water temperatures and pressures and the use of quantities of solvent. Such variations must be instantly and easily obtained for efficient results on varnished surfaces, rough parts, inaccessible parts, and so on. Next, the device must be simple to operate and maintain—durable and economical to use.

The Sellers Hi-Pressure Cleaning Jet meets the above requirements with a compact, inexpensive unit that can be located anywhere that steam and water can be piped.

The heart of the Sellers Hi-Pressure Cleaning Jet is the mixing chamber where steam, water, and solvent are brought together to form a thorough, uniform mixture.

First, water from a water main or overhead tank is admitted to the mixing chamber. Next steam. In this chamber, the steam is condensed, giving up its heat and adding its velocity to the weight of the water, thus producing and maintaining a pressure in the hose of approximately double that of the initial steam pressure. At the same time, condensation of the steam produces a vacuum in the mixing chamber which draws in the solvent from the supply tank below.

It is the condensation and velocity of the fluid in the mixing chamber which causes a violent turbulent action, thus producing a perfect mixture of hot water and solvent. Furthermore, the mixture is maintained through the hose to the work.

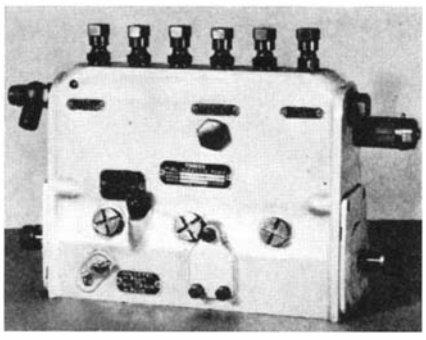
To facilitate economical operation, three convenient gages are provided, indicating at all times the steam pressure, jet pressure, and jet temperature. In addition, an indicating control on the solvent supply permits setting for accurate regulation of the exact amount of solvent for various types of work, and likewise permits instant shutting off of the solvent when desired.

To operate, the workman merely opens the water and steam valves until the desired jet pressure and temperature are reached. Quick visual indication is given by gages in front of the operator. Then the solvent needle valve is opened until the surface being cleaned shows the desired finish. A little experience will permit the operator to establish the correct position of the solvent valve for various classes of work, and he will set it automatically at that point.

Fuel Injection Pump for Diesel Engines

MEETING the demand for a dependable high-speed, solid-injection fuel pump for Diesel engines, The Timken Roller Bearing Company has just announced two sizes of multiple unit, integral cam-shaft pumps, one using a 4-9 mm range of plunger sizes and the second a 5-11 mm range. At present these pumps are being made for one-, two- and six-cylinder engines.

As will be seen from the accompanying diagrams, these pumps are of the cam-operated, helical plunger type, the metering being adjusted at the factory and sealed. At the lowest position of the plunger, the cylinder receives a charge of oil from the feed line, which is kept filled by a special feed pump connected to the fuel tank. Delivery of the fuel to the engine starts as soon as the piston covers the inlet port and ends when the upper helical edge of the annular groove in the piston opens the overflow or by-pass port on the opposite side of the pump cylinder wall, releasing the pressure to the discharge line. The effective delivery stroke of the piston may be regulated by turning the piston in its cylinder or barrel to vary the point of the delivery stroke in which the overflow port is uncovered.

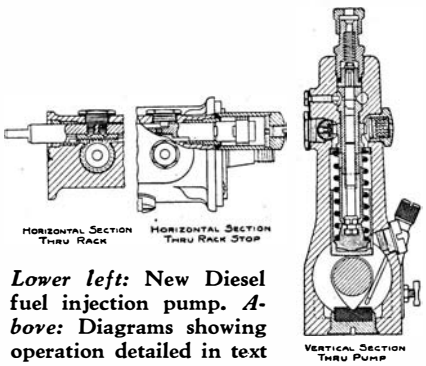


A feature of these Timken pumps is that they are driven by constant velocity cams. Thus the delivery speed of the fuel entering the combustion chamber of the engine is maintained constant at a speed adapted to the rate of combustion, thereby increasing the engine efficiency and fuel economy. The deceleration portion of the motion comes late in the stroke, thus permitting the use of a lighter spring and reducing the spring load between the tappet and the cam.

As these pumps must operate under pressures running as high as 10,000 pounds per square inch, and clearance between the plunger and the bore of the pump barrel is only .000030 of an inch, it is essential that the housing be specially designed to provide the necessary stiffness, for even the slightest deflection would affect the accuracy of the unit.

Vehicle Weight Law Barred by Court

THE South Carolina law limiting the weight of trucks to 20,000 pounds and their width to 90 inches has been declared by a Federal Court to be an "unreasonable burden" on interstate commerce, insofar as its application to arterial and federal-aid highways is concerned. Local roads and bridges on main roads were not included in the decision of the Court, which granted the petition of motor truck operators, the American Trucking Association, Inc., and the Interstate Commerce Commission for a permanent injunction enjoining the state from enforcing its law.



Lower left: **New Diesel fuel injection pump.** *Above:* **Diagrams showing operation detailed in text**

The Court stated in part:

"Within the past decade there has been a great development of interstate commerce by truck, and a corresponding change and development of industry in the southeastern part of the United States based upon truck transportation. The market gardening industry, the textile industry, the fertilizer industry and many others have changed in large part their method of doing business as a result of the facilities afforded them by

the use of trucks in interstate commerce. This traffic has developed transportation units of great efficiency designed to carry a maximum load with a minimum of burden or strain to the roads over which they pass. . . .

"A large part of this interstate traffic, with all that it means to the life of the people of the southeastern part of the United States, will be virtually barred from the highways of South Carolina, and a barrier will be erected not merely against the commerce of the state, but also as against the commerce of sister states, if these restrictions are enforced. . . .

"So far as safety is concerned, the evidence shows clearly that there is less danger to traffic from the standard trucks of interstate commerce than from smaller trucks carrying a load for which they are not designed; and certainly there is not enough advantage in a 90- over a 96-inch width to justify the exclusion from an 18- or 20-foot highway of trucks of a width permitted by all other states of the Union."—*Virginia Highway Users Magazine.*

Sleepy Drivers Often Few Hours on Road

WHENEVER the driver of an automobile falls asleep at the wheel long enough to cause an accident—and that is not very long—he will be lucky if he ever wakes up. A study of driver-asleep accidents in a dozen states reveals that one out of 12 kills somebody, and that one third of the time it is the driver himself.

A surprising fact developed by the National Safety Council and reported by *Science Service,* is that nearly half of the drivers who fell asleep had been driving for less than two hours. A third of these drivers, however, had been without sleep for 16 to 20 hours, so that it is evident that lack of proper amounts of sleep rather than gruelling grinds at the wheel is responsible for a large number of these mishaps. The drowsy driver returning home from a late party is the most common victim of the highway nap, and he usually drops into slumber and oblivion at about two o'clock in the morning.

Pedestrians need not worry too much about slumbering motorists because only 2 percent of fatalities involved the innocent bystander. A case was found, however, of a pedestrian falling asleep himself, with equally fatal results.

Motorists who have a hard time keeping awake at the wheel should get off the road immediately. Otherwise they will have a harder time waking up.

Why Governed Vehicles?

THERE are now 1,500,000 motor vehicles in the United States equipped with speed governors. It has been thought that governors increase operating costs and retard deliveries, but the experience of the General Electric Company has resulted in a favorable opinion of this method of curbing maximum trucking speeds.

Approximately six years ago, an overnight trucking service was inaugurated between Schenectady and Philadelphia, a distance of 265 miles, with ungoverned high-speed trucks. Heavy trucks were driven at speeds up to 60 miles per hour, creating an accident hazard and shortening vehicle life. Although instructions were given that a speed of 40 miles per hour should not be exceeded, excuses for greater speeds were made on the grounds that lost time had to be made up. Such lost time was found to be the result of numerous stops during the night, which operators knew could be made up by fast driving.

Governors were consequently installed limiting speeds to 40 miles per hour. Maintenance costs have been reduced, and road failures are a thing of the past. Although 90 percent of the 1,600,000 miles traveled have been in hours of darkness, only four minor accidents have occurred, resulting in a cost to the insurance company of 242 dollars. Speed was sacrificed for safety and economy, yet schedules were stabilized and maintained.—*E. I. Hibbard, Transactions, National Safety Council.*

SKID-RESISTANT

IN England, paving blocks of iron, rubber, and other materials have been produced with studs of various shapes projecting above the main surface of the block, and it is claimed that a surface of this sort grips the automobile tire like a gear and prevents skidding.

Well, Some May Like the Trip

INTERWOVEN for centuries with the history of Paris in its most desperate hours, and immortalized to the world through Victor Hugo's "Les Miserables," the 700 miles of sewers under Paris are a sightseeing novelty for tourists.

This extraordinary underground voyage, made in boats over the black swirling waters flowing far beneath glamorous Paris, is proving of great interest to adventuresome visitors looking for something different. Last summer, 1107 persons undertook the trip which starts at the Place de la Concorde and finishes below the Madeleine Church.

The vast sewers of Paris, one of the great engineering feats of the world, have been visited by comparatively few of the hundreds of thousands of visitors there. Even to Parisians, this is one of the least known of sightseeing trips.

Pennsylvania Electrification

THE Pennsylvania Railroad now plans completion of the electrification of its lines for both passenger and freight service east of Harrisburg, Pennsylvania. The purpose of this forward step is to promote better service to the public and increase efficiency and economy in operation. The results of the present electrification have been so satisfactory to the company and the public that, in order to secure the full measure of benefit, the directors have decided to complete the original electrification program on its eastern lines as announced by the Pennsylvania Railroad in the fall of 1928.

The four-track main line is now electrified between New York and Washington, as are also the commutation lines around

Philadelphia and New York. It will require about 18 months to complete the new work, during the progress of which upwards of 10,000 men will be employed directly on the project and a like number in the industries furnishing materials.

The roadway construction work for the new electrification will be of the same type as that now employed elsewhere in the railroad's eastern electrified territory. It is known as the cross catenary type of construction and is based upon a system of overhead conductors held in place by an arrangement of flexible wires supported between structural steel poles set in concrete beds beyond the outer edges of the track.

The new work will involve the electrification of 315 miles of line and 773 miles of track. Upon its completion, the Pennsylvania Railroad system will have 2677 miles of electrified trackage, or 41 percent of the total electrically operated standard railroad track in the entire United States.

(End of Transportation Section)

Synthetic Resin Insulation

A NEW resin made from polyvinyl chloride has rubber-like properties but is said to be superior to rubber as an insulating material for covering electric wires and cables. It is applied on a conventional rubber tubing machine and requires no curing, as does rubber.—*D. H. K.*

If You Employ Servants

EXAMINATION of all domestic servants as a means of checking the spread of venereal and other communicable diseases was advocated by Dr. Charles V. Craster, health officer of Newark, New Jersey, at a conference on venereal diseases held by the U. S. Public Health Service.

Such a health examination, which is compulsory in Newark, is aimed at protecting the entire community and not merely families employing domestic servants. Examinations of special groups, such as domestic servants, taxi drivers, beauty shop operators, and barbers are, in Dr. Craster's words, "the spearhead of the attack on the venereal disease problem."

As long as the servant with syphilis is undergoing treatment to make her non-infectious, the family she serves is in no danger, Dr. Craster emphasized. He has found that domestic servants constitute a reservoir of venereal disease, and he suspects other such reservoirs exist in the other groups named.

Among the first 10,000 domestic servants examined in Newark, 1900 cases of venereal diseases were found. Of these 1900, over half—900—were not having any medical treatment at all. There were more cases among itinerant day-workers than among servants who lived in the homes where they were employed.—*Science Service.*

In Fine Flavor

WHETHER food is eaten for nourishment, or for the sheer pleasure of eating, flavor is the magnetic influence which increases the quantity of food consumed, and favors a sufficient intake for the needs of the body. Flavor is also selective. It enables us to choose that which is best for

us, provided experience is heeded and one's better judgment is followed. Certainly, among the lower animals, where experience is relied upon and where convention is almost unknown, flavor is a dependable guide to the selection of suitable food, in proper condition.

Discussing this subject recently, the *Industrial Bulletin* of Arthur D. Little, Inc., says that flavor is of vital importance to all producers and handlers of foods, so that they may be able to deliver satisfactory goods to a flavor-conscious public. There is much uncertainty as to how flavor problems should be handled. Teas and coffees, on receipt in this country, are graded by professional tasters, whose word is final. Many other types of foods are commonly judged by juries or tasting squads. Some people believe that these types of inspection and evaluation should be extended to a wide variety of articles. Others feel that a sufficient guarantee of flavor is the good name of the producer, it being taken for granted that he will not neglect this essential phase of quality. Some producers certainly do not.

There is a general groping for real standards of flavor that may be applied fairly for all. Flavor considerations today may dominate executive action on matters of production, storage, and transportation of foods and beverages. The public appears willing to accept rich natural flavor as proof that the food is right in vitamins, minerals, and other nutritive values. Actually, a packer frequently must select articles of much better than average quality in order to insure the fine appearance and flavor that is now commonplace.

It is widely appreciated that flavor consists of a complex of sensations in which taste and smell predominate. Of these two senses, smell is usually the more important, and, without realizing it, most of us judge food largely by its aroma. The aroma may pervade the atmosphere and bring forth high expectations regarding the food about to be eaten, and serves to advertise occasional foods such as fried clams, doughnuts, or popcorn. It may not be perceived until the food is actually in the mouth, where the warmth and moisture intensify the aroma, so that when it rises into the smelling area above and back of the nose, it is readily sensed. The sense of taste may be reinforced by condiments: sugar for sweetness, vinegar and lemon juice for sourness, and salt for saltiness. Bitterness, though not supplied by ordinary condiments, may be had in relishes, coffee, or beer.

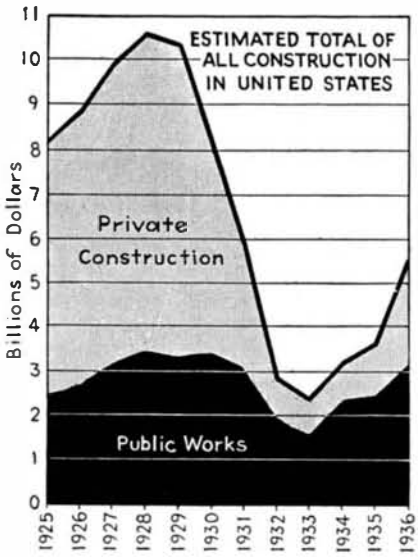
The texture of cereals, desserts, and other prepared foods, and even of natural foods, greatly influences the flavor, through the feel on the tongue or inside the cheeks. While eating walnuts, pecans, or avocado, one becomes very conscious of the value of texture, and also of oiliness. We detect flavor with our eyes also, to some extent. A mint jelly without green is only partly satisfying, and clarity and appropriate color are required in many desserts and beverages.

During the past fall, notable conferences were held in Chicago, New York, and Washington to consider better methods of grading butter, eggs, and other important foodstuffs. Large and small groups worked together to establish useful standards of quality. The American Chemical Society held a symposium on flavor at its spring meeting. The present burst of interest in flavor reflects the natural increasing desire of food

manufacturers, advertisers, and purveyors to learn about this important yet difficult subject, so that they may be able to keep abreast of the steadily increasing interest in flavor on the part of the American public.

Public Works or Private

STUDY of the accompanying graph, which is used through the courtesy of *Engineering News-Record*, will show a surprising fact. Much criticism has been generally made of the various public works programs, the intent of such criticism being to show



that there has been an alarming increase; while, on the other hand, much political capital has been made of the fact that the Administration is spending money on public works. Both critics and boasters might as well have saved their breath, if we are to believe the figures here.

Both public works and private construction through 1929 were high and then dropped with the depression. Private construction has not regained its former volume, which is to have been expected. The extraordinary thing is that, despite all the talk pro and con, public works also is still behind 1928, 1929, and 1930. At the end of 1936 the estimate was 3,140,000,000, while in 1928 it was 3,480,000,000; in 1929, 3,263,000,000; and in 1930, 3,363,000,000 dollars.

The answer is that public works are a permanent thing and there is no need for anyone to make political capital of something merely because the public can be so easily deluded.

