IN THIS ISSUE

NIKOLA TESLA • WILLIAM B. STOUT
HENRY NORRIS RUSSELL • F. ZWICKY

SCIENTIFIC AMERICAN

Vol. 150 No. 3 MARCH, 1934 35c a Copy

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Streamers of Sparks From Van de Graaff's Generator (See page 132)

THE ROMANS had a phrase for it—

"CAVEAT EMPTOR," meaning "Let the buyer beware." This wasn't used as a bit of balm to ease the ancient conscience; nor, yet, was it placarded in the booths and stalls of the market-place. It was a piece of every-day knowledge, born of dear-bought experience.

A shopkeeper knew little about the source of his merchandise. This tunic he bought from a trader, who said it came from Byzantium. So he sold it as the latest Byzantian style. The trader told him the dye was pure Tyrian—it wouldn't fade. So he sold it as Tyrian dyed. But the buyer knew the responsibility was his own. If he guessed wrongly, or his judgment was poor, it was *his* hard luck.

Today, fortunately, there are safer guides than the blanket-warning to "let your eyes be your market."

These guides are the advertisements. In this magazine, they are a daily catalog of the best values—signed by responsible manufacturers. If the goods are not all that is claimed for them, their sponsors would need to "beware." For no business can thrive on a one-time sale, or on dissatisfied customers.

A signed advertisement is, in a way, like a promissory note. The advertiser has made a statement, and affixed his signature as a sign of good faith.

So, read the advertisements before you start out on a buying-trip. Make this a habit, and see how much you save . . . in time, in temper, in money, in shoe-leather.

SCIENTIFIC AMERICAN

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NINETIETH YEAR • ORSON D. MUNN, Editor

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SCIENTIFIC AMERICAN, March, 1934. Vol. No. 150, No. 3, 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. Foreign $5.00. Manuscripts are submitted at the author's risk and cannot be returned unless accompanied by postage.

ACROSS THE EDITOR'S DESK

ONE point in the science of government which SCIENTIFIC AMERICAN has always approved is the maintenance of our national defenses on a par with other world powers. We are firmly convinced that adequate military forces are the surest safeguard against prolonged warfare with its consequent horrors. For this reason we are gratified at the turn which has recently been taken in naval building operations, and particularly so since we have obtained a promise from Assistant Secretary of the Navy Roosevelt that he will prepare for us a complete and authoritative article on the subject. Thus you will be able to get, from a near future issue, the inside story of the important developments that are taking place, and will have a better understanding of their vital effect on our national welfare.

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"MENTION China to the average American citizen who has never traveled abroad, and there immediately comes to his mind a picture of a far-off, half civilized country, vaguely located 'somewhere east of Suez,' where strange and mysterious things happen; a land of quaint, picturesque cities teeming with humanity, full of queer sights and smells. . . . This is the China of the movies. . . . Get into that picture the modern steel-and-concrete 22-story structure of the Joint Savings Society of Shanghai" and, according to William S. Shipley writing in our next issue, you will have to reform many of your ideas of China. And, what is more, that modern structure is air-conditioned! Woven into the story of this building is a background of the unique economics of the Orient; century-old methods being used side-by-side with the most modern equipment.

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IT is one thing for a person to remain afloat in the water and move his arms and legs in such a manner that he can make progress, but when he decides that he wants to swim fast enough to break records, that is quite another matter. He then finds his movements must be studied with a view toward decreasing the resistance of his body and its movements to the surrounding water. Dr. Karpovich, Professor of Physiology at Springfield College, has recently completed a study of this resistance and the factors that contribute to increasing or reducing it. His findings will interest everyone who likes to swim, and provide a number of ideas that will tend to make swimming easier and more efficient. We expect to publish Dr. Karpovich's article in next month's number.

COMING

¶ Hon. Henry L. Roosevelt, Assistant Secretary of the Navy, will write on the new and important construction policy of the United States Navy.

¶ "Working and Thinking and Eating" is an article that will reveal surprising facts regarding these three processes.

¶ William S. Shipley, an authority on air conditioning, has prepared a "different" article on the work being done in China.

¶ "How Not to Swim Faster," by Prof. Peter V. Karpovich, deals in a practical way with the physics of swimming.

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WITH summer approaching, now would be a good time to decide that you will make a sundial to be placed as a scientifically useful ornament in your garden or lawn. There are many types of dials which may be constructed, the exact form frequently being determined by the position which the dial is to occupy. The authors of the series of articles on dials which we are publishing have reduced the directions for dial design to the simplest terms commensurate with accuracy, and have covered or will cover all of the types that the amateur would care to tackle. Articles have already appeared in the February and the present numbers; the third will be published next month. While sundials are usually regarded primarily as ornaments, don't forget that, if properly laid out, they can be depended upon as quite accurate timekeepers.

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THE contest for higher operating speeds in the air-transport business is still being waged, with cruising speeds nearing and in some cases touching 200 miles per hour. Here is no flashing, dashing burst of speed by some dare-devil aviator straining for a new record, but a result of much thought and study by level-headed technicians and conservative business men bidding for new conquests in the world of industry. Up goes the speed and smaller shrinks the air map. What does this mean to you in terms of airmail, express, and passenger service? Reginald M. Cleveland, well known to our readers for his keen analyses of air-transport conditions, will answer this question in an article scheduled for our April issue.

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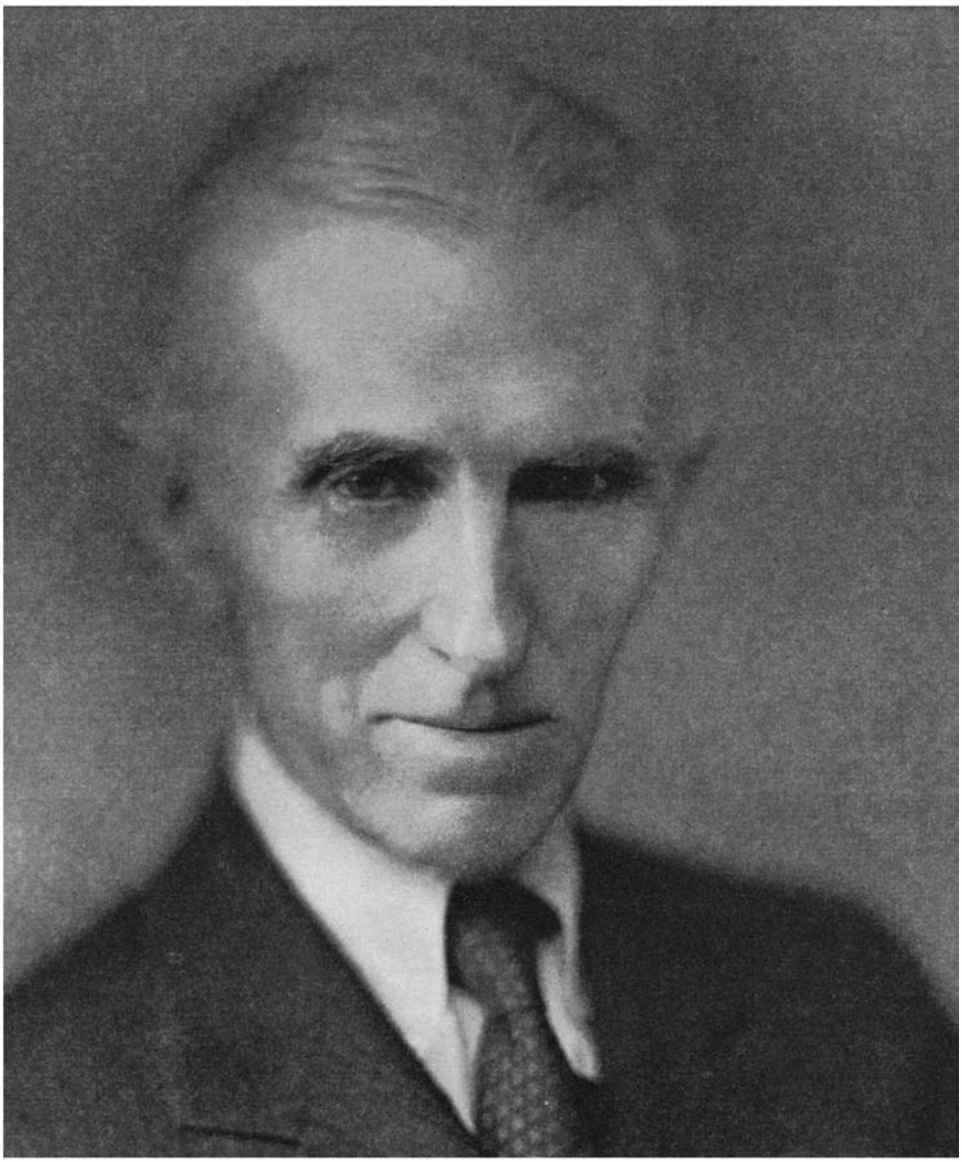
IT sometimes happens that we announce on this page a certain article for our next issue, but that the article announced does not appear. Invariably when this occurs it is because of our desire to get into each issue articles that are timely or otherwise desirable. Since this page must of necessity be written before the next issue is made up, the information contained here is gleaned from a tentative schedule of coming articles. If, then, before the next issue is complete, some article is obtained that we feel our readers should have with the least possible delay, it becomes necessary to take out something else in order to make room for it. This is what has happened with the articles on Bug Battles, on the energy in foods, and on the refrigeration of the concrete which is being used in Boulder Dam—all of which have already been announced. They are still in hand, however, and will be presented in the near future; in fact, they are scheduled for April and unless something else of vital importance intervenes, you will find them in that issue.

Editor and Publisher

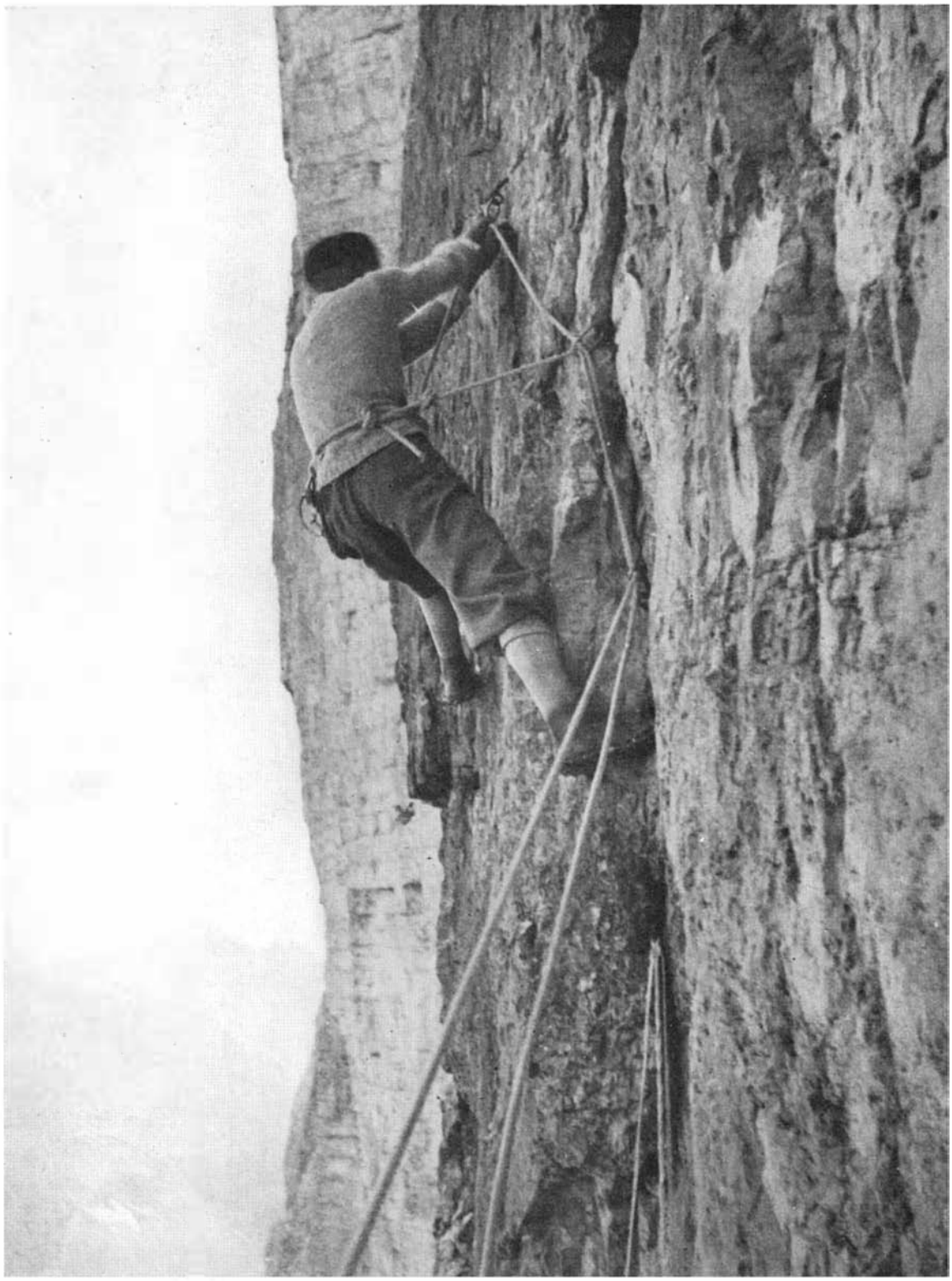


NIKOLA TESLA

NIKOLA TESLA was born at the stroke of midnight, July 9-10th, 1856, in Smiljan, Jugoslavia. His father was a distinguished clergyman, and his mother, Georgina Mandic, came from a long line of inventors. Dr. Tesla's inventive genius was apparent from an early age; his education was received at various European universities where he studied the sciences and acquired a knowledge of a dozen languages. In 1884 he came to the United States and became a citizen in 1889. He has always, and is now, engaged in independent experimental research.