Science In Advertising

IN an editorial discussion of the bills before Congress for control of food, drugs and cosmetics, *Industrial and Engineering Chemistry* states that the industries most affected by such improved laws seem "to be actually inviting someone to take charge of the situation, and the facts which science has to offer or could ascertain continue to be ignored in many instances." The editorial decries the exploitation of science in business ballyhoo and cites examples.

"Back in 1934," the article said in part, "an advertisement caught our attention. This was in the field of cosmetics, and, appearing in a reputable publication, we thought we would ask a few questions. Here was an irradiated skin cream which offered the beauty benefits of sunshine while you sleep,

slowly, gently, safely applying tiny rays to one's skin all night long. It has required some time to reach the end of this story, but we found the manufacturers only too anxious to get to the truth. It now develops that the irradiated cream did give the effect of ultra-violet rays on photographic plates and, in the enthusiasm of that discovery, the advertisement was born but was soon discontinued when a reputable investigator found that, on the evidence of carefully conducted experiments, there was no radiation of any significance and the process was abandoned. That, of course, is to the credit of the manufacturers and no doubt when another idea is brought to them, the lesson having been learned, the investigation will precede, rather than follow, the advertising.

"In the spring of 1936, another cosmetic preparation came to our attention in a full-page advertisement with an illustration in gilt. The attractiveness of gold was evidently being employed, but imagine our surprise to read that this new cream had been blended with pure gold, that science had transformed gold into an astonishing form, soft and pink, that cleanses and revitalizes skin tissue to exquisite loveliness. That, of course, was interesting, but how about this? 'Every atom of this new live gold carries a negative impulse of natural electricity. This negative electricity attracts the positively charged impurities deep in skin pores. Every trace of dirt is drawn away, leaving your skin marvelously fresh and clean.' We had visions of those early experiments with the magnet drawing iron filings around the table and were interested in getting at the truth of this new application of colloidal chemistry.

"After some correspondence, we had analyses made and this cream was found to contain approximately 0.015 percent of gold. Its charge is negative but it is apparently stabilized with soap as a protective colloid. Thus, the gold with the adsorbed soap micelle as a protective coating would be negatively charged and the properties of the gold sol protected by soap would be, not those of a gold sol, but those of a soap micelle. It has not been explained to us why the colloidal gold does not react with the ointment base, nor do we know what the magnitude of the electrical charge must be to yank the organic debris out of the pores of the skin, nor just why the embedded debris does not pull the gold in after it, rather than having the reverse phenomenon occur.

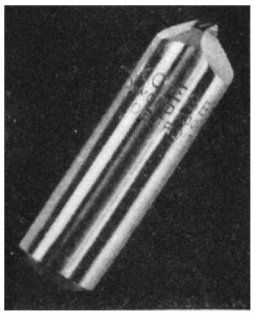
"We are told that some further investigations give reason to believe that the cream we have been discussing may act as a mild skin stimulant, increasing the activity in a way to promote a cleansing action, but that is a very different statement from the published advertisements to which we have referred.

"It is doubtful whether any of the cases we have cited—and there might be many more—deal with preparations that are actually harmful to health, although as is well known, the cosmetic field is not without its examples of horribly toxic preparations. We simply object to the prostitution of science as an aid to obtaining a five dollar bill for a product which, including the jar, may have cost a quarter. We frankly are skeptical that there is any cosmetic preparation, admitting that we have tried none of them, which would make our skin 'grow

young,' 'revitalize withered cells,' 'restore youth to the complexion,' and do those other things that are so much desired in some quarters. Is it not strange how so many can be talked into believing the impossible? It appears to be clearly a case where, if people will not protect themselves from exploitation, the authorities must do the job for them. Far more serious cases might be discussed, but even in this big business of cosmetics common decency demands close adherence to the truth and some effort to produce and supply materials that can be sold on demonstrated merit and backed by scientific data that can be accepted as sound and authoritative." —*D. H. K.*

Hardness of Diamond Proved in Industrial Use

THE diamond is generally accepted as the "hardest material known." Just how hard this is in comparison with other substances (hardened tool steel, for example) is seldom realized. The recent production



Diamond pointed boring tool

record of an industrial diamond in use in a Detroit automobile plant provides a dramatic demonstration of this hardness and wearing quality.

The tiny point of an industrial diamond, weighing less than one carat, used in a diamond boring machine in taking the finishing cut on the wrist-pin holes in aluminum alloy pistons, removed a chip or thread of metal 9000 miles long before it required re-pointing! The total length of the hole bored through the pistons, if the pistons were placed side by side, would be 12 miles! This tool removed 926 feet of metal per minute.

This feat is the more impressive because (a surprising fact to most people) this piston alloy is actually more abrasive in character than ferrous metals—iron or steel.

Moreover, the diamond is not worn out even after this period of use. Only its tiny, but extremely accurately shaped point is worn. It requires only re-lapping to the correct radius to prepare it for a similar period of production life.

"Winter Overcoat" Boosts Cotton Yield

A FIVE-ACRE field near Rome, Georgia, yielded one half bale of cotton per acre in 1932; two bales per acre in 1936. In the intervening years, the owner, J. S. Cutton, planted a cover crop of legumes each winter. The legumes provided a "winter overcoat" for his field, that otherwise would have been exposed to the rains, according to the Soil Conservation Service. They also fixed nitrogen in the soil and made it capable of supporting a heavier growth of cotton. He saved the soil of the five-acre field, increased

its fertility, and conserved moisture. His 1936 cash income from the field was 740 dollars. If his 1932 crop had been sold at 1936 prices, he would have received 185 dollars.

More than a half million acres of cropland in the cotton belt will be covered with legumes throughout the winter months, as a result of the programs of the various state experiment stations, the Soil Conservation Service, and other agencies advocating this practice.

SWIMMING

AUTHORITIES say that swimming is one of the best reducing exercises while at the same time being a good exercise for building up underweight bodies. This is explained by the fact that swimming tends to develop the body uniformly, so that it works both ways—reducing or increasing weight as the body may require.

PROTECTIVE WRAPPINGS FOR FRUIT

PROTECTING fruit on its way to market by wrapping in paper has long been practiced, and for years it has been sought to impregnate this wrapping with a material which will prevent spoilage by mold. Experiments have shown that iodine (see page 271, May 1936 Scientific American) is useful in this respect were it not for the fact that it may stain the fruit. Diphenyl has been found much more satisfactory for oranges and grapes, which it keeps quite free from mold. The slight odor from diphenyl is not imparted to oranges or grapes, but even the trifling amounts of this compound necessary will injure bananas and apples. Benzoic acid and several of its derivatives, as well as a number of essential oils, have little or no value as shown by experiments conducted in England.—*D. H. K.*

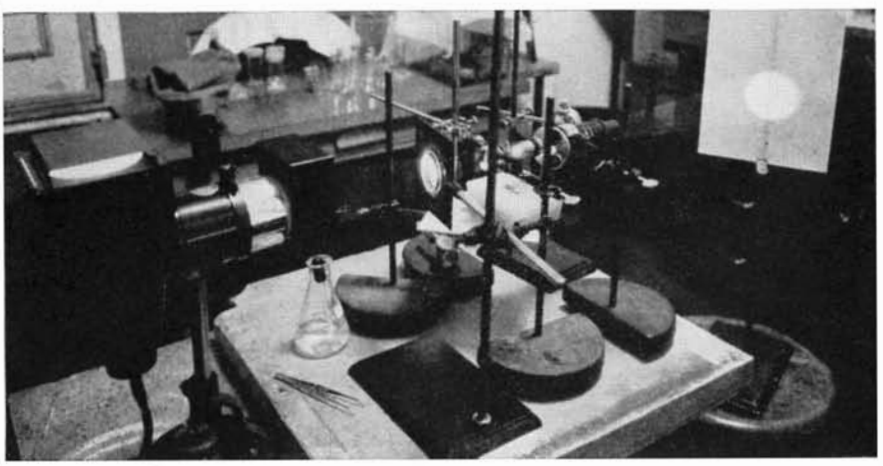
INSECT HEARTBEATS BASIS OF POISON TEST

LARGE, clear pictures of insect heartbeats made by a delicate photographic method recently devised by Dr. J. Franklin Yeager, of the United States Department of Agriculture, make it possible to compare the behavior of the heart before and after contact with any one of the substances that look promising in the Department's persevering hunt for better insecticides. The new method also makes it possible to learn more about the way in which the insect heart mechanism operates and to gain physiological information that will be helpful in the search for better ways of controlling insect pests.

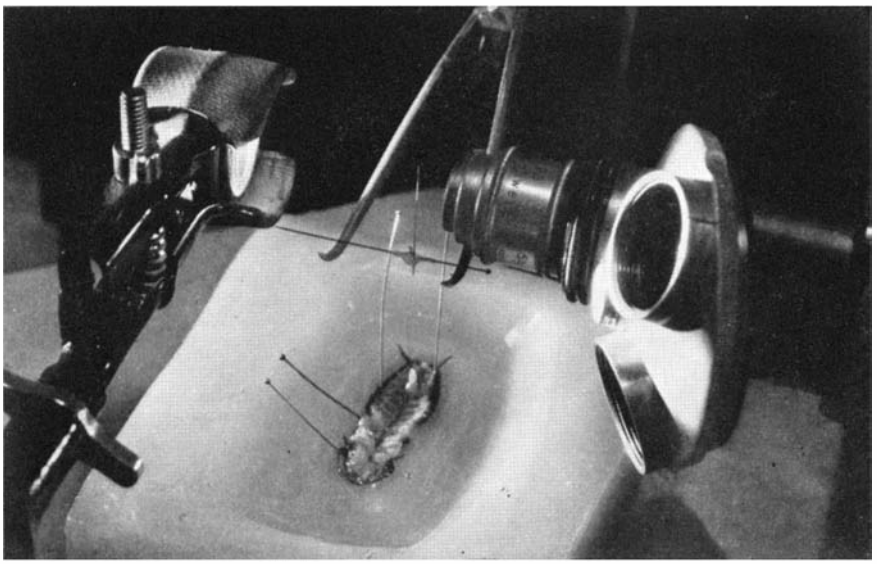
Heartbeat records have been obtained from the cockroach, a useful experimental insect that serves the entomologist in somewhat the same way that the white rat or guinea pig serves the zoologist. To obtain a record, the entire back of the insect, with the tiny heart—too small to handle easily alone—attached, is dissected from the anesthetized roach and placed upside down in a beeswax receptacle. The heart tissues are kept alive with a salt solution that acts as artificial blood.

The experimental equipment used is amazingly delicate. With a human hair, attached at one end to the heart and at the other end to a tiny glass lever, every motion of the heartbeat is passed on to the vertical arm of the lever, stained to make it opaque. A strong beam of light turned on the lever passes through the lenses of a powerful microscope and is then projected into the eye, or slit, of a special camera. A moving roll of photographic paper in the camera registers the fluctuations of the greatly magnified shadow cast by the opaque arm, the movements of which correspond exactly with the heart movements. The developed

Adding nicotine to the salt solution which covers an exposed insect heart



The laboratory set-up for photographing the heart beats of insects



Close-up of a roach with its heart exposed for experiments with insecticides

photographic paper forms the heartbeat pictures, or "mechanocardiograms."

Analyses of the mechanocardiograms already made show that, in general, the insect heart contracts, relaxes, and rests, much as does the human heart. Unlike the human heart, however, the insect heart often expands slightly and suddenly just before it contracts. The significance of this "precystolic notch" has not yet been determined.

When nicotine is added to the salt solution, the pictures show that the heart loses its ability to relax. As more and more nicotine is added, the heart relaxes less and less until finally it ceases to relax at all and, in a contracted state, stops beating.

OYSTER

FOUR feet by three feet are the dimensions of the biggest oyster-shell in the world which, in fact, is a fossil recently dug up in the Big Bend National Park area in western Texas.

Aspirin, Generally Safe, Hits Hard at Sensitive Persons

WHEN a person is sensitive to aspirin, he is violently sensitive to aspirin. And when he isn't, he isn't.

From the Mayo Clinic, Rochester, Minnesota, comes a report of hypersensitivity to this familiar and ordinarily innocuous drug, involving 62 cases. All one of these persons needs to do is to swallow a five-grain aspirin tablet. In from ten minutes to two hours, dreadful things begin to happen. Asthma in an alarming form is the most frequent and serious type of reaction. Other people get terrible sneezing fits and their noses stop up. Some have "giant" hives and others break out into a rash. Some persons' faces swell until their eyes are closed. Others get severe cramps in the abdomen. Still others develop great purple splotches on the skin. Women are more sensitive to the drug than men. Everyone who is upset by aspirin seems to have a personal or family history of allergy. Those with asthma are particularly likely to be sensitive and if along with the asthma they have nasal polyps, it goes hard with them indeed. Patients such as these have been known to die following a dose of aspirin.

If an individual knows he is sensitive to aspirin he can avoid it, and he will after one attack of any violence. But the presence of acetylsalicylic acid, its scientific name, in many "patent" medicines makes them an unsuspected source of danger.—*Science Service.*

Cranberry Emulates Jumping Bean

BEFORE a cranberry is shipped it must prove its vitality and fitness for market by bouncing over a barrier. This is the way the berries are graded. Those that have decayed or otherwise deteriorated will not bounce when they are allowed to drop a short distance. All grading is done by machinery and the berries are given about four chances to bounce over the barrier.

Aerogel

JELLIES of such typical materials as agar-agar or gelatin are composed of a felt of minute fibers plumped out by water, which is held tenaciously in this fine network by capillary attraction. When a jelly dries down, the felt collapses to a film, but this can usually swell up again to the original volume if soaked in cold water. Several years ago, Professor Kistler of the University of Illinois devised a process whereby the water of a jelly could be displaced by a liquid such as alcohol, leaving the jelly mass in its original volume, and then by converting the alcohol carefully to a gas, leave the felt in the uncollapsed condition. This pithlike form which is called "aerogel" can be secured not only with the jellies noted above, but also from the jellified oxides of silicon, iron, nickel, tin, titanium, aluminum, and other elements. The aerogel of silica under the name of "Santocel" is now available for commercial use, and its producers are seeking practical applications.

Silica aerogel comes as a powdery mass of extreme lightness, soft and compressible. Bulk weights are four to ten pounds per cubic foot. If kept dry, it is a good insulator and has been suggested for Thermos bottles,

(*Please turn to page* 342)

THE AMATEUR TELESCOPE MAKER

Conducted by ALBERT G. INGALLS

WE give the entire space this month to 20″ Pyrex mirrors and to the "Twenty-Inch Club" of which all automatically become members when working on these new, standard 20″ disks, unless they can give good reason for escape. The first letter is from the Gemini twins, Edward P. Woolcock and W. E. Lester, respectively Sec.-Treas. and Pres. of the Amateur Telescope Makers of Long Beach, 319 Hermosa Ave., Long Beach, Calif.

"IN the March issue of Scientific American you mentioned your hope of hearing from those who are grinding 20″ Pyrex mirrors. Here is our bid for membership in the Twenty-Inch Club.

"We received our solid disk on January 9. The disk weighs about 125 pounds and is slightly over 4″ in thickness. The raw slug had 34 flat sides where the ceramics used in the mould had joined to form as nearly a circle as possible. One side of the disk was marked with grooves, indicating that it was apparently the bottom of the disk when cast. The other side had several large surface bubbles and was far from being flat. Unlike the smaller Pyrex mirrors, which are smooth and transparent, the 20″ disks are more frosty or opalescent and do not have as much amber tint.

"We anticipated lots of labor before we tackled actual work, and our beliefs were well founded. The large disk was a good deal harder than the smaller sizes. Carborundum is a good abrasive for plate glass or even small Pyrex mirrors, but it breaks down too fast when grinding the harder type of Pyrex. We spent many hours trying to face our disk with silicon carbide and aluminum compound abrasives. We had fair success using cast-iron filings. Crushed Steel, however, proved to be the best bet in grinding. It does not break down, cuts four times as fast as Carborundum, makes one tenth the mess, can be used over and over again (one wash and it's as good as new), grooves more than it pits, and above all it is practically as cheap per pound; because it can be used over and over, it is actually much cheaper than any other abrasive for this type of grinding.