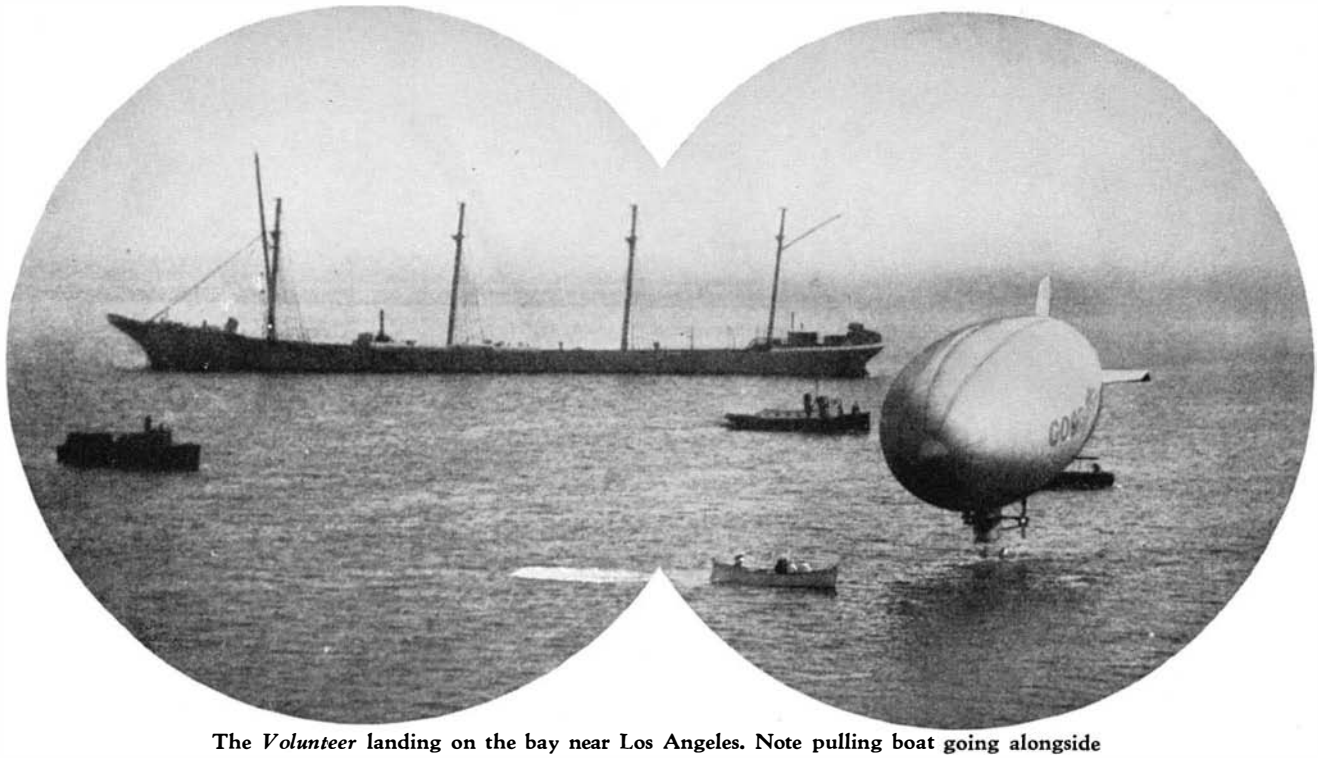
The inventions and discoveries of Dr. Tesla have been many and varied. Stated in chronological order, some of the more important ones are: The rotating field induction motor and alternating current system of power transmission, 1882-1888; Tesla coil and oscillation transformer, 1889-1892; electro-mechanical isochronous oscillators, 1890-1892; Tesla wireless system, 1891-1893; electron tubes, 1892-1893; theory of radioactivity, 1896-1898; high-potential vacuum tubes, 1896-1898; telautomatics, 1897-1899; discovery of terrestrial resonance and law of propagation of conduction currents through the globe, 1899; high-potential wireless transmitter, 1899; art of transmitting energy by stationary terrestrial waves, 1906; speedometers on new principles, means for lightning protection, types of steam and gas turbines, pressure and vacuum pumps and other apparatus, 1916-1926.

Due to unfavorable circumstances, Dr. Tesla states, some of his most important results have not yet been announced, among them being a new refining process for producing steel, copper, aluminum, and other metals at low cost.



WHERE LIFE HANGS ON A SIX-INCH NAIL

THREE Italian guides recently accomplished the hazardous feat of scaling the North Face of the highest rock of the Drei Zinnen in the Dolomites. Heretofore this climb has been considered impossible, but it was accomplished by the use of special nails and a double safety rope—a modern technique which has been found suitable for scaling overhanging precipices. Four- and six-inch nails were used, the ropes being passed through ringed heads, the climbers sometimes resting their feet on the ropes and at other times in crevices. The nails were driven into the rock as the climbers advanced.



The *Volunteer* landing on the bay near Los Angeles. Note pulling boat going alongside

Sky Boats

The "Blimp" Fills a Definite Niche in the General Scheme of Aeronautics; the Author Makes a Splendid Case for Its Versatile Accomplishments

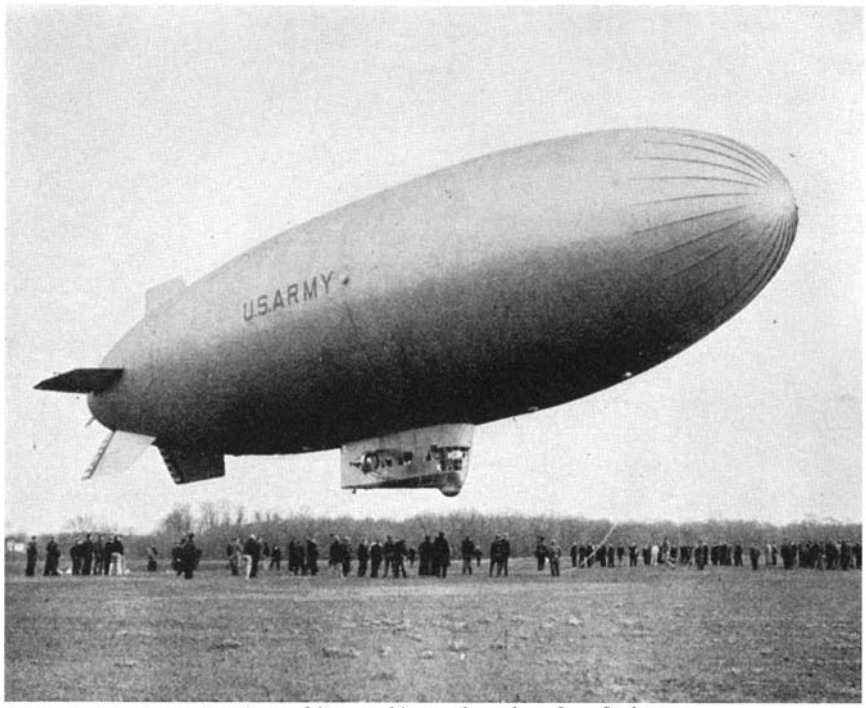
By JOHN T. ROWLAND
Late Lieutenant, U.S.N.R.F

WHEN the steamship *Titanic* sank with an appalling loss of life after ramming an iceberg on the Grand Banks one foggy night some 20 years ago, the American public did not demand that all seagoing ships be scrapped forthwith. There *was* created in the public mind a temporary prejudice against very large steamers, and this prejudice had some foundation in fact. A similar prejudice exists today with respect to the airship, but with this important difference, that the general public is strangely unaware of what the smaller types of airships have done, are doing and can do.

This is not intended as a tacit admission that the case for the big dirigible is hopeless. How could that be when the *Graf Zeppelin* has circled the globe and has run on a mail-and-passenger service across the South Atlantic? Even away back in 1921 the Zeppelin *Bodensee* made 100 flights in 97 days between Berlin and Friedrichshafen, and carried upwards of 2300 passengers without mishap. No, the case is not hopeless, though the big dirigible appears to have certain definite limitations. However, the point of this writing is not to start a controversy on Zeppelins but rather to draw some merited attention to that extraordinary and little appreciated sky boat, the humble "blimp." We quote the word because it is really a nick-name, being a contraction of the official British Air Service designation, "B—Limp," which applied to small dirigibles that boasted no interior framework to help them "hold their shape." *Limp*, that is, as opposed to *rigid*. From official slang the word passed into the general tongue and now is applied indiscriminately to small airships of any type. It is to "Zeppelin" what "boat" is to "ship."

To the majority of our newspaper reading public, who regarded the recent loss of the Navy blimp *J-3* as just another tragic proof of the futility of airships, it may come as something of a surprise to learn that the British maintained a continual patrol of their coasts with such craft during the latter part of the World War, and that certain blimps, of a type far more antiquated than the *J-3*, went aloft *every day* in the year, with only a short period out for routine refit and overhaul, and that they kept the air in weather when the going was more than lumpy for a 300-foot destroyer at sea. This I saw with my own eyes, from the bridge of one of the latter. Once we, on the U. S. S. *Wilkes*, were intercepted and given a message by a tiny blimp with a crew of three men that came ramming out from shore on the back of a blustering Irish nor'wester. Seeing her coming, we thought she was out of control, and stood by to rescue; but when she had semaphored her message she turned about and bored back into that roaring head wind faster than we could follow under all four boilers. And *Wilkes* was a destroyer, bear in mind.

ONCE again I must qualify a statement. This sounds pretty much like a knock at our own Navy fliers. It is nothing of the sort. A de-commissioned ship, gotten ready in the haste of emergency and taken aloft under storm conditions by a scratch crew (however able they might be as individuals) is in no condition to offer a fair test. The resultant disaster proved as misleading as the act itself was heroic—for be assured that those men in the *J-3* knew the risk they were running and took it only in the hope of saving some of their comrades who had been reported clinging to the wreckage of the *Akron*. It



An Army blimp taking off on her first flight

seems a pity that the pressmen did not grasp this essential fact.

It may be our extraordinary preoccupation, as a people, with mere bigness which has caused American eyes to be focused on the monsters of the sky while overlooking the capabilities of the pygmies. Personally, I must confess to the diametrically opposite type of mind. As an amateur explorer, it has always given me a peculiar satisfaction to undertake with a very small boat and meager equipment what others have felt required a million-dollar outfit; and I am, I believe, one of the three or four persons living to have navigated a 30-foot sailboat to the Arctic. This is not written in boast but rather as a necessary foreword to what is coming, if my opinion is to carry any weight.

IN civil life and even in the Navy itself I have been singularly impressed by the importance which we too often attach to mere size, as, for example, by assuming the command of a battleship to be more important than that of a destroyer, when, as a matter of fact, the destroyer's duties may be the more important and may call for a higher degree of leadership and technical skill. The same comparison (I believe) holds true as between Zeppelin and blimp, though not necessarily in a military sense. Let us see what are some of the remarkable feats at which the little sky boat excels.

Coming back to the wartime blimps —since they had certainly the severest test of any—it is interesting to discover that on a particularly stormy section of the British coast there were *only 8 days without airship patrol* between January and November, 1918. The sky boats making these patrols were mostly little three-man blimps of the famed British Coastal class. Their envelopes looked like over-stuffed sausages—the same shape at bow and stern—and their control cars consisted of a long and narrow boat-shaped affair suspended some distance below the bag, with a motor and prop at each end. They were officially credited with a maximum speed of 40 knots. Yet one of these little "rubber cows" remained in continuous service for 805 days, during which she was in the air approximately 2500 hours, or an average of 3 hours and 6 minutes per day. And yet people say that blimps are toys. Perhaps the very smallness and handiness of these little Coastal jobs—they could shelter in a copse of wood—was what gave them success.

To return to America: I was talking not long ago with a student pilot in one of the Goodyear company's blimps—the sort we are accustomed to see towing an advertising banner over Los Angeles or New York—and he told me the following yarn. He and the pilot were returning to the coast from a "voyage" to some city in Texas or New Mexico when they encountered an unexpected easterly gale. This was a tail wind for them and would have been very fine had it not been for the great mountain barrier of the Sierras which lay across their course not many hundreds of miles ahead. They did not like to think of barging in upon those ragged mountain peaks after dark without perhaps being able to gain altitude enough to cross them safely. Accordingly, they turned her head to wind and ran the twin motors wide open in an attempt to win back to "harbor"—a town with an airport where they might moor and ride out the gale.

But after an hour or so of snail-like progress the little ship began going backwards over the land. This was not so good, since she was getting nowhere and her supply of fuel was low. The country beneath her was mostly desert, with an occasional small town nestling beside the railroad tracks. Each hour the blimp's speed backwards increased as the gale steadily mounted. She could cut across it, like a boat in a swift current, but buck it she could not. And out on the great desert there was no port of refuge under her lee.

Now it happens that every one of those desert hamlets has a great water tower rising out of its midst. Maneuvering the blimp like a powerboat, the pilot managed to work the bight of a mooring line round one of these towers. As the ship eased back he paid out line until she fetched up on the bitter-end (which was a nautical term long before it came into literary use) and the mooring line gradually took over the strain from the motors. There she lay, moored to a water tower, for all the world like a powerboat fast to a buoy, while the gale blew itself out. The irony of the situation was that, so close to water, her crew suffered acutely from thirst, as they could not get to the ground and the blow lasted more than three days.

A PLANE would have been obliged to land and risk cracking up and a big airship would have had no choice but to hurdle the Sierras—unless, of course, she could have run south into Mexico far enough to get out of the storm.

Cross country blimping is not all beer and skittles even in good weather. The big gas bag offers an apparently irresistible target to farmer lads who have never "drawn a bead" on anything larger than a squirrel. No one has been killed to date, but there have been some miraculous escapes and much valuable helium gas has been expended. A curious mental squirk, this; and a most uncomfortable one for the victims. It may be due to the blimp's proclivity to stray off the beaten track and fly over backwoods country where aircraft of any kind are rarely seen. The ability to do this is one of the great advantages that sky boats enjoy over the plane, which is obliged for safety's sake to follow established routes where there is always an emergency field handy to glide to in case of trouble.

The blimp, on the contrary, does not stay aloft merely by the grace of God and a speeding motor; she floats in the atmosphere as a fish does in the sea. She can shut off her engines entirely and drift as a free balloon—which must be a delightful way to travel with a fair wind.

Three Typical American Blimps

Name	Year	Length (feet)	Power	Number of Passengers	Capacity of Envelope (cubic feet)
Pilgrim	1925	110	1— 60 h.p.	2	56,000
Volunteer	1929	133	2— 80 h.p.	4	96,000
Defender	1929	184	2—165 h.p.	8	183,000

Compared with British Coastal Class Used in War-Time Patrol

Name	Year	Length (feet)	Power	Useful Lift	Capacity of Envelope (cubic feet)
Coastal	1915-'16	196	1—110 h.p. 1—220 h.p.	0.9 ton	170,000

The maximum speed of the British Coastal class was 40–45 miles per hour, that of the larger American blimps is as high as 80. The British ships were inflated with hydrogen, whereas helium gas is used in American blimps. Its cost for commercial use is about 85 dollars per thousand cubic feet.

Since 1925 the Goodyear fleet has carried, in round numbers, one hundred thousand passengers, and covered a million and a half miles round and about the United States. A small blimp, which is able to carry three or four passengers, is some 130 feet long overall and has a cruising speed of 45 miles per hour with twin motors consuming gasoline at a rate of 11 gallons an hour. This means but four miles to the gallon, air speed. It appears therefore not to be an economical means of transport.