"We rigged up a vertical spindle to rotate the disk as it was being ground. An iron plate fastened to the spindle, with three roller bearings to take the weight of the mirror, constituted our grinding machine. With a rotating speed of 30 r.p.m., we used a flat, 12″ cast-iron tool weighing 75 pounds. This tool was used for facing both sides of the disk, and was later turned to curve and used to hog out the center of the mirror. Because the edges were so uneven, we decided to grind the disk to a circular shape and remove the 34 little flat edges. Two parallel, 4″ wooden rollers mounted on a 2 by 4 frame and swung over a rotating, horizontal iron plate, made up our edging machine. [A sketch was submitted but could not be reproduced. The principle is the same as shown in "A.T.M.," fourth edition, page 135—if the separation of the rollers D,D were adjustable, the drop of the larger disk, and therefore its bearing on the rotating plate, would be variable at will.—*Ed.*] By spinning the mirror over the rollers by hand, and by feeding No. 60 Crushed Steel between the iron plate and the edge of the disk, we were able to true the mirror edge in about five hours.

"We have spent about 15 hours a week working on the mirror. In 6 weeks, or 90 hours, including time for adjustments, tests, experiments, and so on, we have accomplished the following results: The mirror has been faced on both sides, and the edge has been ground into a perfect circle. We have hogged out the center of the mirror, and we are smoothing the curve by hand, using a 1″ thick, full sized plate glass tool and No. 60 Crushed Steel. We tried a marble tool, but it was too soft. Polishing will probably be done by machine and figuring by hand.

Castor and Pollux with mirror

"Let's hear from the rest who are making 20's."

THE two workers having omitted to describe the machine shown in their photograph, we asked for more data and received the following, dated two weeks later:

"We have been working steadily at the job, and we are now just about ready to enter fine grinding. Like all TNs, we changed our minds several times about the focal length. At first we thought we would make it *f*/7, hoping for ease of grinding and figuring. The mounting difficulties of a long focus mirror did not bother us as much as the fact that we wanted an all-purpose mirror if possible—one that could be used for nebular, planetary, and photographic work. We finally decided to make the focal length *f*/5. With this focal length we can get a rich field for studying faint nebulae, a good light for photography and, by using it as a non-perforated Cass, we can have sufficient power for planetary studies.

"You asked for a little more detail on our grinding machine. It is hardly worthy the name of machine. Basically it is only a rotating vertical spindle with an iron plate on top for holding the mirror. The bearings under the plate are old automobile ball bearings. These bearings are strong and steady and, although they support the weight of the rotating mirror, there is no side play during grinding. A ¼ h.p. motor with a 3″ V pulley drives a 5″ pulley on a shaft—on this same little shaft (Sears Roebuck polishing support) there is another 3″ V pulley which drives a 14″ pulley mounted on a pipe shaft and supported by 2 by 4 wooden bearings. A 2½″ flat-belt pulley is also mounted on this shaft, and a 2½″ flat belt connects this pulley with a 12″ flat-belt pulley mounted on a 1″ vertical spindle which supports the mirror.

"We have no mechanical device for moving the tool across the mirror. The 2 by 3 braces and many wooden braces which you see slung across the table are merely supports to hold the tool. Our 12″ cast-iron tool has a 1½″ hole in the center. We plugged this with a handle from an old shovel. The handle then stuck up about 10″. A ⅜″ hole was bored through this handle and a steel rod was passed through. This rod served to keep the tool from twisting, yet provided a means for sliding the tool back and forth across the mirror.

"After having ground the edges with Crushed Steel, as explained in our last letter, we fine-ground the edge with 220 and 280 Carborundum. A piece of thin sheet metal was mounted as a band around part of the mirror's circumference. One end of this tin strip was fastened to a board and the other end was kept taut and snug against the edge by means of a spring. As the mirror rotated, we painted fine Carborundum on the edge. With this simple device we put a fine finish on the mirror's edge in less than one hour. This little time spent on finishing the edge improves the mirror's appearance many times.

"After having roughed out the mirror to an approximate *f*/8 on the machine, we have since been grinding by hand on our plate-glass tool. Using Crushed Steel, we were able to take the focal length down to *f*/5 with comparatively little trouble. At first two of us pushed the glass across the tool, but later we found that it was rather easy for one man to handle the job. So now we each take a ten-minute try at grinding, alternately with a ten-minute rest period. With this method we can grind for a much longer period and with less fatigue. We are having such good success with hand power, in fact, that we may not resort to the machine again, except possibly for some preliminary polishing. The machine, however, was indispensable or almost indispensable when truing the rough blank, edging, and hogging out.

"Incidentally we have taken several feet of motion pictures showing our crude but effective method of attack on the 20″ disk. Someone might be interested in viewing the action."

THE rest of the Twenty-Inch Club appears at present to consist of C. R. Tinsley, 3017 Wheeler St., Berkeley, Calif., whose job we described in the February number; A. W. Everest, Pittsfield, Mass.;

Walter L. Moore, Coral Ridge, Ky.; Lew Lojas, 1510 White Plains Road, New York; and Amos H. Huff, Escuela, Ariz., but we don't know at present writing (March 16) how the three last-named of these members are making out. There are probably other workers on 20″ Pyrex disks, either the solid variety (less expensive) or the waffle variety (more expensive, being replicas of the 200″ disk), but we hope these comments will smoke them out. With these disks purchasable at reduced rates, in clubs of six or more, there is likely to be quite a future development in 20″ telescopes and an interesting one at that—especially when it comes to the mountings.

The machine—overgrown spindle

WE sent the two preceding letters to Everest, who returned them with comments on *his* 20″ disk—which, by the bye, was given him for Christmas by Mrs. Everest (Wives! Buy your husbands 20″ disks, and you will then know they are safe and at home.—Adv.). Everest wrote:

"Been puttering around with the 20″. Weighs 115 pounds, less a couple of pounds of bubbles. Hogged her out to an *f*/5 curve, 200″ R/C. This meant ¼″ deep in the center, and the removal of over three pounds of the hardest glass I ever worked on. Took nine pounds of No. 50 Carbo, ten hours hard labor, and gallons of sweat.

"She was roughed out with a washer tool, which is about four times faster than a glass tool. This is made by cementing large iron washers over the face of a glass tool having the proper radius of curvature. In this case it was a 12½″ Pyrex blank which had been used for an *f*/8, 12½″ mirror, 200″ R/C. The washers wear very little, give the fast action of the channeled cast-iron tool, and can be knocked off for the fine grinding, where glass-to-glass gives slower but much smoother action. There is a little trick to getting them on with a uniform film of pitch. This is accomplished by dropping them into a pan of pitch and bringing them up to almost the boiling point. The tool is cleaned with turpentine, placed face up with the handle down in the milk bottle [See "A.T.M.A.," page 43.—*Ed.*] and the washers hooked out of the hot pitch one at a time and placed in position. If hot enough, most of the pitch runs off and the balance of the surplus is squeezed out by pushing around in ¼″ circles until the pitch is nearly set after placing on the tool. This pushing around also gives them a better toe-hold. I always start by putting one in the middle, six around this spaced about ¼″, and so on.

"To start the central depression, a circle of washers 8" in diameter was cemented on the tool, the extra diameter of the glass merely representing useful weight for this spell. 4" strokes were used until the depression spread to 10" diameter. When it had reached about 8" diameter it was found that the depression lacked nearly ½" of being concentric with the rim of the mirror. So the side that needed it was favored a bit for the remainder of this spell. Didn't worry too much about exact concentricity at this point, however, as the surface was so far out of flat, to start with, that this concentricity was sure to shift a little one way or the other before the depression spread to the rim of the mirror. At 10" diameter the spit test ["A.T.M.A.," page 26.—*Ed.*] showed the R/C about 10" too long, showing that the center washers had worn a little faster. This was a natural result of their being the only ones in contact at the start.

"At this point, I made a little experiment I have always wanted to try, in order to determine the difference between Steel grit and Carbo. I never could get any speed out of the Steel on Pyrex without such tremendous pressure, over two pounds per square inch, that astigmatism was sure to be ground in. It always *sounds* as if it were cutting fast, but unless there is pressure enough to get a crushing action on the surface of the glass, not much of anything happens. Steel is not hard enough to get the shearing action of Carbo.

"I tried 2 oz. of Steel grit first and ground for 15 minutes with about 25 pounds' additional pressure. There was no noticeable reduction in size of the grit. Took tool off mirror and left them to dry, after which the grit and gunk were carefully brushed into the scoop of a balance scale. The total weight was 2½ oz., meaning that ½ oz. of glass had been removed.

"Same experiment now tried with Carbo: 2 oz. ground down to the point where it was useless for further rough grinding in less than four minutes. On weighing up, however, I found that ⅝ oz. of glass had been removed—more than with the Steel and in one fourth of the time. Several more trials with different pressures gave about the same results with regard to the amount of glass removed, the time taken being in about direct proportion to the pressure. This seemed to indicate that it was going to take three times as much Carbo by weight as glass to be removed, and this was found to be actually the case after the rough grinding was completed. Carbo, of course, was selected for the job, and I used all the pressure possible with my hands at the start, gradually tapering down to 10 or 15 pounds at the finish.

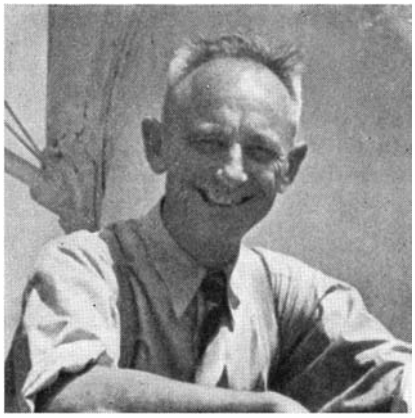
"After the Steel grit experiment, a larger tool was in order but, being suspicious of those center washers, I knocked them all off and replaced with a new set covering the whole face of the 12½" tool.

"With the washer tool, the mixture of Carbo and water must be exactly right. If too much water, the Carbo will be quickly pushed off over the edge. If not enough water, it will pile up in the center. A few trials when throwing water between tool and mirror to wash out the gunk, will show how much water to leave when sprinkling on fresh abrasive.

"Continuing with the grinding from the 10" depression, 4" diametrical strokes were used till it spread to 12". Spit test showed the R/C back where it belonged and examination of the tool showed a uniform wearing away of the black oxide from the surface of the washers. There was no danger of the tool getting out of shape from now on.

"The remainder of the rough grinding, the fining, and the preliminary polishing to date have been done with the zigzag stroke shown on page 35, "A.T.M.A.," Fig. 30, left. A job this size must be done on the barrel—as much as I hate it—taking a short step to the left at the completion of each cycle of the strokes shown.

"Zigzag strokes inside about an 8" circle were used to spread the depression to 15". R/C shortened 2".



A. W. Everest

"Strokes bringing center of tool to within 2" of the edge of the depression were used to 17" diameter. Spit test showed R/C back at 200" with about 1" turned down edge. Otherwise, zone-free sphere.

"Strokes shortened to within 3" of the edge of the depression and ground to 19" diameter. Edge a little cleaner and R/C shortened 2".

"At no time, till now, had the depression been truly circular, since the surface was not flat to start with. So, at this point, a handle was cemented in the middle of a 28" square of plate glass, and the flat rim of the mirror was ground with No. 240 until it was in contact all over. The local applications of abrasive tried first pushed out from between the two surfaces about as fast as applied. Filling the whole depression with Carbo and water corrected the trouble, allowing the plate glass to pick it up and drag it over where wanted about as fast as required. I didn't time this but it took about 20 minutes, leaving the depression with an exactly circular boundary.

"The depression was spread to the rim of the 21" disk with strokes to within 2" of the rim, to prevent shortening the R/C, which it did. But the rough grinding wound up with turned edge plainly visible under the spit test, due to the fact that there is no suction with the washer tool or with such coarse abrasive, and this allows the tool to rock over slightly as it comes nearly to balance over the rim of the mirror with such long strokes.

"The washer tool is not recommended for fining—too harsh action and liability of scratches. So the washers were knocked off and the glass tool was used with the regular sequence of Carbo and fine emery, 1½ hours of each. Although the long strokes were continued, in order to get sufficient abrasion way out, the edge cleaned up during the 280 stage where no turn could be detected either under the spit test or by the

bubble test [see "A.T.M.A.," page 35.—*Ed.*].

"Well, there is the story of the 20" to date. Have given her two hours of HCF on the 12½" tool: surface semi-polished, zone-free, ellipsoid with about 25 percent of full correction. Probably will be most anything else when the preliminary polishing is completed, but I am keeping an eye on her and won't let her get too far out. Requires frequent addition of rouge or water, but nothing like the rapid drying of a full size HCF lap on top of, say, a 10" mirror."

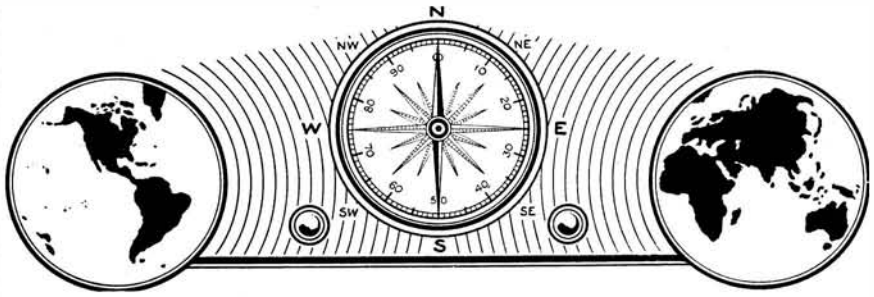
Everest had not yet edged his disk when he wrote. His photograph, which appears opposite, was taken by one of our special secret service sleuths, E. Dayton Thorne, of Patchogue, Long Island, who snuk up on him one hot summer's day at *Stellafane* with a candid camera disguised as a seidel—note the smile. Since Everest would not furnish his own photograph for the end of his chapter in "A.T.M.A." (which, by the way, is going very well) this is how we circumvent his innate modesty: we suggest that you cut out the picture and paste it on page 48, "A.T.M.A." That, in fact, is why we left that space. With Ellison's loss it seems to us that Everest will now slide into place as the leading mirror expert.

Obviously, Everest and the Lester-Woolcock partnership are in disagreement about the relative virtues of Crushed Steel and Carbo. On seeing Everest's letter the two came back with: "Steel is at least ten times better than Carbo. Of course, you must have plenty of weight on the tool. We used a 75-pound tool and rigged up a lever on which we sat, so that we had about 150 pounds' pressure. Don't worry—the 20" can take it."

Everest had mentioned above that, with too great a pressure, astigmatism would be ground in; he speaks of 2 pounds per square inch as "tremendous." The pressure used by the other two figures about 1½ pounds. But your scribe is not foolhardy enough to inject any snap opinions into this Battle of the Abrasives; let 10,000 other amateurs make 20" mirrors, try each kind, and turn in their votes. Woolcock and Lester continue: "When we used Carbo we had to stop very often and clean off the milky residue and replenish the grit. With Steel, however, we merely rubbed a paint brush over the mirror to stir up the particles. We use Diamond Crushed Steel obtained from the Pittsburgh Crushed Steel Co. When you see the grooves that steel makes when used with plenty of pressure, you will give up any other abrasive for rough grinding of Pyrex."

As we go to press the California pair have the final word but maybe, if Everest had it, he would grin and add, "Yes, and when you see the astigmatism. . . ." Or perhaps he wouldn't. It would seem to depend on whether we grant the premise on which the California workers appear to base their argument—that there is no risk of astigmatism.

THIS scribe's face is red, for he omitted a name from the Twenty-Inch Club's list, given earlier. Architect Clarence L. Jones and son Art Jones, of Chattanooga, have been making one, and Marion P. Wall designed the mounting. The job is nearly done. Judging from some newspaper pictures we have seen, this is a swank job. It is to be a community telescope, a labor of love by the makers.



WORLD-WIDE RADIO

Conducted by M. L. MUHLEMAN

Editor, *All-Wave Radio*

Coronation and Sunspots

ENGINEERS of the British Broadcasting Corporation are anxious lest what is wrongly called a "sunspot" fade-out should occur during the Coronation broadcasts on May 12th. The chances of such a fade-out during the actual Coronation ceremony are almost negligible, but there was a complete fade-out on December 3rd which affected all daylight transmissions and lasted for half an hour. This was *not* caused by sunspots but by bright hydrogen eruptions which have nothing to do with sunspots.