No doubt in actual mileage that is the case, but the blimp can do things no plane could dream of, as, for example, coming down in the Florida Everglades and taking on board a marooned aviator whose plane had crashed in the swamp. This man might never have gotten out otherwise, since the character of the country was such that he could neither walk nor swim, nor could boat, plane, man or horse get near him. The blimp in this case never actually touched; it nosed down slowly and came to rest in the air a few feet off the ground, and the marooned man was drawn up to it. In another case a flyer who crashed in Biscayne Bay and swam to a small island covered with scrub was discovered by one of our Navy blimps, which came to rest over the spot and lowered a rope ladder, up which the rescued man climbed.

IT is for work that involves hovering motionless or drifting slowly with an air current that the blimp's peculiar qualities are best suited. This includes observation of various types, map-making and photography. This is so obvious that it does not require elaboration, but it recalls the story of some chaps I knew aboard a subchaser who came upon a British Coastal blimp apparently down at sea. On running up close they found her to be lying a few feet off the surface with a couple of buckets for sea anchors, while her crew of two took advantage of a rare spell of fine Irish weather to do a little fishing. It used also to be said that British blimps would sometimes hover over an American ship and lower a bottle of wine on the end of a string in exchange for a carton of cigarettes, but for this breach of regulations I will not vouch. It could easily be done. Blimps have landed on the decks of ocean steamers with no more ado than bringing a powerboat up to a float. This matter of landing is perhaps even more vital than the ability to hover motionless *en plein air*.

To summarize, blimps have been used (1) to rescue persons from terrain on which no sort of airplane could possibly land, not only in mountainous country but also in forests and in swamps; (2) to land passengers on the roofs of skyscrapers, in small city parks (such as the Battery in New York) and on the decks of ships; (3) to set down scientific workers and their equipment on mountain ranges and go back and pick them up when their work was done; (4) to remain for hours aloft watching for forest fires, with little expenditure of fuel; (5) to operate on regular passenger runs without the need for special landing fields at every stop; and, finally, (6) as already cited, for observation patrol in time of war.

If this little craft has such exceptional powers why has its use not been more eagerly sought? The answer is probably that it lacks three qualities which are today all important in commercial flying, viz.: (1) reasonable cost, (2) high speed, and (3) carrying power. Three passengers is all the load a blimp will carry that costs perhaps as much as a twelve-passenger plane and goes only half as fast. What more need be said? Only this: If and when the present high cost of manufacturing and sewing those wonderfully light, thin, strong, and tight fabrics that form the envelope of the blimp is reduced—fabrics three layers of which are but one-thirty-second of an inch in thickness and yet which sustain the weight of the car by "finger-patches" and permit a gas leakage so slight it can scarcely be measured—if and when, I say, the cost of this fabric is lessened so that the blimp can compete on a dollar basis with motor cars and boats, many of its interesting features will suddenly be "discovered."

For example, there is a certain spot in the western portion of these United States that can be reached only by air, since it is girt about by whole series of precipitous cliffs thousands of feet in height. At the bottom of the deep canyons between those cliffs no other air-craft could find a place to land. No man, so far as I know, has set foot there yet. I hope to some day—from a blimp. But I am pretty certain that the blimp will not be mine!

A typical field landing of a small blimp

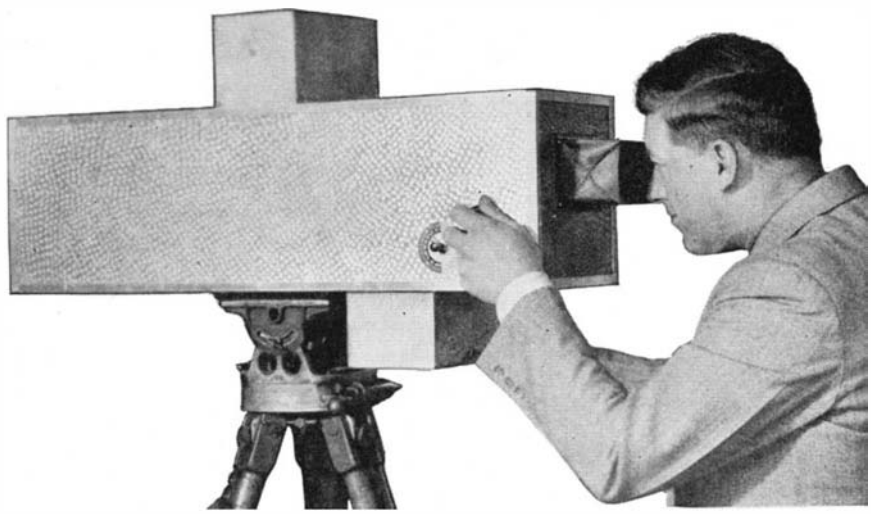
Infra-Red Rays Dispel Fog Dangers With New

Quick-Action Navigating Camera

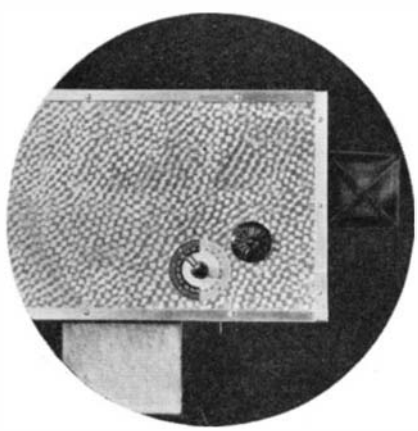
A HINT of the new development in navigating equipment described here was given on our editorial page in the January issue. At that time the following statement was made: ". . . it is understood that the operators of the United States Lines are now working on a new development, explained to us in confidence, which will assure safer navigation in dense fogs than has ever before been possible." Now the story can be told. The device explained to us during an inspection of the S. S. *Manhattan* was the Fog Navigating Camera invented by Captain Flavel M. Williams, which has been given thorough and conclusive tests in actual service and has been found to constitute an outstanding achievement in man's battle against fog.

Briefly, the camera is a combination, in one compact housing, of a lens and shutter arrangement, a holder for infra-red sensitive film, and a developing and fixing compartment. By the use of special film produced by the Eastman Kodak Company of Rochester, New York, and developing solutions adapted to the purpose, the operator can make an exposure and within a few seconds he can view the developed film.

With this camera mounted on the bridge of a vessel, exposures can be made at intervals governed by conditions at the time, and the vessel can proceed through haze and dense fog that ordinarily would mean greatly reduced speed or even the necessity of dropping anchor and awaiting clear weather. Repeated tests have shown that when the visibility to the naked eye was only 400 feet, negatives taken with the camera revealed objects ¼ of a mile and more away. It is well known that infra-red rays, to which the eye is insensitive, are able to penetrate fog to much greater distances than visible light. (A chart showing the place of infra-red in the spectrum is reproduced on page 139 of this issue.—*Editor.*) These rays can be used to affect a specially sensitized film and to make a record that does not differ materially from that made by visible light on the ordinary photographic film exposed in the usual manner.



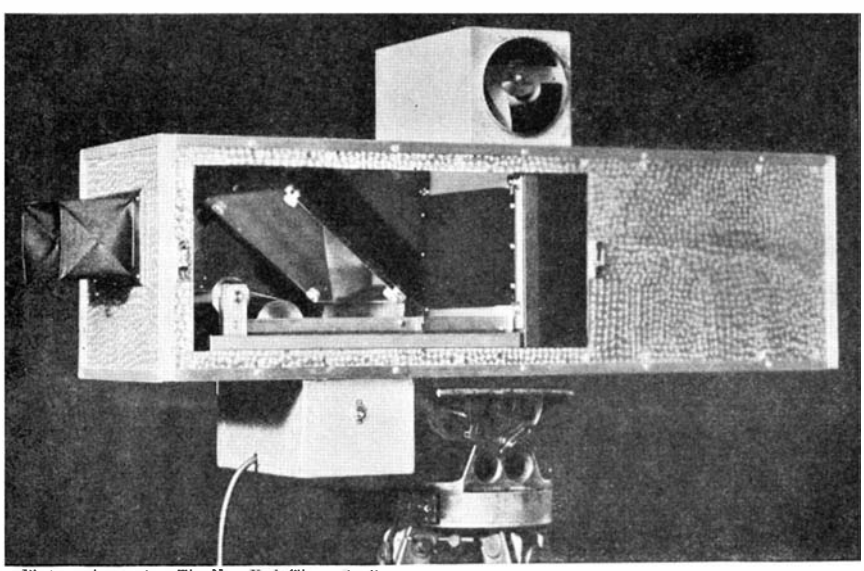
Captain Flavel M. Williams with his fog-piercing camera



The film operating knob and indicating dial on the side of camera

THE illustrations on this page show the construction of the camera. The lens is in the forward part, shielded by the housing from rain and snow. Immediately behind the lens is a pressure plate through which is fed the eight-inch-wide infra-red sensitive film. After the exposure is made, the operator turns a knob on the side of the housing, winding the film into the developing bath, after which it is fixed in another tank and viewed in a mirror while still wet. The entire time required, from making the exposure to seeing the image on the film is less than 30 seconds. This can be further reduced by refinements in emulsion and developer.

A scale at the pressure plate, which is photographed directly on the film at each exposure, and another scale on the tripod of the camera, enable the navigator to fix the exact positions of distant objects relative to the heading of his vessel.



Photographs courtesy The New York Times Studio

Side plates of the camera removed to show, in the upper compartment, the storage reel for film, and the pressure plate, chemical tanks, and viewing mirror

OUR POINT OF VIEW

What Ails Railway Service?

JOSEPH B. EASTMAN, the Federal Coordinator of Transportation, wishes to discover ways by which passenger service in this country can be improved, and has issued thousands of ballots on which passengers on the railroads can express their opinions of existing service and suggest changes.

One thing our railroads need is the redesign of passenger coaches by someone who is not a railroad man and who will not be influenced by any sacred traditions of railroading. Just as the early motor car was an evolution from the horse-drawn vehicle, so were our passenger coaches an evolution from the old-fashioned horse-drawn coach. It took the motor industry a full generation to abandon all of the sacred traditions of this ancestor of the motor car, while the railroads still cling to the descendent of the old coach. Like Topsy, our railway cars "just grew"—with the exception of two recent innovations—compartment cars with beds, and air conditioning.

Again, take dining car service: Why are meals on board train so expensive? Because the maintenance of this service is so wasteful—wasteful mainly because of the wide variety of food which must be carried and offered and largely thrown away in the end. In Great Britain an attendant passes through the train and hands out tickets for "sittings." Later, at a call, all the holders of a given sitting ticket repair at one time to the dining car. There are two choices of entrées—enough to suit all except the epicure and a few constitutional objectors. Meals are served by courses to all at the same time. The savings in food and labor thus made possible enable the British people to dine on their trains at a reasonable cost. Such a service is not quite so resplendent as the one we have, but ask the objector whether it is not likely to be quite as good as he has at home (where most of us take just what is served and "like it").

The inquiring Federal Coordinator asks the people's opinions regarding accelerated train speeds. Just now the air is full of easy talk about 100-, 110- and 120-mile speeds. Train speeds can be accelerated but in our opinion, before it has been learned that there is a maximum safe speed, the public will have hounded the railroads into putting on very fast trains which are destined one by one to be wrecked. It is hoped that the railroads will not allow thoughtless speed maniacs to stampede them too far.

Industrial Pensioners

THERE is one important industrial problem—or should we say sociological problem of industry—on which no one seems to have put much thought. This is the problem of the retired employe. What is to be done for this man who has filled a job with one company for 35 or 40 or 50 years and is retired on a pension? He gets his retirement pay, it is true, but is that enough? The record of such men shows that, once he is taken off his life-long bench or lathe or desk, the retired man wanders in a sort of daze, lost in a strange life of leisure, and rapidly loses interest in life and often dies quickly.

This question was recently brought to our attention by a remark made by an executive of one of the country's largest manufacturing concerns. He expressed his sympathy for these "old fellows loafing on street corners." This started a train of thought from which the following plan evolved:

To provide the work-interest for these older men to whom work is a habit not easily broken without serious psychological consequences, suppose such firms as Westinghouse, General Electric, Eastman Kodak, and the like, each set aside a small building to be used by the pensioners exclusively as a shop-laboratory. In this building let there be installed small lathes, work benches, tools, chemical equipment; and let the pensioners be told to make themselves at home, to build whatever they please, to work on inventions, to play at hobbies. A paid superintendent, to keep them peaceful and happy, might also be an instructor in hobbies such as the making of machinery models, wooden objects, telescopes, or delicate scientific instruments. There is no doubt that the small cost of carrying this building and this equipment would be repaid many-fold not only in the happiness of the pensioners but also in that it would open up a pleasing prospect for those nearing the retirement age. Last but not least, actual dividends might accrue to the company in the form of worth-while inventions or discoveries which might emanate from these men with a lifetime of training behind them.

This is our plan in brief; details could easily be worked out to provide for all contingencies. We would welcome the comments of industrialists concerning our plan and would be glad to assist in working out further details.

For Fathers Only

SOME months ago W. F. Bond, the Mississippi State Superintendent of Education, sent a questionnaire to three groups concerned with the upbringing of the youth—state superintendents and commissioners of education, college students, and high school students. He asked each group to name the three most deadly enemies of the youth today. *School Life*, a magazine published by the United States Department of the Interior, Office of Education, reports his findings, which are that idleness and lack of responsibility, strong drink, and improper relations between the sexes are the three culprits; to which moving pictures of the wrong kind was added as a fourth. The expression of opinion among high school and college students did not differ essentially from that among state superintendents. These being the findings, Mr. Bond asks: What shall we do about it?

In the first place, what *can* we do about it—what can we ever expect to do about it? In some fields, medicine for example, diagnosing is often more difficult than curing. Here the diagnosis is relatively easy but the cure eludes us. So far as is known, there is no patent method of curing these deadly enemies of the youth, for their cure depends upon the provision of one prerequisite, unfortunately a difficult one to attain: the building of character.

In such circumstances, what direction, beyond those conscientious attempts to build character which are assumed on the part of all qualified parents, can the average practical parent's efforts take? How should a father instruct his son regarding strong drink, sex relations, gambling, and so on? Should he go on the assumption that *his* boy will always be a nice boy and therefore counsel him only to be a nice boy, or should the father assume frankly that the young boy is the old boy's son—that he will probably get into as much deviltry as dad did, and therefore attempt to forefend against the worst of its damage by instruction which is really practical if nothing else?

Among our readers there are known to be many fathers of growing boys. Would they like a series of articles containing instruction of that practical kind?