There is a great increase in solar activity this year, and sunspots are larger and more numerous than usual; but this will not be prejudicial to the reception of the Coronation broadcasts. The BBC engineers have found that the effect of sunspots on nighttime Empire transmissions is generally beneficial. As regards daytime transmissions, the sunspots have less effect, but they, too, are beneficial, and there is only a very remote possibility of bright hydrogen eruptions.

Italian Short-Wave Center

PLANS for Italy's new Imperial short-wave center, recently approved by the Italian Council of Ministers, include the enlarging of the well-known 2RO, increasing the power of the present two transmitters from 25 to 40 kilowatts, and building two new 100-kilowatt transmitters and a 50-kilowatt reserve transmitter.

Each of the four principal units will be able to work on either of the two wavelengths, each carrying a separate program, while the fifth (reserve) transmitter, will be able to operate anywhere between 14 and 60 meters, either as a substitute for one of the four principal transmitters or as a completely separate experimental station.

The new antenna system, both directional and omni-directional, will include fourteen lattice-work towers, some 240 feet high, while particular care will be given to the beam array for Italian East Africa.

BBC SOS Messages

DURING 1936 the British Broadcasting Corporation broadcast 1120 SOS and police messages, an increase of 117 over the previous record figures of 1935. There were 765 appeals for relatives in cases of illness, of which 444 were successful. There were also 53 such appeals, of which the results were not known.

These SOS messages are broadcast only when all other means of communication have failed. Ordinary police messages (appeals for witnesses of accidents) numbered 301, and of these 145 were successful. There were 36 "special" police messages for missing drugs, and so on, of which nine were successful; and 18 crime appeals with four successes.

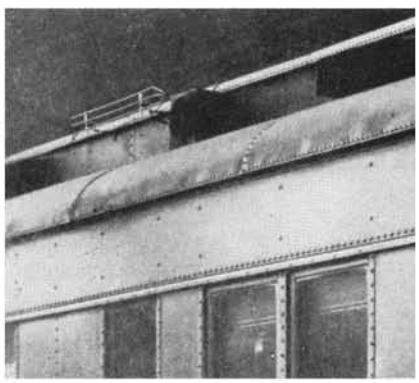
In tracing either criminals or missing drugs, radio only plays a part, and it is often difficult to assess its value in a given case. For the purpose of analysis such a message is classified as "unsuccessful."

United States broadcasting stations are seldom used for such purposes, the commercial factor involved precluding the allotment of time to public services. As a consequence, police radio systems have been established to take care of "specialized crime" and the broadcasting of appeals often relegated to the radio amateur.

Occasionally a broadcasting station issues an appeal for information regarding a lost child, but ordinarily such matters are left to the police. In times of emergency, such as the recent floods, our broadcasting stations perform a valuable service by issuing instructions and proclamations to the public, obtaining outside assistance, and handling routine traffic. They are converted from mediums of entertainment into instruments of aid. Their value in the latter aspect is often overlooked.

Railroad Radio

A NEW type of radio installation has recently been completed on the three sections of Baltimore & Ohio's Diplomat Limited which runs between St. Louis, Washington, and New York. It was especially designed and installed by engineers of the Crosley Radio Corporation to overcome



The antenna that helped solve a reception problem on a railroad train

certain apparently "dead" radio spots in the Potomac Valley, which had caused previous installations to fail. The receiver has seven tubes and operates on the 32-volt lighting system of the train.

A new and more efficient type of antenna system also had to be provided. Whereas it previously had been impossible to get reception in the Potomac Valley, perfect reception of some 30 stations in that area has been reported under all conditions during daylight hours, the most difficult time for radio reception. The installation includes a standard automobile under-car antenna about three and a half feet long. It is placed horizontally and lengthwise of the car only a few inches above the roof at the lower side, as shown in the accompanying illustration.

All-Continent Radiophone

SHORTLY after Christmas, and during the early part of this year, radio amateurs operating in the 20-meter phone band set up a new world's record in short-wave communication by establishing an all-continent "party line" encircling the earth. Those who took part were: W4DLH, of Goulds, Florida; HK1Z, Colombia, South America; G5ML, Kenilworth, England; SU1CH, Cairo, Egypt; VU2CQ, Bombay, India; and VK4LO, Brisbane, Australia.

The operators of these six stations stood by in the band on pre-arranged schedule on December 30, 1936. One operator conversed as the other five listened; then the transmission was turned over to the next in line until the entire circuit was completed. In each instance the transmission from one station was clearly heard by the other five.

Similar contacts were made during January, and the time required for completing the "Round Table" has been reduced from 27 minutes to 8 minutes, 10 seconds. The experiment has been so successful that these six operators now "meet on the air" every Tuesday and Friday morning at 7:30 A.M., Eastern Standard Time. Conditions do not always permit the completion of the circuit, but at least some of the stations manage to "break through."

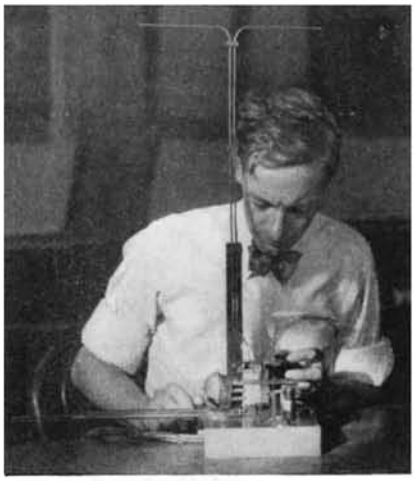
Here is a nice bit of distance reception for the short-wave listener. The next time you are up and about at the hour and days specified, tune your receiver to the 20-meter (14 megacycle) amateur band and see what luck you have. All transmissions are by radiophone.

Fractional-Wave Transmitter

DEVELOPMENT of radio communication at ultra-high frequencies has proceeded with such rapidity that whereas a few years ago the range of frequencies from 30 to 100 megacycles was practically unexplored, today experimental activity extends to much higher frequencies.

Frequencies from 300 to 600 megacycles —corresponding to a wavelength of less than a meter—are now readily generated, and the day is not far distant when these ultra-high frequencies will play an important part in "short-haul" communication.

In the accompanying illustration is shown a recently-developed ultra-high-frequency



Courtesy Western Electric Company

Six watts can be radiated from this transmitter at a frequency of 500 megacycles—less than one meter

transmitter capable of producing from 8.5 to 4 watts, respectively, at frequencies from 300 to 600 megacycles. The heart of the transmitter is the new Western Electric "doorknob" tube, so called because of its shape, which makes possible the generation of minute radio waves. It may be seen mounted vertically just above the metal base of the transmitter.

The copper rods, with their ends extended out horizontally like the feelers of some insect, form the antenna system. This aerial is similar in many respects to the "doublet" of much larger proportions used extensively in conjunction with the modern all-wave receiver.

Proposed Government S.-W. Station

AFTER introducing a bill to establish a government-owned Pan-American short-wave station in Washington, D.C., Representative Celler (Democrat), of New York, outlined a program policy for the United States Commissioner of Education to follow in directing the station.

The station's broadcasts, he said, might be divided into four classes:

(A). For Pan-American Use: Such as concerts at Pan American Union, important government events as the President's message to Congress, concerts by leading United States musical organizations, and outstanding theatrical productions as those by the Metropolitan Opera Company and the Chicago Civic Opera.

(B). For National and Pan American Service: Addresses by the President and other government officials, and various national events.

(C). For National Service: Broadcasts dealing with aims, functions, and policies of the government, economics and government, home economics, and the like.

(D). For Education: Vocational guidance and programs dealing with the liberal arts, music, drama, the arts, and so on.

The bill has met with opposition—possibly on the grounds that the program policy bears a striking likeness to the policies of a number of the more powerful foreign government-controlled short-wave broadcast stations which, though their intentions may be good, contrive to become involved with propaganda.

CAMERA ANGLES

Conducted by JACOB DESCHIN

Dance Photography

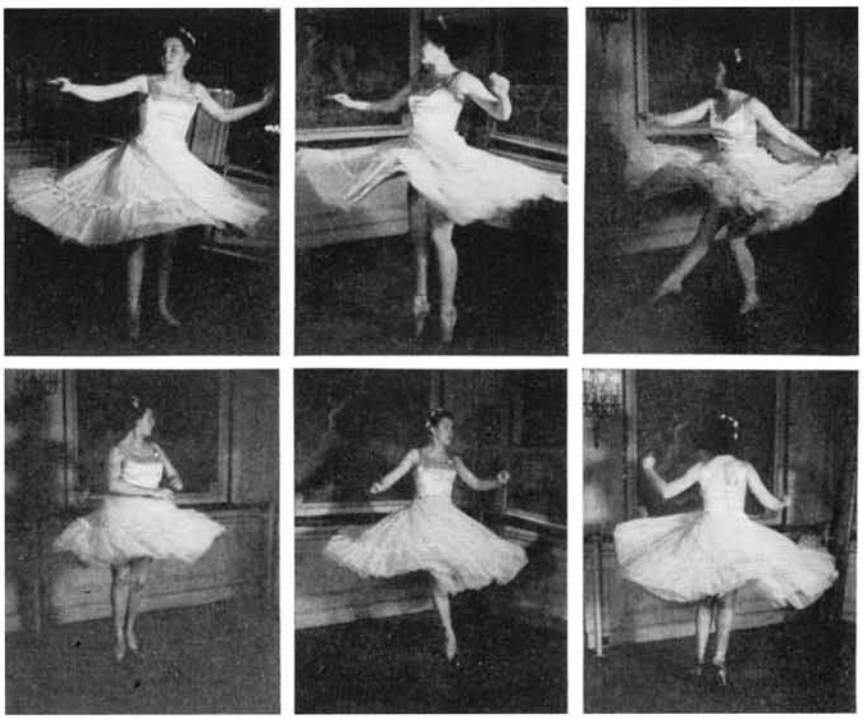
RHYTHMIC movement is the chief characteristic of the dance. Arnold Genthe, whose photographs of the dancer Isadora Duncan won him wide fame, appreciated this. Instead of posing his subject in front of a still camera, he hit on the idea of using a motion picture camera and photographing his subject in action. Afterward he selected the best "stills" and made his photographs from them.

The high-speed lenses available today and the facility with which exposures in rapid sequence may be made with the modern "candid" type cameras give the contemporary photographer of the dance somewhat of an "edge" over the photographer of yesterday. An extremely useful camera for this purpose, the Robot, is so constructed that with a single winding of the knob one may shoot 24 exposures without once stopping to rewind. About four or five exposures can be made each second so that it is possible to "stop" the dancer's movements 24 times within as short a period as five or six seconds. Because of the fast movement of the dance, the Robot will be used to best advantage outdoors in daylight, the fastest lens with which it is at present equipped being the Tessar F:2.8. However, the double spotlight often employed in stage lighting for dancing numbers will serve too, provided the action is not too rapid. Moreover, since the recording of a little movement is preferred by many to actual "freezing" of the action, because a sense of motion is thus conveyed, the lack of complete sharpness is not an actual detriment.

The accompanying group of photographs of the young ballet pupil was made with the F:2.8 wide open at 1/50th of a second as it did not seem safe, with a total of but 1500 watts of projection bulb lighting, to give a faster exposure. The 3 cm focal length of the lens, covering a film area one inch square, gave enough depth of field about 12 feet from the subject to permit free movement of the dancer within a relatively wide area.

The worker who attempts dance photography must be prepared to use a lot of film. Not every shot will be a "hit" and quite a few will necessarily have to be discarded after the results are seen in the final negatives. But the good pictures that one will eventually select will be of a type rarely obtainable in a posed photograph.

The tremendous light-admitting power of the F:1.5 lens now available for the Leica and Contax cameras permits exposures, under artificial light, at as fast as 1/500th of a second and faster. Even 1/250th of a second, however, is often sufficient to stop movement. The film used will, of course, always be of the "super" panchromatic va-



The rhythm of the dance, captured with a Robot camera

Below and right: Examples of dance photography with Contax and Leica

riety, the fastest obtainable. A few Photoflood bulbs and a good subject, a plentiful supply of film and lots of room to move about in will provide all the requisites for indoor dance photography.

Subjects are not too difficult to get. If there is a budding ballerina in the family one need not go beyond one's home for opportunities. If not, an instructor in stage dancing will be fairly easily persuaded to let you come into the studio when a class is in progress provided you do not create too much of a disturbance. The group here shown, incidentally, was made in a dancing studio, permission having been obtained through a friend of a friend.

Flash Bulb for Focal Plane Shutters

ESTIMATED to give 50 percent more total illumination than the foil type flash bulbs and to maintain the peak of the flash three times as long, a photoflash bulb called the Superflash has recently been developed and placed on the market. Designed principally to use with professional synchronizers on "candid" cameras of the focal-plane type, the flash element resembles a fine wire fluff, which is really a carefully controlled hydrolanium wire of a precise length and diameter. The timing characteristics and intensity and volume of light are controlled by the precise measures of this wire, the manufacturers announce, so that it has been possible to lengthen the flash at its brightest point, thus assuring full coverage and evenly exposed negatives.

A blue Safety Spot in each Superflash bulb is protection against misses, spoiled negatives and exploding bulbs. The entrance of air into the bulb—the cause of explosions—causes the Safety Spot to turn pink, which means a defective bulb that must be discarded.

Dry Hypersensitizing

AN increase of from 50 to 150 percent in emulsion sensitivity is claimed to have been obtained by a new method of dry hypersensitizing of film with mercury vapor, the results of experiments by Drs. F. Dersch and H. Luerr, of the Agfa Ansco Research Laboratories. The film, either wrapped or unwrapped, is placed in a sealed container with a small amount of liquid mercury (0.5 gram) or silver amalgam containing a high percentage of mercury. The film is allowed to stand at room temperature from 36 hours for loose, or unwrapped material, to about a week for wrapped or tightly spooled film. It is further reported that this hypersensitization has no apparent effect on the gradation or the grain size of the photographic material.

The following are some of the facts ascertained by Drs. Dersch and Luerr in their experiments:

"(1). The film does not have to be put through a bathing process and then dried. (2). The increase of sensitivity is general throughout the range of wavelength of light to which the film was originally sensitive. (3). The stability of the film is not permanently affected, although the increase in speed is gradually lost over a period of four weeks of aging. By a second treatment with mercury vapor the hypersensitization can be renewed in a film that has recovered from previous hypersensitizing."

Using Spiral Tanks

SOME workers occasionally run into difficulties in attempting to insert film into the spiral of the film-processing tanks which have now become so popular—and indispensable. The film seems to start off jubilantly enough but once in a while strikes a snag a little further along the trail. This is because the end of the film strip has been made extra stiff by being attached to the paper leader. You can smooth the path of the film's progress through the reel by cutting off this stiff end or by cutting a diagonal snip from each corner, or do both. For 35-mm film a scheme that has worked successfully is to fold back the film end about an eighth of an inch. The claim is that with this treatment the film will slide in "like butter."

"Out, Out, D—d Spot!"

WHILE this department is ordinarily immune from metol "poisoning," its hands do not seem to be proof against the staining proclivities of paraphenylene-diamine. Since this is ordinarily used in tanks, we never before had occasion to test our resistance against it. Recently, however, in a

jam in the darkroom, on one of those occasions when things don't run according to Hoyle and it is essential "to get through with it" under the dim illumination of panchromatic green light, we were forced to develop a roll of film in a tray of "P.P.D." solution after pouring the bath from a recalcitrant tank into the tray. It was pretty messy work and our fingers got a thorough soaking in the solution. Nothing seemed to help in our efforts to get rid of the stain so we "let it ride" and allowed nature to take its own course, which it did in the surprisingly short course of a little over a week. Ordinary washing in the regular routine of the daily ablutions constituted the sole "cure."

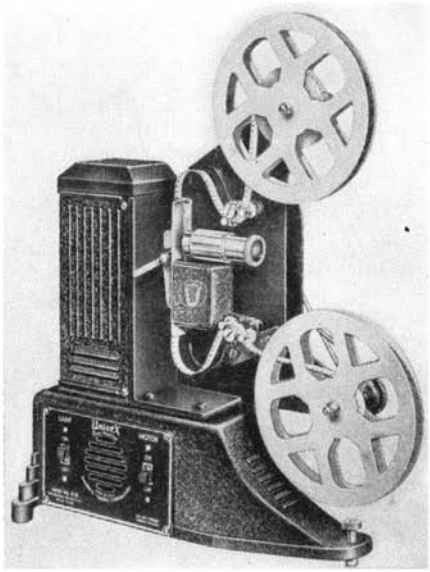
We all know what a boon rubber gloves may be; they certainly would have saved the day in the particular incident recorded above. But, of course, under the circumstances, it was not possible to drop everything and run out for a pair of gloves! In mild cases and if the matter is attended to right away, an application of Edwal's Stain-Go might help, as well as a thorough scrubbing with soap and water.

Movies at Low Cost

UNDOUBTEDLY one of the reasons why more photography fans have not gone in for motion picture work is the high cost of equipment and film. This department knows only too well how family budgets are pared in order to provide the wherewithal to fit the desires of the average "still" photographic bug. Thus, when consideration is given to movie work, the decision usually is in the negative (no pun). Now, however, it is possible to procure a thoroughly satisfactory little 8 mm camera *and* projector for less than 30 dollars, and to shoot motion pictures to your heart's content for a relatively low cost per minute of projection time.

The new camera is known as the Univex 8 mm Cine Camera and is a beautiful job of workmanship, particularly when cost is taken into consideration. The camera is available with any one of four lenses—F:5.6, F:3.5, F:1.5, and a telephoto lens. Standard equipment is the F:5.6 lens and the others can be had as accessories. Even for the fastest lens the price is low.

The projector is driven by an electric motor and is available for either AC or



Projector by Univex

Univex 8 mm Cine Camera in use

AC-DC operation. It can accommodate a standard 200 foot reel of 8 mm film giving a projection time of approximately fifteen minutes. Two switches are provided, one for the motor and the other for the light—which incidentally is a special concentrated filament projection lamp. An automatically operating screen is provided so that stills can be projected without danger of scorching the film.

Small enough to be carried in the coat pocket, the camera is inclosed in a die-cast case, adequately light-trapped. The spring motor will operate for approximately 20 seconds at a sustained speed, amply long enough for the average motion picture scene. A footage indicator tells how many feet of film are left unexposed.

Whether it is used as an accessory to the still camera or serves as the basis for a start in the amateur movie hobby, this new camera with its accompanying projector will give entirely satisfactory results, particularly when the low drain on the pocketbook is considered.

ROLLEIFLEX EXHIBITION

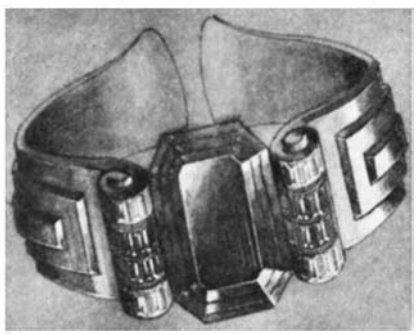
AN opportunity for users of the Rolleiflex, Rolleicord, Heidoscope, and Rolleidoscope cameras to exhibit their pictures and possibly win a prize is offered by Burleigh Brooks, Inc., 127 West 42nd Street, New York City, who has announced an exhibition to be held in a suitable place in New York, not yet announced, sometime in May. Cash awards for the most outstanding photographs submitted will be made in each of four classes: Pictorial, Portrait, Technical, and News. The first prize in each class will be 50 dollars, the second, 25 dollars, and there will be 25 Honorable Mention certificates. A Grand Prize of 100 dollars will be awarded to one of the four winners of the first prizes.

The rules are that no more than four prints may be entered by one exhibitor and prints may not be smaller than 8 by 8 inches, the desired size being 11 by 14 on 16 by 20 mounts, white or cream-colored. The last day on which prints may be submitted is May 7, 1937. Each print must have on its back the following data: Camera used, film, exposure, printing paper. The jury which

will make the selections will comprise Edward Steichen, Dr. F. M. Agha, and Thomas J. Maloney. Entry is open to all users of the Rolleiflex, Rolleicord, Heidoscope, and Rolleidoscope cameras in the United States and its possessions. Following the exhibition, the winning prints will be sent on tour.

Diffused Lighting

FOR the second time, we illustrate how a single light may serve to function efficiently for copying purposes. In this copy of a water color drawing on a sheet of celluloid we show the result of throwing a well-diffused light from one side. Incidentally, prior to taking the picture, there was some doubt as to whether a photograph could be made at all. Of course, to the photographer the subject held no terrors. Was not the drawing made up almost entirely of highlights, even in the gradations of the emerald?



. . . From a water color drawing

Foot Switch

DESIGNED to fill the needs of the photographic worker who has often wished for a method by which he could turn the light in his enlarging camera on and off with his foot in order to leave his hands free for "dodging," a foot switch, inexpensively priced, is now made available. Known as the Watson Foot Switch, it is operated by connecting the plug at one end of the cable (supplied with the outfit) to the main current line and connecting the other side of the switch with the enlarger itself. In use, the enlarger light is turned on by stepping lightly on the tread of the switch and turned off again by releasing this pressure.

The switch is also recommended for use in controlling Photoflood and Photoflash bulbs or any electrical device drawing not more than six amperes at 110 volts, alternating current. The makers guarantee its efficient use on 110 or 120 volt A.C. or D.C. circuits.

Zeiss Exhibition

COMMENTATORS on the Third Annual Zeiss-Ikon Photographic Exhibition, now making the rounds of various large cities throughout the country, see in the more than 350 prints contributed a fairly general trend away from the purely "candid" shot and definitely toward the pictorial. They say that even in the so-called "candid" shots there is a notable increase in examples of the pictorial, one proof of this lying in the fact that even in news photography the trend is distinctly towards prints of related subjects; that is, a story sequence.

"We felt last year," say the sponsors of the show, "that the amateur imagination was being given free rein—that good equipment had minimized the mechanical hazards and that all things being equal the man with the camera eye and brain would take the best picture. This we still feel to be true."

Drying Negatives Quickly

MODERN fine-grain practice has it that the best fine-grain results are obtained when the period of drying the film is cut to the minimum. Not only does quick film drying possess this virtue, but it also means that printing or enlarging from it does not need to be delayed. As an aid in this connection there has recently appeared on the market the Agfa Film Dryer. It comes in solution in several sizes and is used after washing has been completed.

Electric Dryer for Glossy Prints

THE feature about making prints and enlargements on glossy paper that seems to annoy most workers is the long time it takes for the prints to dry and peel off the ferrotype plates. Since the drying process is dependent on the temperature of the room, the humidity in the air, and so on, drying may take a number of hours. The professionals are able to do the job in a few minutes by using an electrically heated unit. As such an outfit is rather too large for amateur requirements—and much too expensive—a professional dryer is out of the question for him. An adaptation of such a dryer to amateur requirements, however, has recently been placed on the market that will do the job just as efficiently as the professional units. Considerably scaled down both in proportions and in price, the new dryer—the Standard Print Dryer—can be used for quickly drying both glossy and matt finish prints. It will dry a single weight print in four minutes and a double weight print in seven minutes.

The claims for the Standard Print Dryer are that it will dry prints flat, without curling or spotting; that thermostatically controlled heat keeps the heating unit, which is made in three sections and arranged to give a maximum amount of heat with minimum power consumption (300 watts during operation), always at a steady, uniform temperature; that the 12 by 17-inch chrome-plated ferrotype plate is removable, making it possible to prepare additional plates while others are drying; and that it is unnecessary to watch or to turn switches on and off as the heating unit cannot damage prints.

"Wings For Your Salon Prints"

IN this charming way do the manufacturers introduce us to a new type mailing case for sending prints to exhibitions. It is made of the light, strong metal called duralumin, the same material that is widely used in airplane construction. The inside measurements are 16¼ by 20¼ inches, estimated to carry four or more of the regulation size 16 by 20 mounts and the case is designed to be wrapped in paper and tied. Each case is furnished with 12 sheets of 16 by 20-inch soft interleaving paper.

The manufacturers' "confession" of how they finally decided on duralumin and the

design of the case is illuminating and gives an inkling of the thoroughness with which manufacturers of photographic equipment usually work in order to bring out a completely practical article of real use to the amateur. Here it is:

"We went to the best cabinet maker we knew and had a wooden case made but decided it was too bulky and too heavy. Next we tried standard hard fiber board and made a case that looked promising but when it went through the mails, the walls collapsed. One after another we had ten models made by four craftsmen in different lines. We tried thin fiber sheets but they proved too flexible; we reinforced those with rigid boards but that was not quite right either. We tried an all-metal case, then one having rigid fiber top and bottom with attached metal walls but when that went through the mails, the sides were badly dented. With the tenth model, we have reached the answer. It is a case made of strong fiber pressed specially thin for us by the mill to achieve light weight and it has rigid top and bottom with solid fiber walls that are incased in folded and riveted duralumin."

CLOUDS IN THE CITY

IT is not without reason that the photographer is attracted to clouds and never misses an opportunity to snap them. In the city he finds many interesting compositions

Skyline and clouds

which would be worthless without clouds. Buildings silhouetted against the sky are a favorite subject; trees and clouds are another. Clouds are restful, inspiring, beautiful, and gay. They may also be somber, dramatic. The yellow filter has been used for a long time to cut down the intense influence of the blue of the sky on the film and so give the clouds a chance to record themselves in proper contrast, but in recent years a number of new filters have been introduced for the express purpose of obtaining a dark sky in which the blue is not only cut down but cut down to a quite dark gray. The most popular of these at the present time is the light red filter which must, of course, be used in conjunction with panchromatic film. Also, the exposure must be increased four to ten times.

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 329)

household refrigerators, and ice cream cabinets. It is also suggested as a bulker, especially for alkali powders, for the silica is readily soluble in alkaline solutions. Such ready solubility provides a means for preparing the silicates of organic bases.

Aerogel possesses the remarkable property of mixing rapidly and uniformly with pigments. When a tube containing a considerable bulk of aerogel and a small proportion of colored pigment is shaken once or twice, a uniform mixture is obtained. This provides a most spectacular demonstration of its exceptional dispersive properties which may find practical application in paints and lacquers.

A number of interesting uses follow from the remarkable behavior of aerogel with liquids. Certain grades are said to absorb up to 80 percent of their volume of water without getting "wet." After that, a paste is formed. Aerogel is thus of value in drying up watery liquid compositions. It may also be used in making thick greases from thin oils, and has been suggested as a suspending aid for the pigments in paints and printing inks.—*Industrial Bulletin* of Arthur D. Little, Inc.

'Bulb-Within-a-Bulb' Mercury Lamp

DEVELOPMENT of a unique 100-watt mercury lamp, a relatively small tubular "bulb within a bulb" that is expected to accelerate lighting progress materially and bring substantial benefits in commerce, in industry, and to such specialized fields as street lighting and photography, was announced recently by the Mazda lamp manufacturers at Nela Park laboratories.

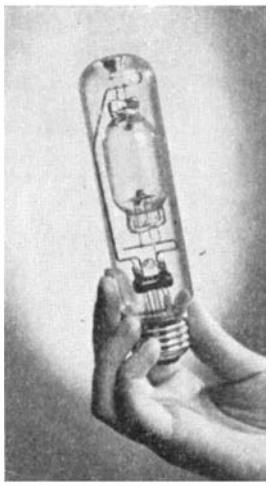
Although the new lamp is still in the experimental stage, laboratory experts were enthusiastic concerning its potentialities. They declined, however, to predict just when the double-bulb specimen would be made commercially available.

In its present stage, the strange lamp produces 30 lumens per watt, or about as much light as the standard filament 200-watt lamp now emits. Early tests indicate that this experimental mercury lighting tool not only has a relatively long life but maintains a remarkably high light-output as well.

About the size of a small cucumber—the outer bulb has a diameter of 1½ inches and an all-over length of less than six inches—the new lamp is less than half as wide as the standard 200-watt tungsten filament lamp and measures two inches less in length. This compactness, plus other efficiency advantages, experts explained, indicate that this bulb-in-bulb mercury lamp will, when perfected, adequately answer urgent needs for a mercury lamp which can be used satisfactorily in combination with filament lamps to give a better quality of light from reasonably small lighting units.

The outer bulb of the new 100-watt mercury lamp consists of a tubular-shaped protecting envelope of soft glass. The inner bulb, also tubular, but about the size of a stubby fat thumb, is made of extra-hard heat-resisting glass. This hollow glass "thumb" is only two inches long and about an inch in diameter. Within is a small amount of mercury and enough argon gas to "start" the lamp.

Unlike the present 250 and 400-watt mercury lamps, this bulb-in-bulb small edition operates from either a 110-115 or 120-volt line without need of a voltage step-up for starting. A reactor or "choke" governing device is, of course, required to keep the lamp



The latest in mercury lamps

from "racing away with itself" while in operation. It operates at about two atmospheres pressure.

When the new lamp is first turned on an arc strikes. This emits a feeble bluish glow. The lamp takes about five minutes to get fully "warmed up." Meanwhile, the glow gradually builds up into an extremely brilliant stream of light.

If used for street lighting, this new lamp would require a transformer to insure proper voltage and current for satisfactory operation.

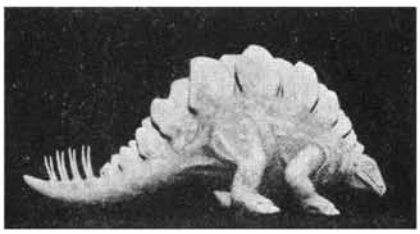
Behold the Mighty (Midget) Dinosaur

SCULPTOR Jack Sather of Fort Peck, Montana, is shown in our illustration putting the finishing touches on a clay model of Stegosaurus, a dinosaur of the Jurassic Period of about 150 million years ago. Stegosaurus is one of the oddest creatures that ever lived and, for his size, had the smallest brain known. He measured 11 feet high and 30 feet long. His fossil remains are found in the territory immediately east of the Rocky Mountains.

In the background are other dinosaur models by the same artist together with a portion of the famous Fort Peck Fossil Collection. The territory near the great dam, now under construction by the U. S. Army Engineers, abounds in fossil remains of dinosaurs and other reptiles. The collection was assembled by workers on the dam and residents of the area. Since the reservoir to be created by the dam will cover 245,000 acres, plans are being made to conduct an intensive search for fossils in the area before it is flooded. Several eastern institutions are particularly interested.

Mr. Sather has been sculpturing for years. While in college, he became interested in dinosaurs. Now he devotes about all of his spare time to their study, particularly in Professor Marsh's "Dinosaurs of North America." His models are correct in min-

Sculptor Sather's models, accurate to the tiniest detail



A model of stegosaurus, the one shown in Mr. Sather's hand, above

utest detail so far as known. Best of all, he can spend his Sunday afternoons in the badlands near Fort Peck and find hoofs, claws, skin-plates, horns, and bones of the creatures he delights in reproducing. He expects to have an entire exhibit case filled with models before spring. Each shelf will represent a different era, beginning with the Jurassic and ending with the uppermost of the dinosaur zones in the Cretaceous. Each group will have a painted background depicting its associated flora and contemporaneous fauna.

Hayfever from Civilization's By-Product

THOSE unfortunate persons who must sneeze and sniffle their way through every summer and fall, unless medical treatment or vacation resorts can give them relief from hayfever, are paying the price of civilization. This view of a miserable ailment was recently presented by R. P. Wodehouse, scientific director of the Arlington Chemical Company, to members of the American Institute of New York City.

An enormous increase in ragweed and certain other hayfever-causing plants is a by-product of our modern civilization which has disturbed the soil and its natural balance of vegetation, Dr. Wodehouse pointed out. Ragweed plants were scarce before civilization came along to plow up large sections of land, dig ditches for sewers, level off stretches for roads, and otherwise disturb the vegetation.