Winter at the laboratory-home: cold outside, balmy "springtime" within

SPRINGTIME

By J. W. HAMMOND

THROUGH many recent generations sentiment and science have combined to enhance the home. In the material improvements which it repeatedly has produced and promoted, science undoubtedly has made the home more livable. It has thus buttressed the powerful but intangible influence of sentiment; and sentiment, in this restless age, might find itself under great disadvantage if compelled to work single-handed.

Yet many persons will contend that various achievements of applied science have a tendency to undermine to a surprising extent the natural home-loving instincts of American families. People today spend far more time "on the move" than did folk of two generations ago. Many factors lure them from their homes in almost every season of the year, particularly during the long, pleasant stretch of outdoor weather from early spring to late autumn.

Suppose, however, one were more comfortable at home than awheel. Suppose the hot muggy evening were confined to the out-of-doors and that the indoors atmosphere were delightfully refreshing, even exhilarating, both to body and mind. Regardless of extraneous attractions none would then think of leaving home. Literally man's domestic abode would be something akin to an oasis in a desert. "Home, sweet home" thereby would become sweeter than ever; it would be transformed into a veritable garden of Eden by air conditioning.

"OUR definite objective," says Elliot Harrington, air-conditioning engineer of the General Electric Company, "is completely to reproduce indoors the conditions of a balmy, sunny spring morning in the open country immediately after the air has been washed clean by a shower of rain. We seek to maintain these conditions throughout the year."

More logically, perhaps, than most engineers who are working in this field can Mr. Harrington talk for publication about the "Edenizing" of homes, for his own residence in Schenectady is the official air-conditioning proving home of the General Electric Company.

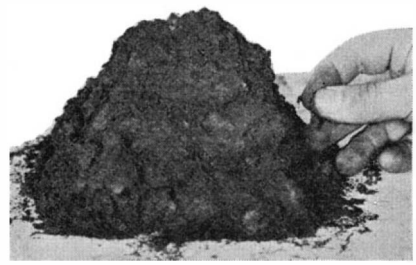
The Harrington home has become the scene of continuous tests in the frontier zone of air-conditioning knowledge. It contains far more equipment than any home that might purchase a standard air-conditioning installation. In this ten-room dwelling there is done all that present conventional practice requires—and a great deal more. The four factors of temperature, humidity, circulation, and purity, which constitute air conditioning as thus far understood, and which in themselves will impart great comfort and health to inhabited interiors, are here efficiently applied throughout the entire house by a central air-conditioning plant located in the basement and operating through a system of ducts.

MR. Harrington and his associates have devised a scheme of recording electrically, by means of thermocouples, the temperature at a hundred places throughout the house, in every room, in different areas of each room, and at different levels between ceiling and floor. These temperatures are received and tabulated in an instrument room in the basement. The records so obtained have revealed that, lacking forced air circulation, a person standing erect may be in a temperature of 70 degrees Fahrenheit at the breathing line while a child playing on the floor at his feet is in a temperature of about 62 degrees, and at the ceiling just above his head the temperature is close to 80. This is a differential between floor and ceiling of about 18 degrees. With forced air circulation, such as obtains under air conditioning, this differential is reduced to three or four degrees—70 at the breathing line, 68 to 69 at the floor, and 71 to 72 at the ceiling.

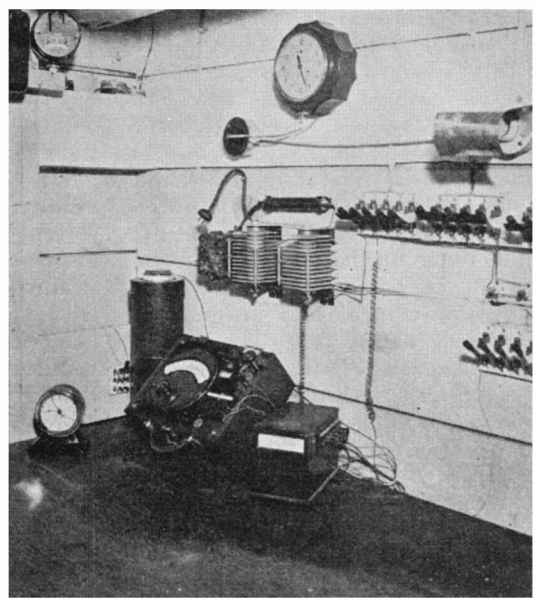
Although air conditioning essentially embraces heating and humidifying in the winter, as well as cooling and dehumidifying in the summer (with air circulation and air cleansing, or filtering, the year 'round) at the Schenectady proving home a somewhat closer analysis was directed toward the cooling problem. Here a calculation was arrived at disclosing the various factors contributing to the cooling load. This showed the following:

Conduction through walls and windows, 15,300 Btu. per hour; five persons (400 Btu. per hour per person), 2000; ventilation and dehumidification, 12,600; conduction from attic, where heat accumulates from solar radiation, 10,200; solar radiation on walls and through unshaded windows, 26,100; total, 66,200 Btu. Cooking was disregarded because the kitchen is ventilated but not cooled. The load as shown was based upon outdoor conditions of 91 degrees, Fahrenheit, with 45 percent relative humidity, and indoor conditions of 78 degrees with 45 percent relative humidity, with slightly more than one air change per hour.

Several possible methods of reducing the cooling load were revealed. Awnings over windows exposed to the sun cut down the load by 11,000 Btu. per



Two quarts of dirt, a month's collection from the air of the home



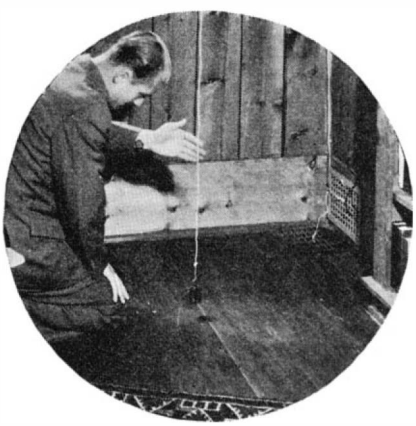
A few of the instruments in the General Electric air-conditioning proving home basement

IN THE HOME

Sultry sun outside; air conditioning and spring-like conditions inside

hour. Outdoor air circulated through the attic by a fan, preventing the accumulation of heat from solar radiation, produced a further reduction of 10,200 Btu. per hour. It was estimated that a layer of insulating material in the walls of the house would have made possible a reduction of 9000 Btu. per hour, giving a total cooling load of only 36,000 Btu. per hour. From this phase of the study it was clearly indicated that the type of house construction has a direct bearing upon the cost of air conditioning. Much may be done, at the time a house is built, to reduce the necessary size of the equipment, and hence both the cost of installation and operation.

As it is, the proving home possesses no structural provisions for air conditioning, except a half-inch layer of Celotex on the lower side of the roof rafters, and storm sash at all windows.

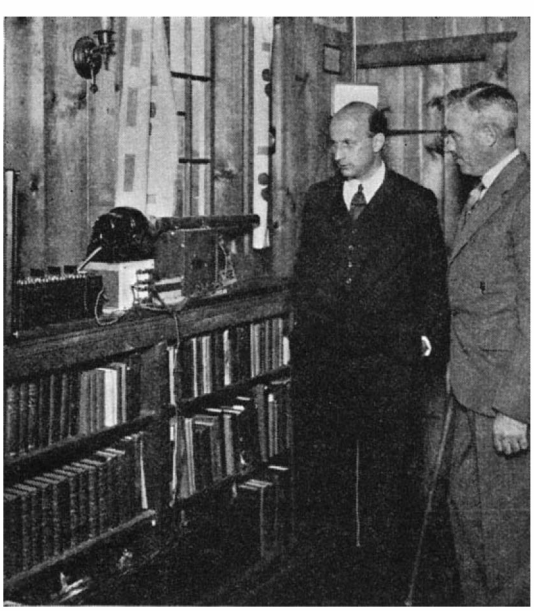


Just above the floor: one of a hundred thermocouples that are used

All the rooms are provided with the following equipment, most of it especially installed for testing only:

Heating by either steam radiation or circulated warm air; cooling by circulated cool air with (a) indirect expansion system to facilitate cooling measurements and (b) storage cooling for special testing; air cleaning by means of oil-treated steel wool filters; humidification in winter and dehumidification in summer. A two-pipe steam system is installed in the sun porch only, with separate automatic temperature control for special study. Forced ventilation to out-doors is employed in the kitchen, and in kitchen and baths steam heat alone is supplied, without air conditioning, so that odors will not be carried through the house. The air-duct system of the house has supply and return ducts at various locations in both floors and walls, permitting an intensive study of the various forms of air distribution.

THE operating performance of the equipment is indicated by the following summary: Humidity control—(winter) adds maximum of 1½ gallons of water to the air per hour; (summer) withdraws water from the air at same maximum rate; filters—remove 90 percent of the dust particles larger than 10 microns, and 35 percent of particles 10 microns or smaller; air distribution—1600 cubic feet per minute; heating—130,000 Btu. per hour; cooling—45,000 Btu. per hour.



Dr. L. R. Koller (left) demonstrating the ion counter in the library of the laboratory-home

Certain aspects of both the normal and experimental operations going on at this home are a distinct revelation to the housekeeper, who in this case is Mr. Harrington's mother, Mrs. Grant D. Harrington. When she was shown two quarts of dirt which had been filtered from the air of the house in a month's time she was greatly astonished, and her first thought was that the neighbors would regard her as a slack housekeeper if they heard about it. But it was explained to her that this was dirt which was removed from the air before it had a chance to settle; and before long she was willing to concede that never before had she presided over such a super-clean domicile.

There are some forms of unique developmental work going on at this home which are far different from the elaborate tests that are being performed with existing equipment and methods. A study of ionization and its effects upon occupants of the home is one of these. An instrument developed in the General Electric research laboratory which measures and records the number of ions (electrified particles) per cubic centimeter in the air of a room is on duty in the library of the proving home. Already it is well known that the number of ions decreases rapidly when human beings are in the room; also that the proportion of ions in the outdoors air is very high on clear, sunny days and lower on cloudy days.

THERE is thought to be some unknown factor involved in ionization which may be of benefit to human health and comfort. It is conceivably a subject for the medical profession to investigate, but meanwhile a careful record is being kept at the proving home of the accumulating data.

It is Mr. Harrington's belief that other elements, perhaps of a psychological nature, may also be lacking. Excellent though it is already, with temperature and humidity control, circulation and filtering, air conditioning still falls somewhat short of that balmy spring morning in the open country just after a shower. Perhaps the smell of earth and grass, the singing of birds, the vistas of landscape and sky may be necessary.

In completely air-conditioned homes of the future, Eden will be at least approximated, and the people living therein will be as much blessed by idyllic atmosphere as were Adam and Eve themselves. It will probably be extremely doubtful if folk will then hanker to leave their dwellings in search of comfort and diversion. Concededly there are various elements in modern life which have rather pulled the American home apart; perhaps air conditioning—"Edenizing," if you please—will cement it together again.

BABIES BY SCIENTIFIC SELECTION

By JOHN HARVEY CALDWELL

BABIES of extra-marital paternity are now being born of women who have sterile husbands, by artificial insemination with the life-giving germ from selected men. This is one of the most significant eugenic developments in the history of man.

Philosophers from ancient times have advocated the breeding of better offspring from selected types of persons for racial improvement. But any such suggestions for the betterment of man have always met with the greatest of disapproval. Nevertheless, science has made artificial conception possible and many of the present generation of married women—those who have sterile husbands—as a matter of expediency are having children by this alternative, using the sperm of some man selected for his hereditary qualities.

As one interested in certain aspects of social trends, I have been making an investigation of this phenomenon, in order that its effects on these trends may be determined. In order to obtain an estimate of the extent to which children of such selections are being born, I called upon 200 physicians and made inquiry about it.

Most of the physicians were specialists. Eighty-four are listed in "American Physicians and Surgeons," edited by Fifield. Several of them had a national reputation for their knowledge of sterility and its treatment.

The physicians were located as follows: Chicago, 45; Milwaukee, 15; Cleveland, 15; Washington, 20; Philadelphia, 25; Newark, 7; Brooklyn, 10; and New York, 63.

FIFTY-SIX of the 200 physicians interviewed had received a total of 275 to 300 requests from patients for artificial inseminations with good sperm from a selected source, because their husbands were sterile. Fifteen of the 200 physicians did not commit themselves as to whether or not they had received such requests. Most of these 15 doctors were "not interested," or else they objected to this practice. One hundred and twenty-nine of the physicians said they had never received such requests. Several of these physicians stated that they had had patients who wanted to talk about this matter, but they discouraged it because they did not think the public was ready to sanction it.

The 56 physicians who received requests for artificial insemination reported their experiences as follows:

Nine of these physicians said that they had used artificial insemination, with sperm other than that of the husbands, for conception in the case of 25 patients, with successful births. (A few of these doctors did not state exactly how many of these conceptions they had charge of, but there were at least 25.)

Five stated that they were doing some of this work, but did not mention whether or not any conceptions had resulted. One, a woman physician, stated that she now has three patients who wish babies from selected sperm, but that she does not like to take the responsibility for it.

Four had tried a few artificial impregnations but had had no results.

Fifteen did not state what they did with regard to the patients making these requests. However, several of them spoke favorably of this method.

Twenty-two turned applicants away for various reasons such as: Not wishing to risk being brought into court; afraid the husband might later change his mind; the patient did not have her husband's consent; or, because they thought the public was not ready to sanction it. Most of these physicians, however, had no particular objection to the practice as such.

Most of these requests have come in the last 10 years, particularly in the last three or four years. In the last year or two, the 56 physicians who reported favorably had received a total of more than 40 requests per year.

Some of the physicians stated that most of these requests came from the wife. An equal number said that most of the requests came from the husband as a result of the wife's suggestion. Others said that they came from both.

THE total number of requests for donated sperm in the United States cannot be closely estimated, but the data at hand are sufficient to indicate that the total of these requests must lie between 1000 and 3000 per year.

The total number of births from insemination with donated sperm can be only roughly estimated. There were 25 births out of 275 to 300 requests (most of the requests having been turned away), a ratio of about one birth to 12 requests. This ratio is probably a little too high for an average. While in this investigation there were enough random selections to provide a basis for an estimate on the total country-wide requests, there were not sufficient random selections to strike an average of the physicians who arranged these births. Therefore a ratio of one to 15 or 20 would probably be nearer the conservatively high average. On this basis, some 50 to 150 babies may be born per year from artificial conception with donated sperm.

The significant aspect of this whole matter is not the number of births at

THE accompanying article deals with an essentially new scientific practice—the artificial impregnation, performed by a physician, of would-be mothers whose husbands are sterile, using semen obtained from a eugenically selected donor.