The hayfever patient and others who suffer from allergies are not invariably abnormal, Dr. Wodehouse suggested. It is their environment which is abnormal. Dr. Wodehouse said that allergy is seldom evident with respect to those things old in the experience of the human race. Pine trees, he pointed out, produce far greater quantities of pollen than ragweed plants, but no one seems to get hayfever from pine pollen. "The human race," he said, "must certainly have been cradled in an atmosphere of pine pollen and has ever since been subjected to annual exposure to it. We are all immune to pine pollen and to a certain extent to the pollen of most of our deciduous forest trees." Civilization has made a ragweed paradise of this continent, Dr. Wodehouse maintains, and the "end is not yet in sight for the ragweeds are still on the increase as more and more areas are laid open to them." —*Science Service.*

TOPSOIL

IN addition to an enormous destruction of property, the January-February floods in the Ohio Valley carried away an estimated total of 300 million tons of topsoil. This loss is irreplaceable and rich farming lands have suffered accordingly.

Glycerol As a Drying Agent

ALTHOUGH glycerol prices in the United States have been rising as new uses for this by-product of soap manufacture have been developed, word comes from England of its economical use to remove moisture from manufactured gas. Glycerol readily absorbs moisture from the gas before it is put into the mains. After absorbing moisture to its limit the glycerol is re-concentrated and used again. The cost is very low because the glycerol can be completely recovered. It is preferred to other drying agents which are corrosive to equipment and may react chemically with the constituents of the gas. —*D. H. K.*

Seaweeds Made Many Rocks

SEAWEEDS are responsible for the formation of many massive rocks in the older strata of North America, the Paleontological Society was told at a recent meeting by Dr. Carroll Lane Fenton and Mrs. Mildred Adams Fenton, *Science Service* reports.

Many seaweeds even today are great gatherers of limestone, which they extract from sea water and deposit as shell-like crusts

about themselves. Some seaweeds of this type are often superficially so like corals that many persons mistake them for these animals.

It is difficult to identify some of these seaweed-deposited limestones, Dr. Fenton said, because they form a maximum of lime and leave a minimum of plant traces. Nevertheless, he and Mrs. Fenton have been able to make out certain form-species that appear to be alike in widely separated regions, such as the Grand Canyon, Minnesota, Montana, and Pennsylvania.

Worms, also, can slowly build mighty rocks. Drs. B. F. Howell and John F. Mason of Princeton University described reefs in certain California strata, formed entirely of the limy tubes in which, ages ago, lived crowds of the marine worms known to science as *Serpula.*

Transparent Utility Boxes

BOXES of transparent resins, particularly cellulose acetate, are finding a ready use as packages for everything from orchids to shirts, hats, and shoes. By providing transparent containers in which a traveler's clothing can be kept in order on a long journey, or in which accessories to milady's apparel can be put away out of the dust but easily identified when needed, these new plastic products are finding great favor. Some retail stores, recognizing the added sales appeal of articles packaged in these relatively cheap containers, supply them gratis with purchases.—*D. H. K.*

Your Brain Keeps on Growing

A MENTALLY active human brain keeps on growing until the age of 50 or 60. This is the most logical interpretation, says Dr. Ales Hrdlicka, curator of physical anthropology of the Smithsonian Institution, of a slight but constant increase in the dimensions of the head which continues in mentally active men and women throughout most of adult life until the changes associated with old age begin.

The increase in head size has been found by Dr. Hrdlicka in measurements made on "old Americans"—persons with at least three generations of American ancestry; on the members of the National Academy of Sciences; and even on a large group of Indians. It has just been demonstrated strikingly by reported measurements of large groups of Russians of various racial groups, and it appears in the great body of data collected by French anthropologists.

"There is no evidence," Dr. Hrdlicka says, "that either the scalp or the bones of the vault thicken with age; the scalp, in fact, it is now known definitely, becomes thinner."

Latex Storage Battery Separators

FAILURE of storage batteries in use has frequently been caused by damage to the non-conducting separators placed between the battery plates. A new type of separator made by vulcanizing rubber latex has been found far superior to the separators generally used. The cured latex sheets resist the chemical action of the acid in the battery as well as the effect of charging and discharging it through as many as 24,000 cycles of charge and discharge. Cedar separators fail before 12,000 cycles have been reached. The natural porosity of the latex separators introduces less internal resistance into the battery than wood separators. —*D. H. K.*

Windmills Come Back— As Protectors

THE eerie squeak of the windmill, once quixotically annihilated by gasoline power, has returned to haunt the home of its successor. Windmills are being used to protect vast pipe line networks from corrosion.

Thousands of miles of underground steel pipe carry crude oil, stabilized crude, refined products and gas. Conditions are ideal for corrosion, with heavy leakage and maintenance costs, for when steel is thus buried underground small electrical currents are set up on which the metal floats away. Technically it is electrolytic corrosion, with the steel pipe the anode from which iron ions go off into the soil. One ampere of current will carry away 20 pounds of steel per year, and, as this loss usually comes from small local areas, the corrosion problem is serious.

By the simple procedure of reversing the current by impressing a small voltage from an outside source, this electrolytic corrosion is stopped, the pipe becomes the receiving end—the cathode—and is protected by a layer of hydrogen formed at that point.

The practice of this new method may be applicable to other situations where steel is buried in moist earth. A hole is dug near the pipe line and scrap iron dumped in. Sometimes rock salt is added to make the ground more conducting. The pile of scrap iron is connected with the positive pole of a source of low-voltage direct current, and the negative pole is connected with the pipe line, usually in a number of scattered places. Through the circuit thus formed, current flows from the positive pole of the source of electricity through a copper cable to the scrap iron, the anode, which corrodes rapidly but is of negligible value. The current then flows through the earth, the ions being carried by the moisture in the soil, to the pipe line, now the cathode, and a protective film of hydrogen forms on it. The current then returns to the source by another copper cable.

Any source of electric power may be used for this "cathodic protection," but the commonest are probably small low-voltage generators driven by windmills. In the pipe line country of Texas and adjoining states the winds are steady and reliable, and the almost obsolete windmill again becomes a familiar mark on the landscape.—*Industrial Bulletin* of Arthur D. Little, Inc.

Frozen Smells

MEASUREMENT of smells by freezing them has opened the way to a new method of filtering odors from re-circulated conditioned air in railroad cars, V. A. Gant of the University of Illinois Medical School and H. D. Shaw, research scientist of the Pullman Company, report to the American Chemical Society.

Conducting tests in a lounge car where passengers were eating, drinking, smoking, and sleeping, the investigators found that in a comparatively short time the condi-

tioned air, composed of 25 percent fresh air and 75 percent re-circulated air, became objectionably odorous.

"Large proportions of tobacco smoke, and the odors of food, liquor, and human bodies from the bedrooms and the lounge were drawn directly into the re-circulated air intake," the report points out.

The problem was to measure the smells individually, so that an efficient filter could be designed to eliminate them, and this was accomplished by filtering the air from the car through dry ice.

"The frozen odor and moisture were placed in a wide mouthed bottle properly fitted with a cork collar through which was inserted an osmoscope," the report continues. "An osmoscope is an instrument permitting the measurement of smells by measuring the concentration of fresh air at the time the smell becomes apparent to the technician."

Once the smells had been measured, Gant and Shaw point out, it was necessary to devise a filter which would remove them without itself exuding any odor, as chemical filters were found to do. The best medium for this purpose, the scientists discovered, was activated carbon. The filter devised was constructed on a principle similar to that of the first gas masks used in the World War, which contained a filter of nut shell carbon. Subsequent tests established that the carbon filters were successful in removing any noticeable trace of odor in the lounge car used in the first experiments, and that the filters have an effective life of at least four months.

GLASS FIBERS

DEPENDING on the nature of the application, glass fibers vary in diameter from 0.02 inch to 0.0002 inch (less than the diameter of human hair) while some fibers for special purposes have been produced as fine as 0.00005 inch.

Social Service and the Weaklings

IN a long letter to the *Times* (London) Lord Dawson has gone to the root of the problem of national health in its politico-medical aspects. He points out that years ago nature's method of selecting the fit was a high birth rate and high infant and adult death rates. Formerly weaklings in body and mind sank to a low economic level, lived precariously, and were prone to elimination by diseases such as tuberculosis. Today, through our social services, they receive maintenance and increasing protection from the ravages of disease. The mortality from tuberculosis has been halved in the last 25 years. Further, these weaklings often propagate to the disadvantage of the race. This nugatory rendering of nature's rough method of elimination necessitates an alternative policy, which we have not thought out. It should comprise (1) plans to promote fitness during the period of rearing and development; (2) plans to secure that the most fit among youth, from wherever they derive, have every opportunity to get to the forefront; and (3) plans of special and kindly measures for dealing with the inherently unfit.

Let us beware lest in our desire to be kind to the weaker brethren of today we are not more than unkind to all the brethren of tomorrow. It is relevant to consider the birth rate. During the 50 years 1880-1930 there was a decline in the crude birth rate of 54 percent in England. The dominant cause is contraception, which is widely and increasingly practiced in all European countries. Its practice is more prominent among the more educated classes, but it has already reached the artisan class and is rapidly penetrating the classes that live by unskilled labor. One potent cause is the fall of the infant death rate from 172 to 57 per thousand births during the last 90 years. Formerly the death rate was the safety valve. But contraception can be misused and in some cases families are too small. Fit citizens should more than replenish their own places.

Finally, the inherently unfit should be actively discouraged from reproduction. Good nurture cannot be a makeweight against bad breeding.—*Journal of the American Medical Association.*

Dyeing Molded Plastics

A NEW method of dyeing articles molded from synthetic resins allows manufacturers to apply colors as desired to their product without requiring them to hold large stocks of various colors. In the past the manufacturer of colored articles from synthetic resins has been compelled to introduce the color into the molding compound before finishing. The new process, developed by Gustavus J. Esselen, Boston chemical consultant, involves softening of the surface of the molded article in a solution containing glycerin and a phenol. This softening process allows dye actually to enter the molded article and give it a depth of color. An advantage of the process, which may be applied to plastics containing a variety of synthetic resins, is that it allows manufacturers to stock uncolored molded pieces and to dye them in colors demanded by changing fashions.—*D. H. K.*

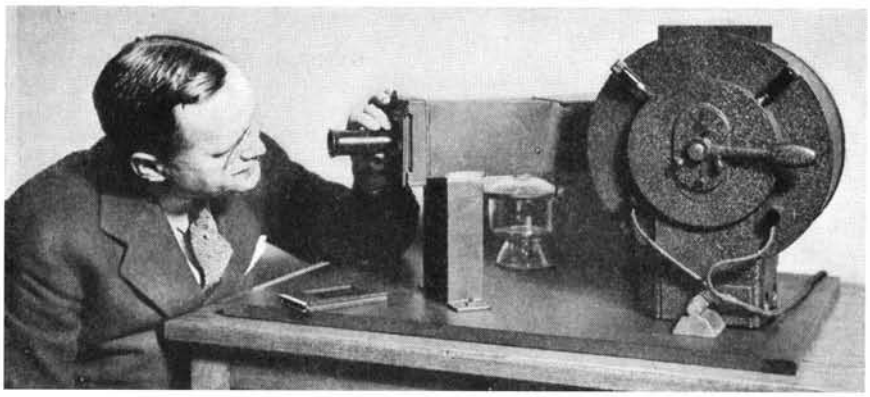
Mill-Impregnator-Truck Makes Stock Feed

DURING the western drought, it was discovered that a remarkably fine stock food could be obtained by mixing almost any food the farmer had—beet pulp, oats, corn, and so on, with black-strap molasses. This addition converts feed that is short in carbohydrates and long on bulk into a tasty, rich, appetizing product of much higher value.

However, the processing necessitated a long trip to the mill, and another complicated operation to impregnate the ground feed with molasses. But today farmers near Lapeer, Michigan, do not have to worry about these costly operations, for their mill now comes regularly to their own barnyard, every two weeks.

This ingenious and practical outfit consists of a portable mill and a molasses impregnator mounted on a Diamond T truck. The truck motor, through a specially built split shaft power take-off, furnishes the power.

The farmer has his feed ready when the truck is due, the feed is ground and impregnated with molasses in a very few hours,



Equipment for rendering fingerprints visible by ultra-violet light

and the truck then departs to the next farm on its schedule. The farmer is left with ample high-grade prepared feed, ready for instant use, without the expense and time of hauling—a remarkable instance of the mountain not only coming to Mohammed, but making a tidy profit in doing so!

Oat Flour Prevents Rancidity

RANCIDITY in foodstuffs is known to be caused by the action of oxygen on fats and other compounds in them. To overcome oxidation, a number of synthetic chemicals have been found effective, but most of these are of such character that they cannot be added to foodstuffs. Recently it has been found that oat flour possesses to a remarkable degree the power to suppress the changes in foodstuffs which result in rancidity. The oat flour may be mixed directly with the fat or other foodstuff, or may be used to treat the wrapping material of the food package. A small amount of oat flour (1 to 5 percent) incorporated into a surface coating on paper has been found effective. Treated paper has been used successfully for wrapping butter, lard, bacon, cereal products, potato chips, salted nuts, and coffee, among others.—*D. H. K.*

Invisible Light Makes Fingerprints Visible

A NEW tool for crime detection was described recently by Dr. Francis F. Lucas of East Orange, New Jersey, as one outcome of his years of work in the field of photomicroscopy. Noting that the fatty deposit which constitutes a fingerprint does not always catch and hold the fine powder which is dusted over it to make it visible, Dr. Lucas cast about for some other way of making the imprint visible.

In his contacts with biologists, Dr. Lucas learned many of their experimental methods, one of which is to "fix" a fatty substance by exposing it to the fumes of certain chemicals known as Fleming's reagent. This should make a fingerprint insoluble, reasoned Dr. Lucas, and then if the print were on paper, the paper with its fixed print could be dipped in a dye which glows brightly under ultra-violet light. This phenomenon, known as fluorescence, is one which Dr. Lucas regularly makes use of in his high-power microscope study of metals at Bell Telephone Laboratories. Experiments showed that he was on the right track, and now he is able to make a fingerprint visible as a black pattern against a brilliant blue-green background. This pattern can easily be examined through a small telescope or it can be photographed and enlarged to any convenient size for close study.

One advantage of Dr. Lucas' invention, on which a patent has just been granted, is that the presence of printing or writing on the paper does not obscure the fingerprint pattern. The light by which the print is viewed is invisible to the eye and hence any writing on the paper could not be seen.

Parapsychology

PARAPSYCHOLOGY! A new scientific term to describe a new scientific approach to an old subject. Making its bow at Duke University, a new journal, and the first in its field to appear under the sanction of a recognized university, will be devoted to clairvoyance, telepathy, and other arts of mind-to-mind communication without benefit of the inventions of science.

"Para" means beside. In the Greek from which it comes, it also had such meanings as "amiss, faulty, irregular, disordered, improper, wrong," according to the Oxford dictionary. These latter meanings are probably not intended by the sponsors of the new journal devoted to parapsychology, however, for the editors, Prof. William McDougall and Dr. J. B. Rhine, are convinced that men can trasmit ideas without recourse to wires, radio, postal facilities or even speech—"extra-sensory perception" they call the art.

For many centuries man has sought the means for looking into the minds and hearts of his fellow men. Perhaps it is because communication arts, amazing as the radio and telephone, telegraph and television are today, lag still behind the fleetness of human thought. Perhaps it is because of the truth of the saying that words are but a cloak to hide thoughts. Man has need to supplement the clumsy inadequacy of his language skill; he needs also to pierce the veil of human deception.

If there exists a way to reveal our thoughts to others without the medium of voice or post or printing press, then the persistent conscientious research of enthusiasts in the field of parapsychology should demonstrate it.

On the other hand, if such hopes are a delusion luring the credulous into the murky pathways of morbid self-deceit, then such research and accurate careful publication and dissemination of the findings should serve as a most useful aid to America's mental health.—*Science Service.*

CURRENT BULLETIN BRIEFS

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

YOU BET YOUR LIFE! is a review of America's shameful automobile accident record, presented in such dramatic form that it can not fail to drive home to the motorist the chances that he takes when he operates his car on the highway. Dramatization is effected by a series of carefully worked-out drawings and accompanying text. Tabulations serve to sum up the entire situation. *The Travelers Insurance Company, Hartford, Connecticut.—Gratis.*

THE HARDEST MATERIAL EVER PRODUCED BY MAN FOR COMMERCIAL USE is the story of the production in the electric furnace of an entirely new substance—Norbide. This material, a close approach to the diamond in hardness, is used in both granulated and molded form for various types of abrasive work in industries. The booklet tells the story of the manufacture, characteristics, and uses of Norbide and presents several interesting photographs. *Write for Bulletin 537A to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

THE REALITIES OF UNEMPLOYMENT, by Harry L. Hopkins, is an attempt to face the facts of the present situation in the United States and to point out what can be done about the unemployed and the unemployable. *Works Progress Administration, Washington, D. C.—Gratis.*

KNOW YOUR ROPES is an 80-page booklet concerned particularly with the selection of wire rope and its applications and uses. Particular stress is laid on increasing working life of wire ropes in any industry that uses such material. Many illustrations throughout the booklet show the right and wrong ways of handling and applying wire rope. Since this booklet is of interest only to those who have particular use for wire rope, please make your request for it on your business letterhead. *Wickwire Spencer Steel Company, 41 East 42nd Street, New York, New York.—Gratis.*

YESTERDAY AND TODAY IN REFRIGERATION is a brief, factual survey of the principles and history of refrigeration, together with a simple explanation of the operation of a modern electric refrigerator, accompanied by a drawing that makes everything plain. *Write for Bulletin 537C to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

THE STORY OF NEOPRENE is told in nontechnical language with strict attention to scientific accuracy. Neoprene is one of the so-called "synthetic rubbers" and was originally produced under the name "DuPrene." This 6-page pamphlet tells of the discovery of the material, its commercial development, and its significance to science and industry. *E. I. du Pont de Nemours & Company, Inc., Wilmington, Delaware.—Gratis.*

STRENGTH PLUS—MONEL FOR MECHANICAL JOBS outlines briefly yet clearly the various industrial applications of Monel Metal. A few of the industries covered in the 48 pages of the book are hydroelectric plants, steam turbines and lines, transmission lines, sewage disposal, refrigeration, and railroads. Applications from the smallest to the largest are illustrated and described. *Write for Bulletin 537D to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

NORTON ABRASIVES FOR THE LAPIDARY is a condensed study of abrasive wheels and polishing and buffing powders used in lapidary work, based on the experience and accepted practice of many lapidaries.—*Norton Company, Worcester, Massachusetts.—Gratis.*

RADIO receivers, transmitters, service equipment, public address systems, and parts for all these lines are listed in a comprehensive radio catalog now available: contains over 116 pages. *Write for Bulletin 537E to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

ALIGNMENT CHARTS, THEIR CONSTRUCTION AND USE, by Paul N. Lehoczky. Alignment charts are frequently of value to the engineer for obtaining solutions to certain problems quickly and accurately, yet the subject of these charts is one that is not very familiar to a good many who could benefit directly by their use. In the present book the author has told how to design and use these charts. *The Director, Engineering Experiment Station, The Ohio State University, Columbus, Ohio.—40 cents.*

THE INTER-AMERICAN CONFERENCE FOR THE MAINTENANCE OF PEACE is contained in the March 1937 number of *International Conciliation.* This issue records the proceedings of the Conference, held at Buenos Aires, Argentina, December 1-23, 1936. *Carnegie Endowment for International Peace, Division of Intercourse and Education, 405 West 117 Street, New York City.—Single copies, 5 cents; subscription, 25 cents a year.*

"HOT MONEY" VS. FROZEN FUNDS, by Francis P. Garvan, is a noteworthy attempt at analysis of the situation of American investments abroad, presented in a spirit of helpfulness and with a cordial invitation for comments and criticisms. *The Chemical Foundation, Inc., 654 Madison Avenue, New York City.—Gratis.*

CABINETS of all types for use in machine shops and factories are described and illustrated in this folded circular. Some of the types described are drill cabinets, cabinets for small parts, shelf boxes, and unit cabinets that can be purchased from stock and made up into combinations to fit almost any available wall space. *Write for Bulletin 537F to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

NICKEL ALLOY STEELS IN PETROLEUM PRODUCTION EQUIPMENT, Bulletin U 2, is of particular interest to oil-well drillers and workers in the oil fields. It describes and illustrates several types of new equipment. *The International Nickel Company, Inc., 67 Wall Street, New York City.—Gratis.*

Books SELECTED BY THE EDITORS

MORE FOR YOUR MONEY

By H. Bennett

WHEN you purchase a new automobile, new furniture, fabrics, clothing, toilet requisites, your choice depends upon your past experience and the experience of others who have used similar products and found them either satisfactory or unsatisfactory. Often, you are disappointed in what you bought. "More for Your Money" is a buyers' guide built upon the assumption that you don't like to be fooled, especially where your own hard-earned cash is involved. It would be a hopeless task to attempt to outline the numerous fields covered by this book; hence we will limit ourselves to a statement that it does discuss practically every article in everyday use from toothpaste to furniture and building materials. It gives you not just the personal experiences of a friend but the results of scientific tests; tells you how to choose that product which will give you the best wear, dollar for dollar. Probably one of its most important features is its exposure of the tricks used in selling certain types of products. It will unquestionably save for the purchaser many times its own cost.—$2.90 postpaid.—*F. D. M.*

TELEVISION RECEPTION

By Manfred von Ardenne, translated by O. S. Puckle

DEVOTED mainly to television equipment used in Germany, this discussion gives the technical background and details that bring the readers thoroughly up to date with electronic television.—$2.90 postpaid.—*A. P. P.*

BEING BORN

By Frances Bruce Strain

THE following is quoted from the *Journal of the American Medical Association's* review of this book on sex and reproduction for children of preadolescent age: "This is a book to arouse enthusiasm. It tells everything a young person could wish to know about sex. It uses scientific terminology. It is devoid of emotionalism and sentimentality. It is clear and concise. The method is effective. There is no preaching in this book, and therein lies its power. While it is unemotional and scientific, it is not cold, but friendly and personal. Throughout, the work shows profound thought, meticulous care, and a sympathetic understanding of youth. Altogether, it is an admirable work." With all of this we heartily agree.

It is interesting to note that modern books such as this, written for children, tell even more about the "facts of life" than books purporting to tell "what a young bride or groom ought to know" were presenting a generation ago. In those days they piously left the children to pick it up at the same age but from the gutter.—$1.65 postpaid.—*A. G. I.*

MEXICO TODAY

By Colonel Irving Speed Wallace

TRAVEL books can be of two kinds; they may be dry-as-dust compilations of facts and statistics, or they may be exceedingly interesting narratives concerning foreign lands. "Mexico Today" falls within the latter category and, with its liberal serving of outstanding photographs, tells the story of our ancient yet modern southern neighbor. Read for general interest and information, the book is entirely worthwhile; used as an unconventional guidebook to Mexico, it is priceless.—$2.15 postpaid.—*A. P. P.*

SCIENCE REDISCOVERS GOD

By Barclay Moon Newman

THE author's main thesis is that the universe is a purposive mechanism and that man is its central figure. The God it arrives at is not the conventional one but the Grand Architect. This book is for thoughtful students of the philosophy of science and is the antithesis of anything either emotional or light and fluffy, like some books with similar titles. It is a Book-of-the-Month-Club recommendation.—$2.15 postpaid.—*A. G. I.*

PICTURING MIRACLES OF PLANT AND ANIMAL LIFE

By Arthur C. Pillsbury

MR. PILLSBURY'S engrossing account of his pioneering efforts in developing lapse-time photography will be read with interest and profit by the botanist, the amateur photographer, and the general reader. Written in the clear, unassuming style of the scientist conscious of the romance intrinsic in his achievements, the work is a solid and valuable contribution to the literature of scientific photography. Mr. Pillsbury's story of the remarkable methods by which he has been able to record at pre-determined intervals such matters as the growth of a plant over the course of days or weeks is prefaced by some helpful hints to those who would go and do likewise—if they can afford the price. Illustrated with 66 of the author's own photographs, the book discusses his experiences in photographing by lapse-time methods such subjects as flowers, pollenization, cactus and succulents, leaves, under-sea scenes, and so on.—$3.20 postpaid.—*J. D.*

SHIPS OF THE WORLD'S BATTLEFLEETS

Edited by Pay-Lieut. Comdr. E. C. Talbot-Booth, R. N. R.

ALMOST a miniature edition of one well-known annual book on the world's navies, this volume gives the essential facts regarding the principal ships in the navies of the important powers. There is considerable discussion regarding the details of construction, as well as numerous silhouette drawings and quite a large number of photographs. In our opinion it is well worth the small amount charged for it.—$1.65 postpaid.—*F. D. M.*

THE INSECT MAN

By Eleanor Doorly

A JUVENILE tale about the life of Fabre, the naturalist, for youngsters. Oldster admirers of Fabre would enjoy it equally well.—$1.65 postpaid. —*A. G. I.*

AIR CONDITIONING—INSULATION

By J. Ralph Dalzell and James McKinney

AS has been pointed out many times in this magazine there is a great deal more to the relatively new science of air conditioning than the mere installation of the equipment itself. The public seems to gain the impression that the air-conditioning unit is practically the sole consideration and engineers will have a difficult job educating these same people into the mysteries of the necessary insulation for houses that must accompany an air-conditioning installation. The engineer himself must, however, gain a good foundation in this branch of the new science and he might well do so from this new volume. The authors discuss in detail the many types of insulation, old and new, for the walls and floors of houses and for the air-conditioning equipment itself. They have searched out the facts pertaining

to the products of those large companies which have developed the more modern forms of insulation and have gone into much detail to explain their relative merits, cost, and the like. Many pictures are given and there are numerous working drawings of many kinds of insulation. In addition, there are many tables, and mathematics for heat transmission, heat losses, fuel saving and such are given.—$2.65 postpaid.—*F. D. M.*

READING FOR SKILL

By Angela M. Broening, Ph.D., Frederick H. Law, Ph.D., Mary S. Wilkinson, A. B., and Caroline L. Ziegler, M.Ed.

ADMIRABLY brought out in this book is the fact that reading is not merely the use of the eyes to carry to the brain the meaning of printed words. Reading encompasses much more than just this, particularly if it is desired to read intelligently, rapidly, and skilfully. The book serves as a guide for students —either in school or out—who realize the desirability of absorbing knowledge by reading and who wish to do so with the least possible effort and the greatest possible result.—$1.35 postpaid.—*A. P. P.*

A separate volume is identical with the first except for the fact that it includes a section at the back entitled "Key to Exercises and Check Tests," apparently for the benefit of teachers. The two volumes are readily differentiated between, since the former's cover is lettered boldly in red, while the cover of the latter is lettered in blue.—$1.45 postpaid.—*A. P. P.*

SUPREME COURT OR POLITICAL PUPPETS?

By David Lawrence

A SMALL, compact volume of arguments against the rape of the Supreme Court.—$0.60 postpaid.—*A. G. I.*

ART AND THE MACHINE

By Sheldon Cheney and Martha Cheney

"INCONGRUOUS" is the word you think of when you have seen the photograph in this volume of a gas stove by Norman Bel Geddes. Yet this typifies the trend of industrial design today. Artists noted in their own right have been employed in increasing numbers by industrial firms that make all manner of utilitarian products with the purpose of dressing up these products, making them more attractive and salable. It is the modern "eye appeal" under consideration here—the eye appeal which is the last little touch on a product which already may be a masterpiece mechanically.

The authors discuss this trend from the time Norman Bel Geddes opened the first industrial design studio and labora-

tory just ten years ago, and show by numerous illustrations the effect of this new design-consciousness upon numerous products in everyday use. Much attention is, of course, given to modern building construction, both interior and exterior, and to the design of such things as trains and automobiles. There is no doubt that this new profession has tremendous potentialities for the future.—$3.95 postpaid.—*F. D. M.*

READING, WRITING AND SPEECH PROBLEMS IN CHILDREN

By Samuel Torrey Orton, M. D., Former Professor of Neurology and Neuropathology, Columbia University

DESCRIBES peculiarities such as word blindness, word deafness, aphasia, inability to write, reading disability, speech delay, clumsiness, stuttering; and throws some light on their treatment.—$2.15 postpaid.—*A. G. I.*

THE COSMETIC FORMULARY

By H. Bennett

THERE has long been a demand for just such a book which would give usable formulas on all types of cosmetics. Perhaps the wait was long but the result was well worth waiting for. While offhand it may seem to be a professional book it is an excellent one for the layman who might wish to make, for example, the cold cream for his family and thereby save in a year's time much more than the cost of the book. It contains hundreds of formulas on bath preparations, creams, dentifrices, hair preparations, nail polishes, perfumes, soaps, skin ointments, powders, lotions, and many other products.—$3.90 postpaid.—*F. D. M.*

STARS AND PLANETS

By Donald H. Menzel, Assoc. Professor of Astronomy, Harvard University

A VERY compact, very popular exposition of the science of astronomy, suitable for readers who have no previous knowledge of the subject whatever, but do not expect to learn it all at the first bite.—$1.15 postpaid.—*A. G. I.*

ACCIDENTS AND THEIR PREVENTION

By H. M. Vernon

FROM minor accidents in the home up to and including fatal accidents on the highway, the author covers the whole field of this tremendously important problem. He analyzes carefully the reasons for accidents and discusses preventive measures that have been used. A valuable contribution to the literature is contained in the suggestions given for additional methods of avoiding accidents. The book is based on a thorough study of the entire situation and a careful consideration of its content should go far toward making life more worth living, and living more possible.—$5.20 postpaid.—*A. P. P.*

CHILDLESS

By Sam Gordon Berkow, M. D.

A STUDY of sterility, its causes and treatment, including discussions of our sterile civilization, how we reproduce, and the conquest of sterility. Childless parents should be able to extract a great deal of scientific knowledge from this book.—$3.15 postpaid.—*A. G. I.*

EVERY BOY'S BOOK OF SHIPS

By J. D. Burgan White

AN illustrated book telling about "blue ribbon" liners, oil tankers, sailing ships, yachts, ships of the British Navy, and other kinds of ships. The source is British—a pretty competent source of knowledge of ships, we must agree.—$1.65 postpaid.—*A. G. I.*

WHY QUIT OUR OWN

By George N. Peek with Samuel Crowther

"THIS book has been conceived and written not in a partisan spirit but solely in an effort to take the question of national prosperity and well-being out of the realm of mere words and theory and to discuss them on the sure basis of fact." We can find no better summary of the present volume than the foregoing quotation from the preface. Regardless of what may be said about the unscientific aspects of the science of economics, the facts and figures discussed in this book will at least furnish food for thought.—$0.60 postpaid.—*A. P. P.*

RECOLLECTIONS AND REFLECTIONS

By Sir J. J. Thomson

THE famous discoverer of the electron and head of the Cavendish Laboratory at Cambridge has written his autobiography, giving the reader an intimate, chatty, and friendly glimpse into his long and eventful life, which included three visits to America where most things met his approval. A fascinating narrative. — $4.20 postpaid. — *A. G. I.*

LEGAL HIGH-LIGHTS

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

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

Bank Night

MOVING picture theaters in many parts of the country have adopted the policy of giving prizes, usually monetary prizes, during one or more performances each week for the purpose of increasing patronage. Many different methods of awarding the prizes have been employed.

In a recent case before one of the federal circuit courts of appeals, the plaintiff was the originator of a plan or system for awarding monetary prizes in theaters or other places of entertainment and had designated its plan or system by the name "Bank Night." The plaintiff printed a set of instructions describing the plan or system and the manner of carrying it out. This instruction sheet was duly copyrighted by the plaintiff. In addition, plaintiff had caused the name "Bank Night" to be registered as a trade mark with the Secretary of State of the State of Oklahoma. Plaintiff derived its income by licensing theaters to use its plan or system.

It was alleged by the plaintiff that the defendant had copied its plan or system, and also its name "Bank Night," and plaintiff contended that the use of the system was copyright infringement and the use of its name "Bank Night" was trade mark infringement. The court rejected both of plaintiff's contentions, finding that defendant had a right to use both the system and the name "Bank Night." In reaching this conclusion, the court found that defendant had not reproduced the instruction sheet which was copyrighted by plaintiff, but at most had carried out the teachings set forth in the instruction sheet. The court pointed out that a copyright on a book is only infringed by a printing of the book or any material part thereof, and that the practicing of an art taught in the book did not constitute copyright infringement.