As practically no organized information regarding the present extent of this practice has been available, the author has attempted to gather some, but exact statistics are of course not available at present.

The practice of artificial impregnation is not a widespread one and, though growing, it is unlikely ever to become large. What are its moral and legal aspects? Mainly it is thought by some to be not a moral question but more a matter of sentiment—to be decided in each case by the individual concerned. No social menace seems to be involved, and it is not illegal so far as is known. However, some interesting legal tangles with regard to the status of the resulting offspring may be involved.

Opinions with regard to artificial impregnation will differ widely, and no doubt strenuously. Later it is hoped that a selection of short, concise letters inspired by this article can be published, in order that a sort of "forum" with regard to this little-discussed subject may for the first time be made available. Most of the readers of this magazine are men, but letters from women are especially solicited. Male readers should remember that, in final analysis, women will control the fate of this question, and that their point of view may differ from that of the average man.

—The Editor.

present, but the number of requests for selected sperm, and particularly the extent this practice is likely to reach after it becomes more generally understood.

This recent development in human events has come about in a most natural and orderly manner. Not all women in this age of learning are content to forfeit their natural right to motherhood and their unborn loved ones through no fault of their own.

So accustomed are we of this generation to seek scientific solutions of all our problems and the perplexities of life, that it seems only natural for physicians, occasionally, to receive requests for artificial insemination with good sperm in unions where the wife is apparently fertile and the husband cannot be brought to a state of fecundity by treatment. Particularly is this true in unions where the physician tries artificial insemination with the husband's sperm and finally concludes that it will not fertilize.

Our increasing sterility is becoming a vital problem. Due to the effects of civilization we are becoming biologically weaker and, as in all the great civilizations which have existed before, sterility is increasing. Not only is there an increasing number of childless unions but there is also an increase in limited sterility or "one-child" sterility. Most one-child families, gynecologists claim, are not one child by choice but for biological reasons. In some cases this is due to the husband, his sperm being scarcely good enough to cause conception.

So prevalent has sterility become that many of the large hospitals have established sterility departments. Charity hospitals also have taken up the same work, in order that those who cannot afford a specialist may nevertheless have the services of one. The exact extent of sterility cannot be stated, for there are few statistics.

ABOUT 15 percent of our married couples find, after they have been married a few years, that they have no children, and they go to a physician. Probably less than one fourth of these have children after treatment, leaving about 12 percent (a common estimate) to remain permanently barren. Some unions are barren because both husband and wife are of low fertility, though in many of these unions, either could have children if married to some one of high fertility.

Some unions are barren because of "antagonistic sterility;" that is, both are fertile and normal and could have children, but only with someone else.

About 40 percent of the barrenness is due to the husbands. (Estimates range from 25 percent to 50 percent but 40 percent seems to be the more commonly stated.) This does not mean that 40 percent of the husbands in childless unions are absolutely sterile. Some have closed tubes that could be opened. Some have weak sperm that will respond to treatment and could be brought to a fecundating condition, and some would have children if married to a woman of high fertility.

The scientific study of sperm, its qualities, and its treatment, is comparatively recent. Not many physicians have made a special study of this subject.

Each year about 50,000 women leave the marriage altar, later to discover that they are apparently fertile but childless. Some of these women are themselves sterile, but there remain over 40,000 who are fertile yet in whom conception does not take place.

America now has a million, or nearly so, fertile wives of child-bearing age, most of whom want children yet who have husbands with whom they cannot conceive.

ABOUT five percent of our married women are themselves fertile and must live out their lives barren and childless without the natural development that motherhood brings, or they must do something expedient—must seek some alternative. Artificial insemination would obviate this questionable method.

The physicians' estimates of the potential demand for insemination with donated sperm ranged all the way from the present demand to 90 percent of those having sterile husbands—that is, about 3000 to 36,000 per year (the present demand being those who are now asking for the insemination, plus those who are resorting to an expedient—which is not far from 3000, while 90 percent of the 40,000 fertile women who each year marry a husband from whom they can not conceive would be 36,000).

Obviously both of these extreme estimates are wrong and 10,000 to 20,000 is probably a fair estimate of the annual potential demand, some for having two children, if this possibility were more generally known and physicians were prepared to do this work.

Artificial insemination with sperm not the husband's presents many problems. Many physicians do not wish to have anything to do with it until the courts have declared where we stand, yet there is probably no law covering this matter. Several physicians thought that they could not be prosecuted if the husband and the wife and the donor have given their consent to the insemination. Other physicians wish to wait for social approval of this practice.

Furthermore, the husband may object. If the husband gives his consent and the physician takes the case, then comes the question of the donor. And the donor may be needed several times for one patient.

Women are not naturally as fertile as the animals and, while some women become pregnant on the first insemination, others need several. This adds to the problem of securing suitable donors.

Like blood transfusion, artificial insemination is really the proper work of a clinic or of physicians who are prepared to do such work.

Several physicians, both men and women, suggested that we need a "fertility" clinic, a clinic prepared to provide a staff of selected donors in order that women who want motherhood from selected sources might obtain it. The occasional contribution from a dozen men of excellent mental and physical development and of good stock would provide all the sperm an entire city would require.

WE need not fear, however, that this practice will go too far or threaten the existence of the family unit, for the practice would tend to be self-defeating in its own product, defeating direct repetition. This is because children born of selected sires would tend to be healthy and fertile and would not be in need of this alternative in order to perpetuate themselves. Needless to say, we do not like to face the necessity for the establishment of such clinics, nor the spread of such a practice, but, as several physicians remarked to me—what else can we do? The problem is here and the sooner we bring it out of secrecy and deal with it in a scientific way the better. We must face it just as we have faced other acute problems.

We have accepted, or at least tolerated, and become accustomed to, many things we at first resented and thought impossible, such as the baby show at the county fair; the boy or girl health contests; clinics to teach birth control; and artificial sterilization of the unfit. Obviously we shall soon become accustomed to the idea that nearly all women who have sterile husbands normally wish children. Artificial conception has the preference as an alternative. Departing from conventionalities thus far, most wives, for the sake of the marriage and home, do not wish to know the identity of the donor, but for the sake of the child they want this assistance from the best of sources. This makes possible to humans a privilege, in posterity, heretofore enjoyed only by thoroughbred plants and animals.

Doubtless within a few years there will be clinics to meet this need. Some 10,000 to 20,000 babies may be born every year from selected sources, while less than 500 babies per year are now being born to the men of real talent in our country.

What will be the eugenic effect on the race, if this same tendency grows?

THE NEW TERRANAUTICS

The Findings of the Wind Tunnel Are Not Always Applicable to the Design of Motor Cars

By WILLIAM B. STOUT

THE author of the accompanying article is unusually qualified to express an opinion on the streamlining of automobiles or, as he terms it, the science of terranautics. This science embraces all that is known about automobiles and aerodynamics, and the author has been identified with both for many years. As a designer of motor cars and airplanes, he views the present subject from all angles, and his statements carry added significance at this time when streamlining of automobiles is creating such a furor in the industry. The reader is also referred to the article by Prof. Alexander Klemin, on the same subject, which appeared on page 76 of our February issue.

—*The Editor.*

THE matter of streamlining of motor cars has received so much erroneous attention, both from the automobile man who suddenly "goes aerodynamic" and the aeronautic engineer whose emoluments from aviation have suddenly diminished, who go "terranautic," that some points need very definite clearing up.

There are certain fundamentals that make the streamlining of a motor car an entirely different problem from that of an airplane, or any other vehicle. The first difference is that while the air always comes from the front in an airplane, it may come from any direction in a motor car or land vehicle. An airplane floats free in the fluid in which it flies, and no matter what the direction of the wind as related to the ground, the wind as related to the airplane always comes straight on from the nose. You can visualize this by thinking of a motor boat on a river; when this boat is cleaving forward through the water it cuts the water directly on the bow equally on both sides no matter whether it is headed upstream or down-stream or cross-current.

Streamlined shapes as related to airplanes and boats therefore have no place on a motor car or railplane, where the vehicle is fastened solidly to the ground and the wind blows over it from any direction. In this case, streamlining must simulate more the turtle or the crab than the airplane or the bird, and certainly has nothing in common with the teardrop, except sorrow.

FIGURE 1 shows the teardrop section "A," and a square section, "B," similar to the old type motor car with square corners. The shape "A" is that of a lifting wing and has three times the lift sideways that a square section, "B" would have. That means that if you make a motor car the shape of "A" in horizontal cross-section—similar to some English designs which have been promoted—the car will be three times as hard to hold on the road as the car "B," and we already know that car "B" is fairly hard to steer in a side wind as it is.

When in the streamlining of a car you also combine light weight and strength of airplane structure, then you most certainly must steer clear of high lift in the body section if you wish controlability; and not all cars of this type will be built with a weight of 7600 pounds as was an early model in this country to enable it to hold the road in side-winds. The plan view of the car must be so designed to give a minimum of side thrust in cross-winds; in other words, the shape must approximate streamlining by being completely curved in all directions with no sharp corners. Properly engineered, a great advantage may be had by streamlining.

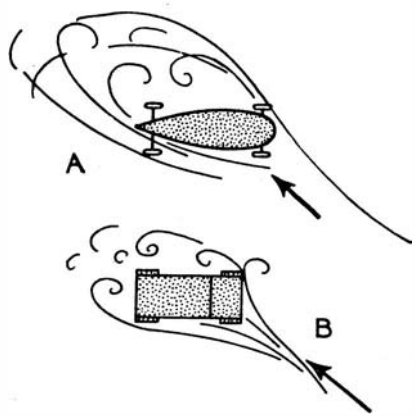
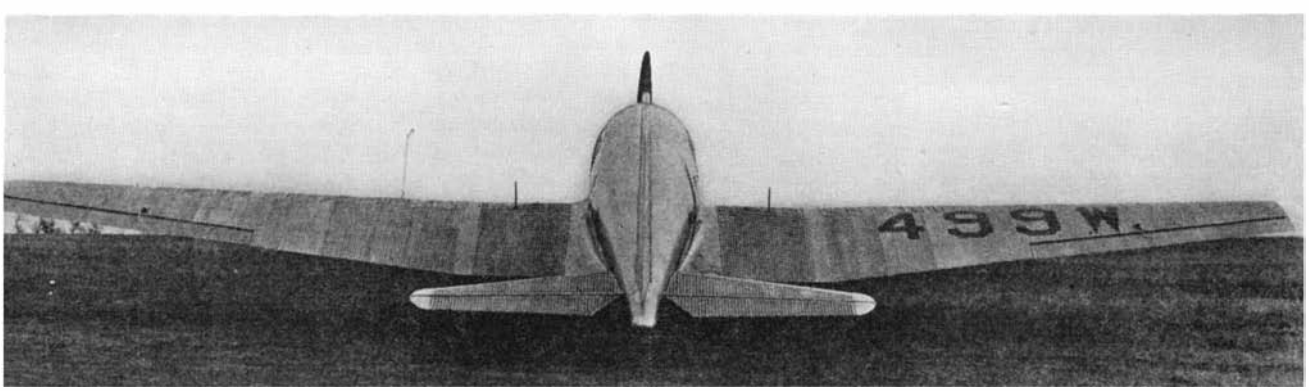


Figure 1: **A "tear-drop" car design, "A," is more difficult to steer than a body of flat section, shown at "B"**

In Figure 2 is shown the effect of a flat curved back to a car. The shape of the front end is not important, as the air will bank itself up in front of an obstruction and more or less streamline itself; but in back is the important part. This must be so shaped that it will form no low-pressure eddies behind the car. However, this condition varies with speed.



This type of plane, designed by the author of the accompanying article, is efficiently streamlined, but not all of the lessons learned from designs of this kind can be applied directly to the production of streamlined motor car bodies, as told in the text

In Figure 2 the curved flat top comes down to the rear of the car as shown. At low speed, as at "A," the air follows down the back of the car very cleanly and with but a very small vacuum, except at the point of drag caused by resistance underneath the car between the road, standing still, and the rough bottom of the car moving. This, at slow speed, however, does not amount to much.

As speed is increased, however, as in "B," this airflow changes. The air does not have time to follow down the steep flat stern of the car, and having no air coming in from the sides in an equal smooth curve, a vacuum area is formed with burbles and turbulence, shown by the picking up of leaves, snow or dust in this area.

Later on at a certain higher speed, the air will break completely away from the car in all directions, as in "C," leaving a long continuous turbulence behind the car, all of this suction re-

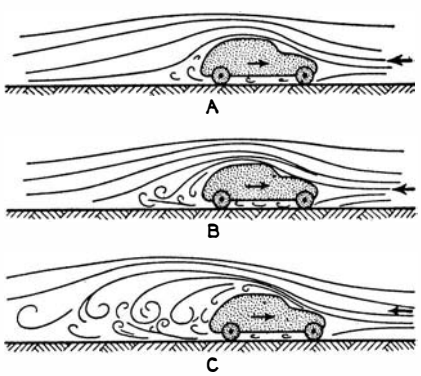
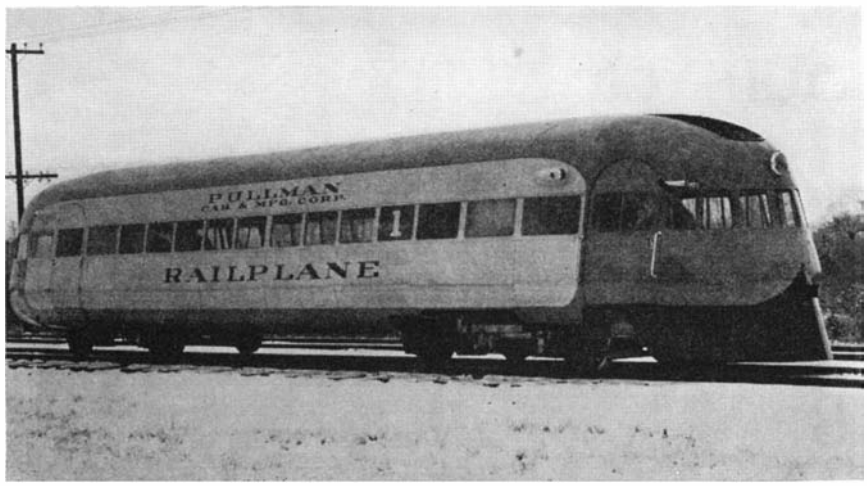


Figure 2: **A streamline for 40 miles an hour may be ineffectual at 60; the streamlining of a motor car must take into consideration the desired "cruising speed of economy"**

quiring additional horsepower. The streamlining of any car, therefore, must be judged by the "cruising speed of economy" at which the manufacturer is aiming.

Figure 3 shows an automobile engineer's idea of streamlining; a very sharp pointed nose tapers away back to the stern. This is wonderful streamlining for a boat, where turbulence in the rear is not as important as is the cutting of the water at the front; but for air, the lines show a great vacuum area at the rear. If any manufacturer making this type of car ran his car backwards, at 60 miles per hour, the horsepower consumption would be not over half and his fuel economy equivalent.

In Figure 4 is an explanation of designing for certain economical speeds. "A" was our old type automobiles—square corners, with visor on top of the windshield (which, by the way, would consume about six horsepower), exposed lamps, bad air conditions between fenders and hood, and so on. On these old cars the best fuel economy was ob-



Streamlining as applied to a "railplane" by the author. Every vehicle to be streamlined presents a different problem that must be solved independently

tained at between 35 and 40 miles per hour. Next, we came to the slanting windshield type with rounded corners and fenders straight into the hood. This next change in air resistance stepped the most economical speed up to approximately 48 miles per hour; the slanting back, or smoothed-in trunk, or even double spare tires on the rear adding to the economy.

By a greater extreme of streamlining, as shown in "C," it is very easy to increase the most economical cruising speed of a car to 60 miles per hour, or better. This will be the next step in motor car streamlining development.

The aerodynamic man will come

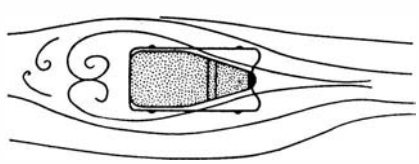


Figure 3: **A pointed radiator is not good streamlining for a motor car; this car would be more efficient and economical if it were run backwards**

along, however, and tell you a lot of things he has learned in the wind-tunnel and quote them for real motor cars. The wind-tunnel is a very great publicity center for motor-car development, and the motor car certainly offers a great field of research for the aerodynamic engineer; nevertheless, wind-tunnel figures on automobiles today are of absolutely no value from a quantitative point of view, on account of one single fact. So far no one has been able in the wind tunnel to simulate, or even approximate, the effect of the moving ground under the vehicle.

Tunnel figures are often given with two models—one up-side-down—placed wheel to wheel, but this is not a simulation of the actualities because there is no ground effect when a model is tested in this way. If the model is tested on a floor, then the drag is not the same as it is in a motor car where the rough ground is continuously moving at high speed under the wheels. Even a method of doing it with a traveling belt has not been developed to a point where it means anything in accuracy. However, great progress is being made if only in acquainting the public with the absolute necessity of cleaner lines for automobiles, of the possibilities of greater roominess inside, greater head room, greater luggage space, more luxury; and more than that, much easier riding through the adoption not only of streamlining but of the other principles which the automobile has already adopted from the airplane: Light structure, balloon tires, pyroxylin finishes, and "knees" which are really airplane landing gears with independent wheels attached to automobiles.

WITH all that aviation has to offer to the motor car, we may look for tremendous changes in this field dur-

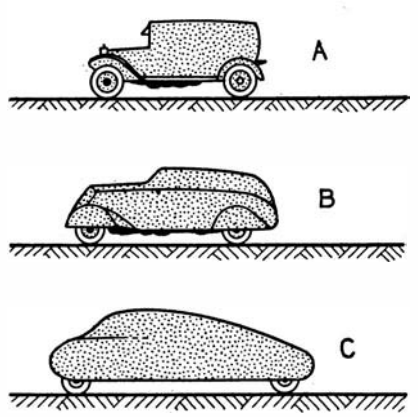


Figure 4: **Each of these body types has a different economical speed of operation, as explained in text**

ing the next few years. All eyes today are focused on airplane engineering as a way to lead all vehicles of travel out of old conventions into a new possibility of faster, better service at lower costs, and decreased risks.

Science Suits Fashion's Fads

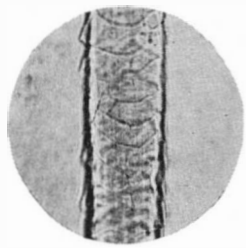


Figure 1

Figure 2

By LLOYD W. DAVIS
Chemist, National Oil Products Company

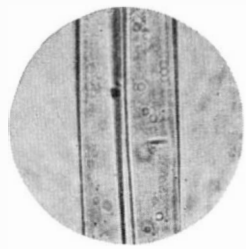


Figure 3

BRIGHT and shining objects always attract us. That is why we value gold and precious stones, why we polish our metal tools and utensils, varnish our wooden furniture, shine our shoes, and lacquer our automobiles.

That, too, is why we hold silk, with its shimmering, lustrous sheen, in higher regard than wool or cotton.

Silk, like all other desirable and expensive materials, has been imitated, and very successfully, too. In fact, in one respect at least, the imitation surpasses the original—artificial silk, or "rayon," has a higher luster than natural silk.

This, however, was going too far. After all, silk is silk—the premier among textile fabrics—and rayon, by conspicuously differing from it even in a desirable feature, merely proclaimed thereby its own artificiality. Hence, rayon chemists were called upon to find some means of reducing the luster of their product.

In attempting to solve this problem, these chemists were guided by the knowledge that a rod of glass is more lustrous than a rod of wood for two reasons: First, its surface is smoother and therefore reflects light better. Secondly, as is the case with all transparent objects, some of the light rays penetrating the interior are reflected back, thus intensifying the surface reflections.

CONSEQUENTLY, a glass rod can be made less lustrous either by roughening the surface, as by etching or painting it, or by reducing the transparency in any manner.

With these facts in mind, a glance through the microscope at the various fibers shows why silk is more lustrous than wool or cotton, and why rayon is more lustrous than silk.

Wool fibers, it will be observed (Figure 1), are crossed at frequent intervals by irregular lines. These lines are formed by the sharp teeth of little scales, which interlock when the fibers are pressed together and give wool its felting properties. They break up the surface of the fibers, and, by preventing extensive reflections, give wool its dull appearance. The scales may be rubbed off by long wear and then the characteristic shiny spots of old garments appear.

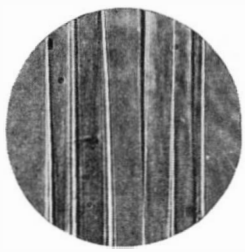


Figure 4

Cotton fibers, under high magnification (Figure 2), look like twisted ribbons. Here again there are no long surfaces to reflect the light, so that untreated cotton goods are non-lustrous also. By special treatment, such as mercerizing or the use of heavy pressures, the cotton fibers can be straightened or flattened out and thus rendered more brilliant.

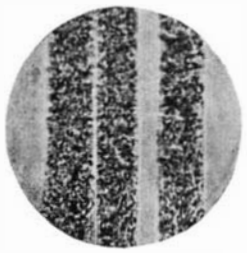


Figure 5

Fibers of silk (Figure 3) and rayon (Figure 4) both resemble glass rods under the microscope and, consequently, are lustrous. It can be plainly seen that the rayon fibers are somewhat smoother and more transparent than the silk fibers, and this explains their superior glossiness.

Since rayon is a synthetic product, it is entirely feasible to reduce the luster of the fibers by decreasing their transparency. Figures 5 and 7 illustrate two methods by which this is done. In the first case an emulsified white mineral oil was added to the solution of rayon material before the fibers were formed; in the second case, a pigment, such as titanium oxide was used. In either case, success is attained only when very small particles of approximately the same size are uniformly distributed through the fibers—which presents a very neat little problem in physical chemistry.

However, this problem was satisfactorily solved, and rayon fabrics with almost any desired degree of luster can be produced at will.

Then a somewhat strange thing happened. The very dull rayons—which are much less lustrous than silk—caught the popular fancy, and silk, perhaps for the first time, found its supremacy challenged. Something had to be done in order to make it as attractive as its imitator! It, too, had to be delusterized.

HERE was another problem for the chemists. The method used to delusterize rayon could not, of course, be applied to silk as there is no way of introducing foreign matter into the fibers of silk. Hence, the only possibility was to find some method of effectually roughening their outer surfaces.

A large number of methods of coating silk fibers with various substances have been devised, but many of these are not altogether satisfactory because the applied material may come off due to wear or washing, leaving shiny areas. Finally, a very careful study of the structure of the silk fiber showed the way to a clever method of overcoming this difficulty.

Silk fibers are not entirely smooth, but are marked with longitudinal lines of varying length. Careful microscope scrutiny has shown these lines to be cracks or fissures in the fibers. It was also found that when silk fibers were soaked in certain liquids, the fibers swelled to their normal proportions and the fissures closed again. Advantage of this fact is taken by applying the delusterant to the silk fibers when they are in their swollen state. A certain amount of the delusterant enters the fissures and is held there firmly when the fibers are dried out again. By this process it is possible to deluster silk (see Figure 6) permanently under normal conditions of dyeing, wear, and washing.

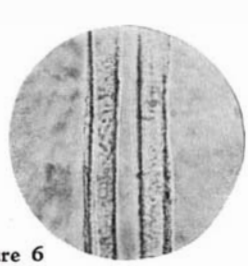
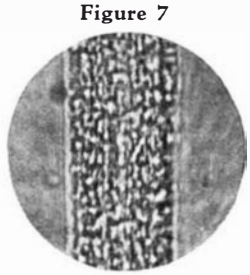


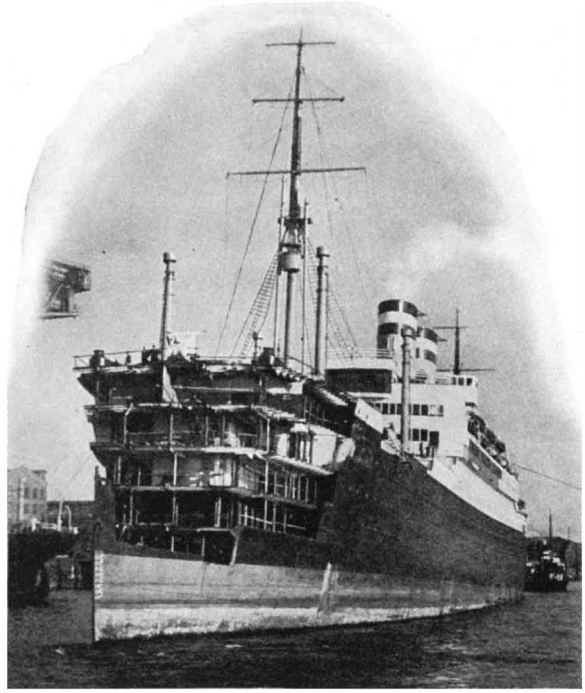
Figure 6

Figure 7

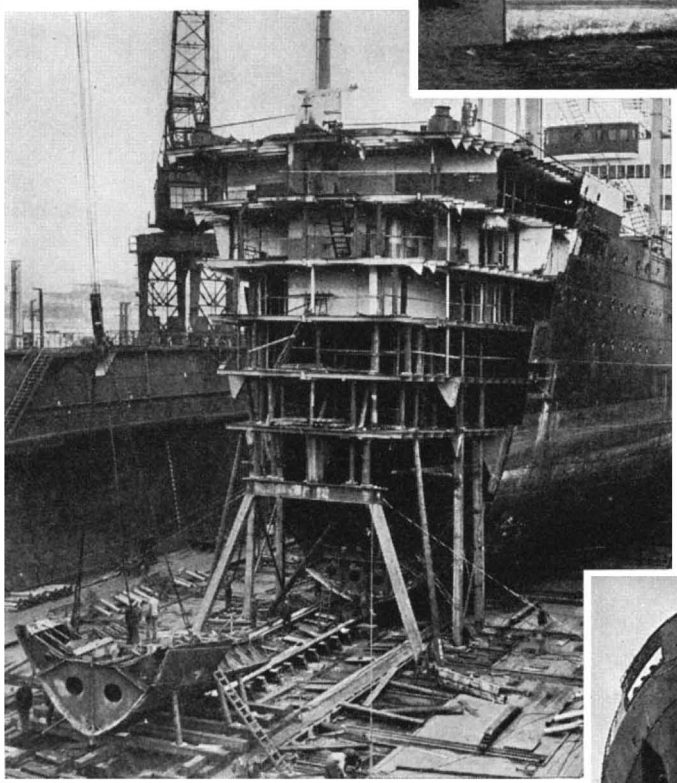


Ocean Liners Get New Bows

FOR the dual purpose of attaining greater operating economy and improved passenger accommodations, four Hamburg-American liners are being lengthened and provided with new bows. It is expected that the last of the rebuilt ships will be back in service by July of this year. The new bows, which are of better design than the old ones, are constructed as units. Then the old bow is partially dismantled while the ship is still afloat, and completely removed when she enters drydock. The new bow is welded to the remainder of the liner, a 28-foot section being inserted to lengthen the ship.