With regard to the alleged trade mark "Bank Night," the court found that plaintiff was not engaged in the sale of merchandise to which it affixed a trade mark, but at most was selling a plan or system. The court then said:

"We fail to find legislative provision or judicial approval and sanction of the use of trade marks with a plan or system of action."

This case, while dealing with a subject matter of a rather frivolous or light nature, is based upon fundamental and important principles of law. Business men, merchandisers, and advertisers frequently attempt to secure protection for a plan or system of action, such as a plan of advertising or a plan of doing business. Under our law no type of protection can be secured for such plans or systems of action. If the plan or system is printed in pamphlet or book form and the pamphlet or book is then copyrighted, the copyright merely protects against the unauthorized reproduction of the pamphlet or book or any substantial part thereof, but does not prevent the practicing of the plan or system described in the pamphlet or book.

Cartography

IF you are considering adopting the map of a country as a trademark, due consideration should be given to a recent decision by the United States Court of Customs and Patent Appeals in a case involving a well-known manufacturer of ginger ale. The ginger-ale manufacturer attempted to register in the United States Patent Office under the important Trademark Act of 1905 the map of Canada as a trademark for soft drinks. The Examiner of Trademarks and the Commissioner of Patents both refused to register the mark and an appeal was taken to the Court of Customs and Patent Appeals.

In its decision the Court held that registration of the map of Canada as a trademark was rightfully refused. In reaching this decision the Court pointed out that the Trademark Act of 1905 forbids the registration of a trademark which consists of "merely a geographical name or term." The names of countries, cities, and other geographical sub-divisions had long been refused registration under the Trademark Act of 1905 due to this provision.

Prior to the present decision, however, the Courts had not passed upon the applicability of the above provision to a trademark consisting of a map. The Court of Customs and Patent Appeals found that the map of Canada was geographical and therefore could not be registered under the Trademark Act of 1905. The provision of the Trademark Act of 1905 which prohibits the registration of a trademark which is merely a geographical name or term might at first glance appear to be arbitrary. The reason underlying this provision, however, is a sound one, namely, that every manufacturer should have the right to indicate the place of production of his product and no single manufacturer should have the exclusive right to use the name of that place.

About Face

THE Court of Appeals of the State of New York recently sustained the so-called Fair Trade Statute of the State of New York, reversing its own decision of January, 1936, in which a portion of the statute was declared to be unconstitutional. The statute provides that any contract fixing the resale price of a commodity bearing the wrapper, trademark, brand, or name of the producer is legal, and that wilfully and knowingly advertising or offering for sale any commodity bearing the wrapper, trademark, brand, or name of the producer below the stipulated price is an act of unfair competition.

In January, 1936, the Court of Appeals had held that this statute was in part unconstitutional. Since that decision the United States Supreme Court passed upon a similar statute of the State of Illinois and held that the statute was constitutional. The Supreme Court decision was discussed on this page in the February 1937 issue. Without re-enactment of the statute, the Court of Appeals of the State of New York has now reversed its former decision in view of the Supreme Court decision and has held the statute to be constitutional.

This decision is of far reaching importance and is a further illustration of the growing importance of trademarks. Heretofore any attempts to fix the resale prices of commodities by contract have been frowned upon under our system of law. Under the decisions of the New York State Court of Appeals and the United States Supreme Court, the owner of a trademark can, in those states having similar Fair Trade Statutes, control the prices at which his products are sold at retail.

The decision is interesting for another reason, in that it clearly brings out the difference between a judicial declaration of invalidity of a statute and an executive veto. Where a statute is vetoed by an executive, it must be re-enacted to become law. The New York State Fair Trade Statute had been declared unconstitutional in January, 1936, by the highest Court of the State, and then without re-enactment of the statute it is now declared by the same Court to be constitutional.

Strictly Personal

ADVERTISERS are constantly advising the American public in the magazines and newspapers and over the radio of the nature and purpose of such articles as depilatories and deodorants. Seldom, however, do the Courts of the land lend their austere dignity to an exposition of the nature of such products.

In a recent case before the Court of Customs and Patent Appeals the Court found it necessary to expound upon this subject. In that case the manufacturer of a dipilatory attempted to register the trademark "Voo" for depilatories in the United States Patent Office and his application for registration was opposed by the owner and user of the trademark "Dew" for deodorants. The owner of the trademark "Dew" claimed that he would be damaged by the registration of the trademark "Voo" for depilatories. The Court sustained his contention and refused to allow the registration of the trademark "Voo."

In deciding the case the Court had to consider whether depilatories and deodorants were goods of the same descriptive properties, and in this connection stated:

"Depilatories unquestionably are of the same descriptive properties as deodorants—one removes hair, the other removes odors. Both are for personal application, and are sold in the same places and to the same class of casual purchasers."

SCIENTIFIC AMERICAN ADVERTISERS

May · 1937

Advertising Manager
CHARLES H. STEINHART
Eastern Advertising Representatives
E. H. KRAEMER J. P. CANDIA
24 West 40th Street, New York City
Western Advertising Representatives
EWING HUTCHISON COMPANY
35 East Wacker Drive, Chicago, Ill.
BLANCHARD-NICHOLS-COLEMAN
Los Angeles, San Francisco and Seattle

Published by MUNN & COMPANY, INC.
24-26 West 40th Street, New York

ORSON D. MUNN, President JOHN P. DAVIS, Treasurer I. SHELDON TILNEY, Secretary

Vol. 156, No. 5. 35 cents a copy. $4.00 a year, postpaid in United States and possessions. Canada, $4.50; other foreign countries, $5.00, postpaid. Illustrated articles must not be reproduced without written permission; quotations therefrom for advertising and stock-selling enterprises are never authorized. "Scientific American" registered United States Patent Office. Files are kept in all large libraries and articles are indexed in all leading indices.
Printed at The Condé Nast Press, Greenwich, Conn., U. S. A.

Now Ready! THE CONSUMERS UNION *1937* BUYING GUIDE

A 192-page handbook containing ratings of hundreds of products *by brand name* as "Best Buys," "Also Acceptable," and "Not Acceptable."

DO you want to know which vacuum cleaner out of fifteen models tested by unbiased experts will give you the best value for your money? Which brands of motor oils can save you from $15 to $20 a year on your oil bill? Which shoes will give you the most wear, which liquors are the "Best Buys," and which brands of other products tested in laboratories are acceptable for consumer use and which are not acceptable?

Then make sure that you get a copy of the 1937 edition of Consumers Union's Yearly Buying Guide. This 192-page Guide is now being distributed to members of Consumers Union.

It contains ratings, *by brand name,* of shoes, tires, radios, toothpastes, soaps, stockings, shirts, refrigerators, automobiles, and most of the other products you buy from day to day.

Prepared in a compact, convenient size which can easily be carried in your pocket or your handbag while shopping, and indexed so that reference can readily be made to the product or products which you are purchasing, this Buying Guide can enable you to save substantial sums on your purchases, help you to avoid inferior or injurious products and give you the information you need in order to make intelligent choices.

In addition to the Guide, membership in Consumers Union also entitles you to twelve issues of the monthly *Consumers Union Reports.*

WHAT CONSUMERS UNION IS

Consumers Union's Buying Guide and *Consumers Union Reports* are published by Consumers Union of United States, Inc. Formed on a strictly non-profit, membership basis, the purpose of this organization is to serve its members as a consumers' testing laboratory by providing them with accurate, usable information on the comparative quality of their every-day purchases.

Professor Colston E. Warne, of Amherst, is president of Consumers Union. Arthur Kallet, co-author of *100,000,000 Guinea Pigs,* is director, and D. H. Palmer, physicist, is technical supervisor. Among the board of directors and sponsors are many prominent educators, social workers, journalists, scientists, and labor and liberal leaders.

CONSUMERS UNION *Reports* FOR APRIL ON:

COLD CREAMS

". . . a particularly blatant example of cosmetic quackery," say the American Medical Association's Bureau of Investigation of a widely advertised and grossly over-priced cold cream. Find out which brand this is in the April issue. Fifty-four brands of cold creams, ranging in price from 2.6c per ounce (dry weight) to $1.53 per ounce, are rated.

RADIO SETS

Supplementing a report in the November issue on lower-priced radios, this report rates more than ten models (including the Stromberg-Carlson and Zenith) ranging in price from $60 to $200. Coming issues will contain reports on automobile radios and on tubes.

GARDENING

Special knowledge and skill are required to raise vegetables which compare favorably with market produce. You won't get this knowledge from seed salesmen or fertilizer manufacturers. A report on gardening in this issue tells you how you can acquire this knowledge; gives you valuable hints on such matters as when to start planting, and which soil conditions are most favorable to which kinds of vegetables and fertilizers, and rates several brands of fertilizers. For ratings of seeds consult the Yearly Buying Guide.

MEN'S SHIRTS

Twelve brands of men's shirts, ranging from inexpensive mail order brands to the popular $2.50 and $3 brands, were subjected to laboratory tests for shrinkage, thread count and wearing qualities. The results of this test and of tests on other products are given in this issue.

AUTOMOBILES

Concluding the report on 1937 automobiles begun in the March issue, this report gives you automotive engineers' opinions on cars delivering in the $1000-$1500 price range—including the Buick, Packard, LaSalle, and Lincoln Zephyr. Ratings are given by name.

Now over 35,000, Consumers Union's membership is growing at the rate of nearly a thousand each week. The membership fee—which puts a large group of technicians to work for you testing the products you buy—is only $3 a year ($1 a year for an abridged edition covering only the less expensive products).

To become a member simply fill out and mail the coupon below. You will receive the April issue of the *Reports* (contents of which are given above) and also the annual Buying Guide. Or, if you wish, you may begin with any of the previous issues listed in the box below.

You Can Begin With Any of These Issues

MAY, 1936—Toilet Soaps, Breakfast Cereals, Milk.
JUNE—Automobiles, Gasolines, Seeds.
JULY—Refrigerators, Used Cars, Motor Oils.
AUG.—Oil Burners and Stokers, Hosiery, Black List of Drugs and Cosmetics, Meat.
SEPT.—Shoes, Tires, Whiskies, Women's Coats.
OCT.—Men's Shirts, Gins, Electric Razors, Dentifrices, Anti-freeze Solutions.
NOV.—Radios, Toasters, Wines, Children's Shoes, Winter Oils.
DEC.—Vacuum Cleaners, Fountain Pens, Electric Irons, Blankets, Nose Drops.
JAN.-FEB.—Men's Suits, Cold Remedies, Shaving Creams, Children's Undergarments.
MAR.—1937 Autos. Sheets, Flour, Canned Foods, Face Powders.
APR.—Radio Sets, Cold Creams, Gardening, Autos, Shirts.

To: CONSUMERS UNION OF U. S., Inc.
55 Vandam St., New York, N. Y.

I hereby apply for membership in Consumers Union. I enclose:

☐ $3 for one year's membership, $2.50 of which is for a year's subscription to the complete edition of *Consumers Union Reports.*

☐ $1 for one year's membership, 50c of which is for a year's subscription to the abridged edition of *Consumers Union Reports.* (Note: Reports on higher-priced products are not in this edition.)

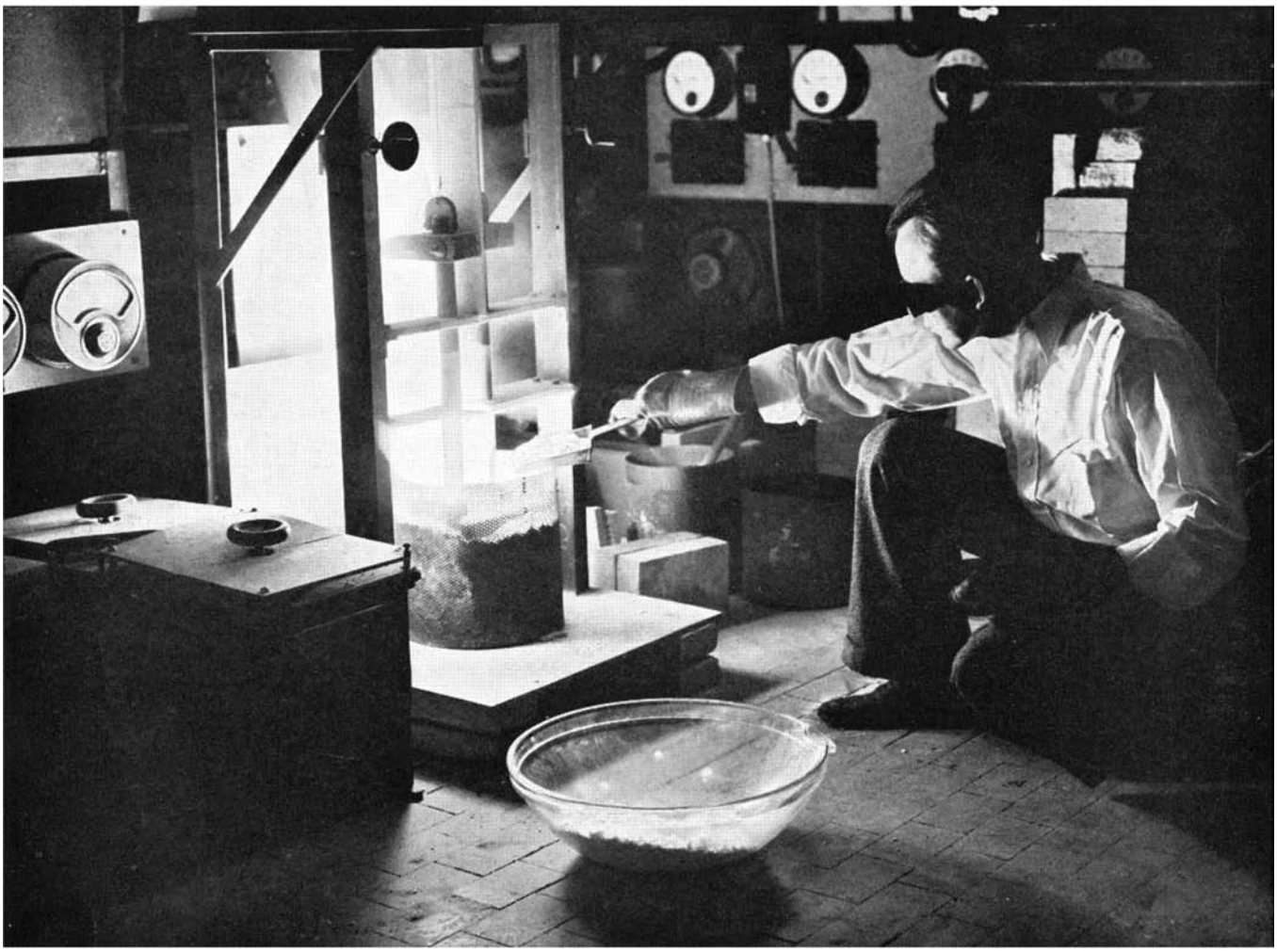
I agree to keep confidential all material sent to me which is so designated.

Please begin my membership with the.....issue.

Signature.....

Address.....

City and State .....Occupation.....SA-5



White Heat Means a Cooler Kitchen

WORKING with searing heat at 5400 degrees Fahrenheit, G-E scientists have evolved more durable, more efficient heating units. These CALROD units, used in General Electric and in Hotpoint electric ranges, provide quick, clean, even heat—localized just where it is needed. This means a cooler kitchen. In thousands of plants, CALROD units are being used for industrial heating because they provide heat at a remarkable saving in cost.

But the CALROD unit is only one achievement of the ceramics experts in the G-E Research Laboratory. New and unusual kinds of glass serve as vital parts in sodium lamps that light miles of American highways—light them for greater safety for drivers and pedestrians. Large insulators support the wires that bring electric power from the generators to your home; tiny insulating blocks help to maintain the high quality of reception in your radio tubes. To these, too, General Electric scientists, in Schenectady, have brought important improvements.

These examples are but a few of the contributions of research which has stimulated industry, increased employment, made available more things for more people at less cost.

G-E research has saved the public from ten to one hundred dollars for every dollar it has earned for General Electric

GENERAL ELECTRIC