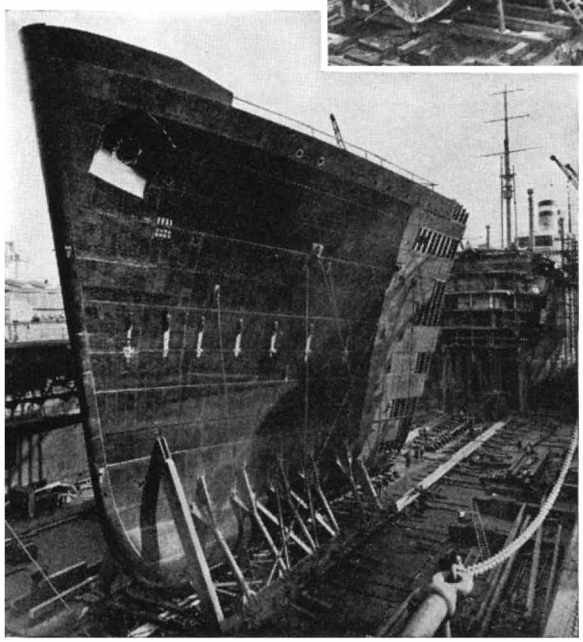


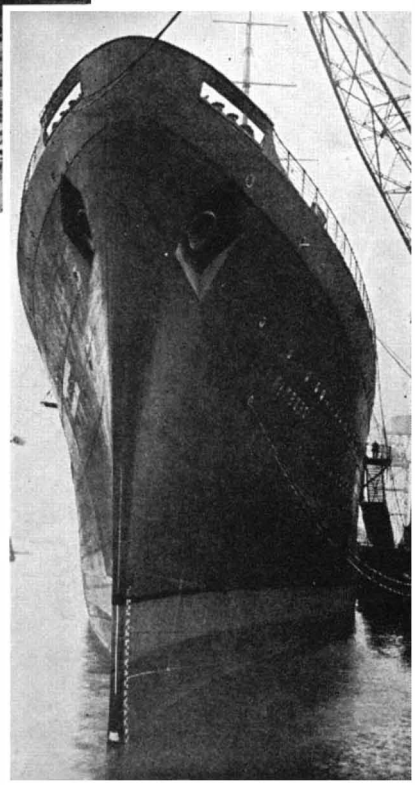
Above: The S. S. *Hamburg*, with old bow partially dismantled, is ready for the drydock. The work is carefully scheduled so as to keep the ship out of service for as short a time as possible. Therefore, the new bow is completed in the Blohm and Voss yards before the ship finally enters the drydock



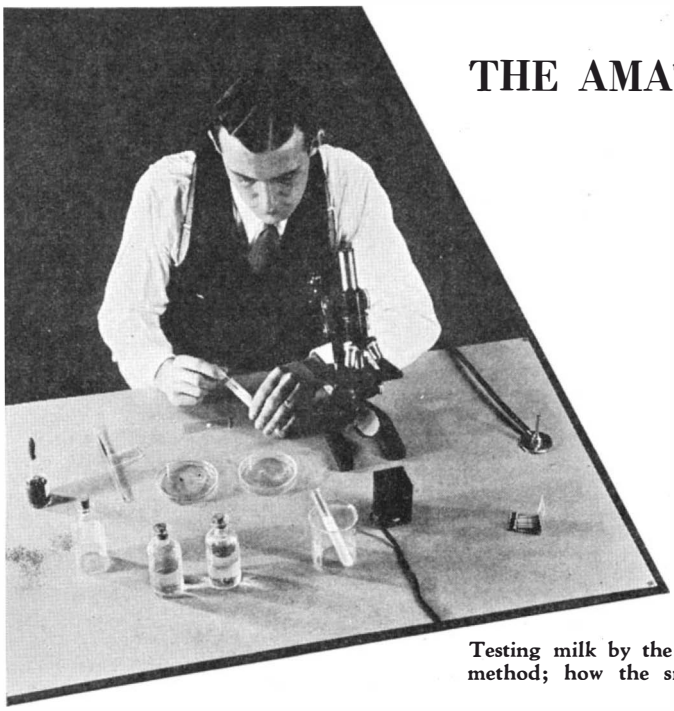
Right: The old bow has been completely dismantled and the remains of the double bottom are being removed. The ship is now in position for the new bow and the joining section to be welded in after perfect alignment

Below: The new bow, mounted on a slideway, is being slowly pulled up to the waiting ship by means of heavy tackle. When the bow reaches the proper point, the joining section will be placed and the welding completed





Right: One of the liners afloat after reconstruction, showing the graceful and efficient curves of her new bow. It is said that this new shape will permit the same average speed, but will require only 20,000 horsepower instead of 28,000 as formerly. Photographs on this page are used through the courtesy of the Hamburg-American Line



Testing milk by the microscopical method; how the smear is made

THE AMATEUR AND HIS MICROSCOPE—IX

EXAMINING MILK FOR

MILK, "the perfect food" is also well liked by our friends and enemies, bacteria. Most of these bacteria are harmless, while others, such as typhoid and diphtheria, cause disease and sometimes death. The more progressive dairies are guarding you against the invasion of these sub-visible enemies with a battery of microscopes. Let us see for ourselves how this is being done.

There are two ways of making a routine examination of milk for bacteria. One is the "plate" method, in which a petri dish filled with agar-agar and beef broth is inoculated with the milk and then kept at body temperature for one or two days. Every single bacterial cell that was in the sample of milk will rapidly reproduce, so that when the plate is examined after incubation there will be a colony of bacteria for each one. In routine work these colonies are merely counted under a specified magnification of 3½ times. The Bausch and Lomb Engraver's Glass, or its equal, is specified in "Standard Methods of Milk Analysis." The total is then multiplied in accordance with the size of the original sample. There are several drawbacks to this method, which we need not enter into here.

The other method is the microscopical, developed by Doctor Robert S. Breed of the New York State Agricultural Experiment Station. This method is quite simple, and is easily duplicated by the amateur, except for the counting. Actual counting involves accurately calibrated special pipettes and an eyepiece for the microscope, the exact field of which is known. Even with these two necessities it really takes quite a bit of experience before the technique can be relied upon. Here is how the expert does it. The following is a quotation from Circular No. 58 of the New York State Agricultural Experiment Station, "Counting Bacteria By Means Of The Microscope," by Robert S. Breed and James D. Brew:

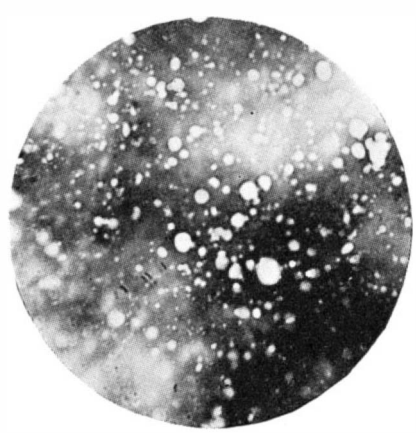
"In brief, the technique used in making counts of the number of bacteria in milk by the direct microscopic method is as follows: One hundredth of a cubic centimeter of milk or cream is measured by means of a *clean* capillary pipette accurately calibrated to discharge this quantity of milk. The milk or cream is deposited on a *clean* glass slide. By means of a stiff needle the drop of liquid is spread evenly over an area of one square centimeter and *dried quickly* in a warm place protected from dust, flies, and cockroaches. The surface on which the slides rest must be level in order that the films may dry evenly.

"THE dry smears are then prepared for microscopic examination by immersing the slide in xylol or other fat solvent for one minute, or longer if desired. After this the slide is drained and dried, immersed in 70 to 90 percent grain or denatured alcohol for one or more minutes, then transferred to a fresh, saturated, aqueous solution of methylene blue. Old or unfiltered solutions are to be avoided as they may contain troublesome precipitates. The slides remain in this solution for five seconds to one minute or longer, depending on the effect desired. They are then rinsed in water to remove the surplus stain and decolorized in alcohol. This takes several seconds to minutes, during which time the slide should be under observation in order that it may be removed from the alcohol before decolorization has proceeded too far. When the decolorization is completed the general background of the film should have a pale blue tint. Where staining has been prolonged a deep blue margin or deep blue central patches may persist. These deeply stained areas do not contain more bacteria than other parts of the film and may be removed, if troublesome, by decolorizing and restaining lightly.

"After drying, the slides are ready for microscopic examination, or they may be filed away and preserved indefinitely. Poorly stained slides may be decolorized and restained as many times as necessary without any apparent injury. If desired, the films may be mounted in Canada balsam with cover glasses, but in routine work it is customary to apply cedar oil directly to the film for examination under an oil-immersion lens."

BY eliminating a few steps in the standard method, you can see, even without an oil-immersion lens, bacteria and leucocyte cells in the milk now in your ice box. It will take you about 15 minutes.

Set out on your work table the following items: a half ounce of milk, a half ounce of cream, a clean glass rod, xylol, denatured alcohol, methylene blue, a clean medicine dropper for the methylene blue, ordinary glycerine, two flat dishes such as petri dishes or saucers, and two clean glass slides. A small alcohol lamp or a micro Bunsen burner, if you have one, will also come in handy, but the kitchen gas stove may be used to pretty fair advantage.



Appearance of clean milk. The fat globules not entirely dissolved

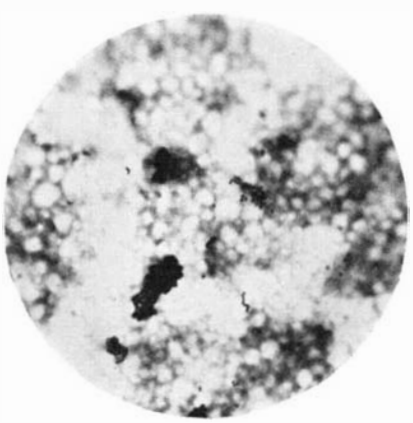
By JOHN F. BRANDT
Bausch and Lomb Optical Company

BACTERIA

Now for the procedure: Dip the tip of the glass rod into the milk and make a thin smear, about the size of a dime, in the middle of one of the slides. Using the other end of the glass rod, make a similar smear of the cream on the other slide. See that the smears are quite thin and that the milk or cream is spread evenly. To dry the smears, hold them perfectly horizontally over the flame of the gas stove, alcohol lamp or Bunsen burner. The heat should be very gentle, and not enough to hurt your hands.

Pour into one of the flat dishes enough xylol to cover the slides. Let the slides stand in this for a minute or two in order thoroughly to dissolve the fat. Take the slides out and let them drain off into the dish. Set them aside with one end resting on the glass rod until they are quite dry, since xylol and alcohol do not mix.

Now pour into the other flat dish enough denatured alcohol to cover the slides, and immerse them in it for another few minutes. Remove them from the alcohol when the smears appear translucent instead of opaque white; allow them to drain and set them in front of you, making sure that they are quite flat.

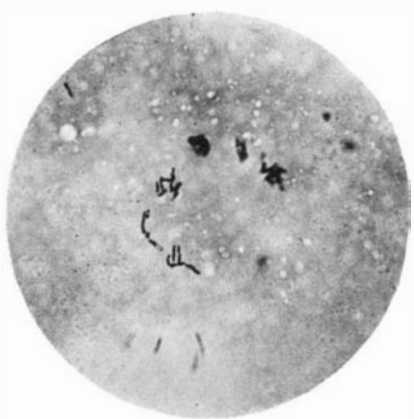


Leucocyte cells (large, round, blue) and bacteria (much smaller objects)

With the medicine dropper, put a small drop of methylene blue on each smear, spreading it around so that it is even over the entire surface, but in spreading do not touch the smear itself. Allow the slides to stand for about two minutes.

At the end of this time, the slides will be over-stained. This is a common practice in microscopy because it insures thorough penetration and the dye can always be dissolved out of those parts where it is not wanted, and lightened in the others.

Since this subject of staining and dyeing is so interesting, let us digress for a moment while we are waiting for the methylene blue to act. Stains and the knowledge of them are an extremely important part of the microscopist's equipment. Microscopists have found stains that will pick out particular parts of structures, color them beautifully and leave the rest untouched; that is, the stain can be washed out of all the parts except those particular parts for which it was intended. Thus we can stain for nerve ends, or for muscles, or the nuclei in a cell, or for red corpuscles or white corpuscles, and almost anything else we wish to study. After we have stained the special part, we can make it stand out even more clearly from the rest by simply choosing a contrasting stain for all the other parts.



Spore forming rods of Bacillus subtiles. The word bacillus means rod

Of course, it is often desirable to use a stain that is not quite so particular. Methylene blue is an example. Methylene blue is very useful for staining bacteria and protozoa, and so on, since it colors the whole organism, making it more opaque. With stains like methylene blue we merely intensify the contrast in what would otherwise be an almost transparent substance. Incidentally, methylene is a "vital" stain. By adding a little to the water in which living organisms are swimming under your microscope, you can stain them without killing them. Replace this colored water with clear water by drawing off the colored water with a blotter and pipetting in clear water at the same time. Another stain, neutral red, can be used as a contrasting hue if you wish.

Now if we go back to our milk slides, we shall find that they are stained a very deep blue. Rinse off the excess dye under cool water from the tap, and set the slide back in the dish containing the denatured alcohol. It may take several minutes, but watch the slides carefully now, agitating the alcohol back and forth over them every once in a while, until they become quite a light blue. The dye will dissolve out of the milk much faster than out of the bacteria, but if left too long the bacteria will be decolorized also. If the stain appears too markedly uneven, it may be best, saving time in the long run, to decolorize completely and restain.

Chain of heat-resisting bacteria growing in some pasteurized milk

When decolorized sufficiently, rinse the slides off again under the tap and allow them to stand until dry. When dry, put a drop of glycerine on each smear and examine under your highest power on the microscope; 300X will do, but the higher you go the better will you see the bacteria. A cover glass is not necessary. If you have an oil-immersion lens, put a drop of oil directly on the smear instead of the glycerine, rack the lens down until it just touches the oil, and focus. Glycerine has a high refractive index, nearly equaling glass, and so it increases the resolution. It is always best to put a drop of glycerine, or even water, on any dry specimen such as a fly's wing, a hair, strands of cotton, and so on. Glycerine may be washed off the slide with water; immersion oil by dipping the slide in xylol.

Examination of the photomicrographs accompanying this article will give you some idea of how the slide should look under the microscope, and what bacteria you are seeing. Remember, however, that if your milk was pasteurized, it is quite probable that some of the bacteria were dead before you started, so do not jump to any rash conclusion. Dairies do not attempt to eliminate all of the bacteria in milk. Their job is to see that the bacterial count is kept down to certain limits and only the harmful bacteria eliminated entirely.

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What preference have you for future articles in this series?—Editor.

Possibilities of
ELECTRO-STATIC GENERATORS

By NIKOLA TESLA*

THE knowledge of static electricity dates back to the earliest dawn of civilization but for ages it remained merely an interesting and mystifying phenomenon. Virtually nothing was done towards the development and useful application of the principle. The first distinct stimulus in this direction was given by the discoveries of Franklin and Leyden in the latter part of the 18th Century.

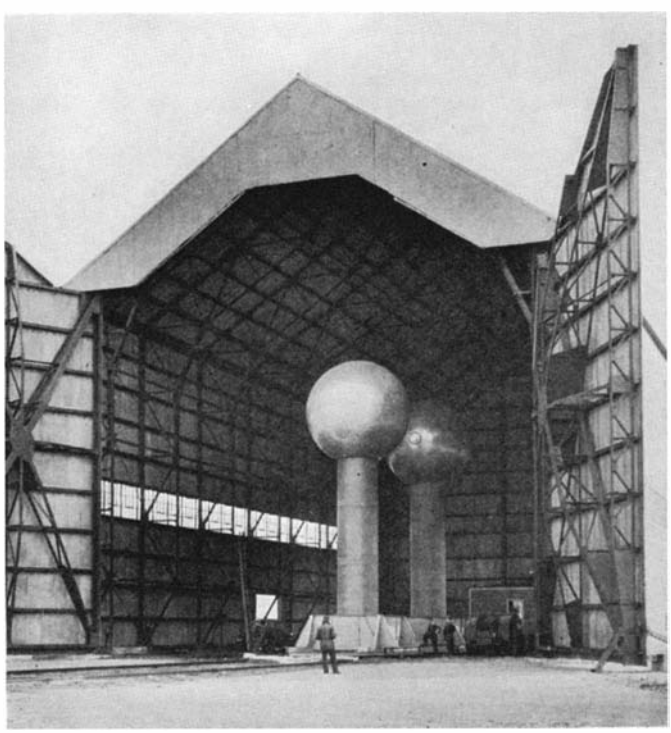
In 1777 Cavallo devised a cylindrical friction machine and from that time on there was a slow but steady evolution of friction and influence machines until the modern Wimshurst, Holtz, Toepler, and other types were produced. Among these machines the one invented by Wommelsdorf 30 years ago was, probably, the most effective. It yielded a current of six-tenths of a milli-ampere and in the present state of science it could be successfully employed for charging large aerial capacities and stepping up its terminal tension of 150,000 to many millions of volts.

Numerous attempts have also been made to generate static electricity by friction of fluids and solid particles but from the earliest records to this day the belt has proved to be the simplest and most convenient means for the purpose. Static electricity from this source gained in importance when evidences accumulated that it was capable of interfering seriously with operations and causing accidents in paper factories, flour mills, and similar establishments. In the early nineties my electrodeless vacuum tubes became extremely popular and were frequently lighted from belts and later Roentgen tubes were operated in the same manner. It is quite easy to improvise such a generator and obtain interesting results under favorable atmospheric conditions.

A remarkable device of this kind, embodying new features, has been recently developed by Dr. J. Van de Graaff at the Massachusetts Institute of Technology, and is attracting extraordinary attention. (See page 96, February, 1934, SCIENTIFIC AMERICAN.—*Ed.*) It is hailed as a revolutionary invention with which wonders will be achieved. The technical papers refer to it as a Colossus, a Master Key expected to unlock the secrets of nature. Naturally enough imaginative scribes have built Spanish castles on this foundation. So it comes that even such an ably edited paper as *The New York Times* informs its readers of a contemplated use of this generator for long distance transmission of power. According to a *bona fide* report in its issue of December 5, 1933, "the possibilities of the colossal generator have been worked out in theory and it now remains to apply it in practice." However visionary this scheme may appear it is not absolutely impossible. A wise Macedonian king said: "No wall is so high that a mule loaded with gold could not jump over it." With unlimited capital and regardless of returns, it might be carried out.

In view of many articles and editorials written in the same vein, which have amazed the layman and amused the expert, it may not be amiss to examine the merits of this odd contrivance in the light of well demonstrated scientific facts.

But first I want to point out an apparent discrepancy in the descriptive reports and photographs showing the apparatus in action, which is illustrated in the accompanying photographs, and consists of two aluminum spheres 15 feet in diameter supported on insulating columns six feet in diameter. Electricity is supplied to the spheres by paper belts charged from a "sprayer." With terminals of such dimensions much higher voltages should be obtained. In most of the treatises it is assumed that the surface-density, that is, the quantity of electricity stored per square centimeter of a spherical conductor, can not exceed eight electrostatic units without a breakdown of the surrounding air. As a matter of fact the density can be pushed up to 20 units before power-consuming streamers appear.



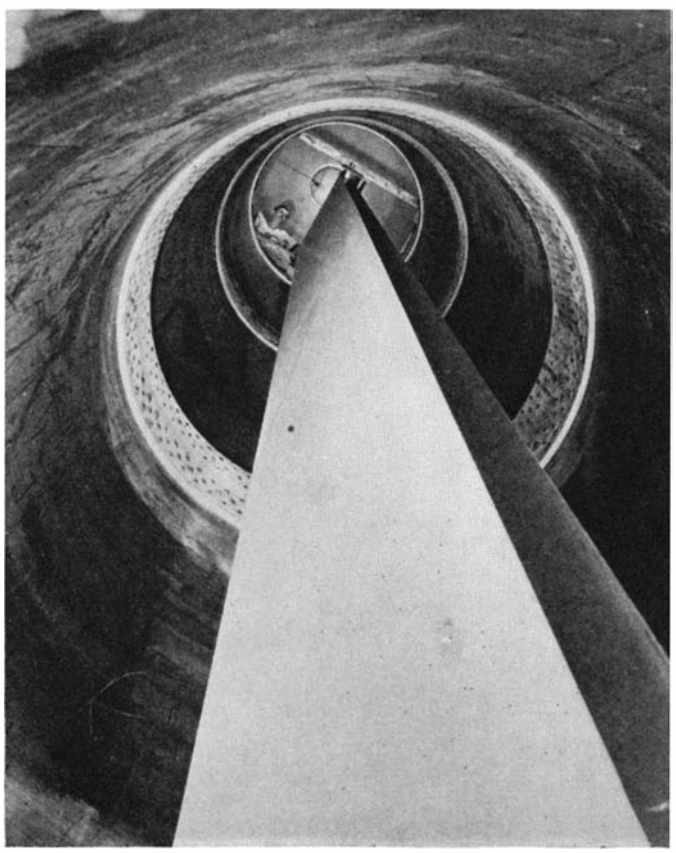
The Van de Graaff generator, shown housed in an aircraft hangar, is discussed by Dr. Tesla in the accompanying article

THIS being the case, the limiting voltage of a sphere having a diameter of 15 feet should be 16,964,700 and, consequently, the potential difference between two such oppositely charged spheres, very far apart, is 33,929,400 volts. It may be useful to state, however, that such large spheres placed at a distance of 55 feet between centers, as contemplated, will influence each other to a considerable extent, increasing their capacities. At this distance the increase will be about 16 percent, which should be taken into consideration when estimating the charge.

The desired difference of potential could be obtained with much smaller spheres and it would seem preferable to employ them as they would yield sparks in quicker succession. Some of the photographs under the terminal pressure of 7,000,000 volts are puzzling because the surface-density in this case was

*See page 115.

only a little over 4 electrostatic units. Furthermore, sparks are shown to pass copiously along the insulating supports. This is a serious difficulty encountered in working with very high tensions but by properly shaping the under side of the sphere and resting it on a support well up in its interior, besides providing a liberal side clearance, the discharges are prevented from following the column and no further trouble is experienced even with the highest potentials. My wireless tower on Long Island, erected in 1902, carried a sphere which had a diameter of 67½ feet and was mounted in this manner. It was to be charged to 30,000,000 volts by a simple device for supplying static electricity and power.



Looking up through one of the insulating columns of the Van de Graaff generator, showing the endless paper belt

MOST people, and not a few electricians, will think that very long and noisy sparks are indicative of great energy, which is far from being the case. An impressive display of this kind, at several million volts, can be readily obtained with any wide leather or fabric belt in dry weather. The only requirement is that the outward surfaces of the highly charged capacity elements be arranged along an ideal boundary everywhere of small curvature. But the electrical energy is trifling and this applies to all electrostatic generators which have been proposed, irrespective of size.

One does not need be an expert to understand that a device of this kind is not a producer of electricity, like a dynamo, but merely a receiver or collector with amplifying qualities. All its energy is derived from electricity which is generated through friction or supplied by the sprayer and pumped into the terminals by the belts. If the columns were as tall as the Empire State Building and the spheres 500 feet in diameter the monstrous machine could not have any more energy than is supplied to it by the electrified belts and no matter how much improved, this type is fatally doomed to small output and low efficiency on account of the existing limitations and the wastefulness of the process of conveying the charges from their sources to the terminals.

As the writers of articles regarding the "Colossus" confine themselves to extolling its size, voltage and possibilities, but give little hint regarding its mode of operation and power performance, I shall endeavor to advance the needed knowledge. With this object let it be assumed that the spheres are placed at a distance of 55 feet from center to center and that the potential difference between them is 10,000,000 volts. Ordinarily, the electric capacity of such a sphere is equal to its radius, namely 225 centimeters, but as before explained, 16 percent should be added to this, making 261 centimeters equivalent to 0.00029 microfarad. Consequently, when the regime is established, each sphere being at a potential of 5,000,000 volts, the electricity stored on each will be 0.00145 coulomb. If this quantity were supplied every second, the current would be 0.00145 ampere. An incandescent lamp of 25 watts requires a current 150 times more intense.

In estimating the amount of electricity furnished to each terminal per second, only the sprayer need be considered as it supplies much more than could be generated by friction of the belts. The device used has not been clearly described but it is sufficient for the purpose of this dissertation to know that it operates at 20,000 volts and energizes, through rows of points, the two belts which are said to be four feet, or 120 centimeters, wide. Assuming that they are run at a speed of 100 feet or 3000 centimeters per second, the area covered in this time interval would be 120 x 3000 = 360,000 square centimeters. If it were possible to charge the belts uniformly to a surface density anything like that existing on an electrified particle, the output of the machine would be very great. But this can never be realized. The following approximate estimate will show what may be reasonably expected.

The discharge of electricity from points has been extensively investigated and from the data available and my own observations I find that the current through each point at 20,000 volts will be about 0.0001655 ampere. No advantage would be gained by a very close spacing of the points on account of their mutual reaction but I shall make allowance for as great a number as seems practicable, say, 200, in which case the integral current would be 200 x 0.0001655 = 0.0331 ampere.

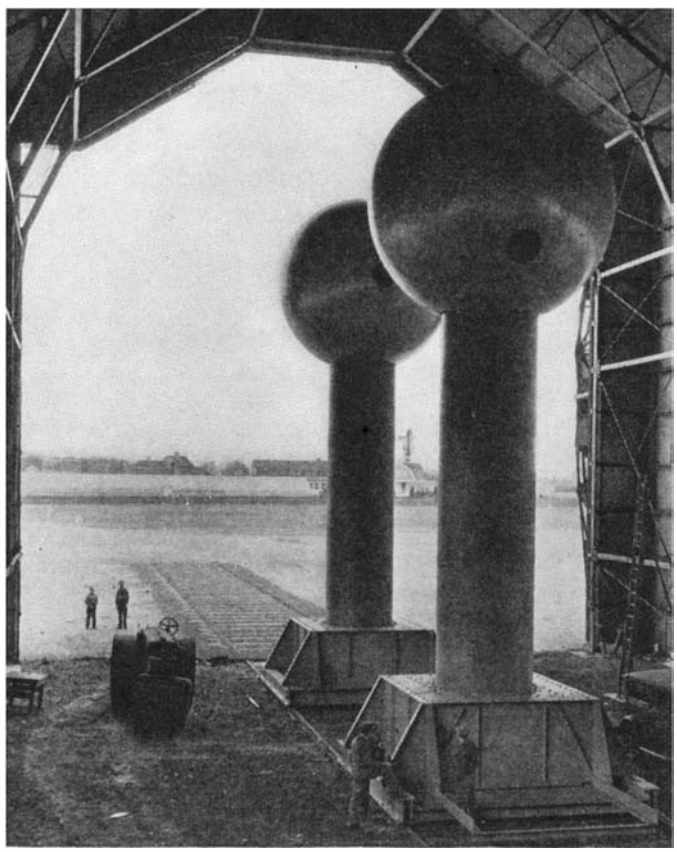
NOW, electricity is transferred from the points to the belt by minute bodily carriers—the molecules of the air. When such an electrified particle comes in contact with a large conducting body it gives up almost all of its charge to the same, but to an insulator, as the belt, it can impart only a very small portion owing to the strong repulsion between the charge deposited and that remaining on the particle. From theoretical considerations it appears that the part usefully applicable will, in all probability, not exceed 1/150 of the whole charge on any particle thrown against the belt. The current from the sprayer is 0.0331 ampere, that is to say, it conveys a total charge of 0.0331 coulomb per second and of this the belt will carry off only 0.00022 coulomb equivalent to a current of 0.00022 ampere. This means that 99.33 percent of the energy supplied by the sprayer is lost, and illustrates the appalling inefficiency of this method of electrification.

As will be seen, the device delivers to each belt energy at the insignificant rate of 4.4 watts and is, therefore, virtually of no effect on the power output of the machine except that it imposes a limit to the same. This is important to remember in view of the general impression created by the earlier reports that all the energy is drawn from the sprayer. Since the quantity of electricity stored on the spheres remains constant it is evident that the overflow current between them under normal working

conditions must be 0.00022 ampere so that at the potential difference of 10,000,000 volts the machine should develop 2200 watts.

As the supply from the exciter is entirely negligible the questions will be asked: Whence comes this great energy and power? How is it produced? The answer is simple. It is derived from the belts which perform the work of transporting the charges imparted to them against the repulsion exerted by the spheres. This force can be approximately determined. The permanent charge on a sphere will be, as shown above, 0.00145 coulomb or 4,350,000 electrostatic units. But 16 percent of this quantity is "bound" and should be left out of consideration. With due regard to the opening on the underside, the free capacity of each terminal may be estimated 222 centimeters, so that at five million volts Q = 222 x 5,000,000/300 = 3,700,000 electrostatic units. The moving charge will be distributed over a length of the belt about equal to the height of the insulating column and with some allowances it may be taken at 24 feet. Assuming a belt speed of 6000 feet per minute this distance will be traversed in 0.24 of a second and, consequently, the belt charge to be considered is 0.24 of the whole carried per second; that is, 0.0000528 coulomb or 158,400 electrostatic units. The upper end of the charged area is 7½ feet and the lower 31½ feet from the center of the sphere. The former is thus r = 225 c.m. and the latter d = 945 c.m. The charged area of the belt being 120 x 720 = 86400 square c.m., it follows that the density of the charge is 158400/86400 = 1.8333 electrostatic units. Accordingly, if the distribution of the charge is perfectly uniform, a transversal strip of the belt one centimeter long will contain a quantity q = 120 x 1.8333 = 220 e.s.u.

Considering now a surface element of vanishing length dx, the charge on the same will be qdx = 220 dx e.s. units of quantity and that on the sphere being Q = 3,700,000 e.s. units, the repulsive force acting on the surface element at a distance x from the center of the sphere, will be $\frac{Q}{x^2}$ dx. Integrating this expression between the limits r and d, and substituting the values for Q and q, the force repelling the charged side of the belt is found to be $F = \frac{Qq\ (d-r)}{rd} =$ 2,756,420 dynes or 2.81093 kilograms. At a speed of 100 feet or 30 meters per second the work is 84.3279 kilogram meters per second, equivalent to 0.82691 kilowatt. Both belts will therefore perform the work of 1.65382 kilowatts. This is 33 percent less than the theoretical electrical activity of the machine and as the power developed by the belts must be, at least, equal to the electric power one is apt to reach the conclusion that the sucking points do not draw off the entire charge, as has been tacitly assumed, and the current, instead of being 0.00022 will be proportionately smaller, that is, 0.0001654 ampere. But this view is found untenable for the limit to performance is imposed by natural law and not by the defects of a device which, moreover, could be readily improved. The discrepancy between the calculated power of the belts and the electric activity of the machine was all the more puzzling as the two quantities could not be harmonized by imagining any kind of theoretical working conditions. Finally, however, I recognized that the charge can not be uniformly distributed on the belt but must increase from the lower to the upper portion of the same. Indeed, such an effect might have been expected although the surface charge on an insulating body is not very mobile.



Another view of the high-voltage generator. Tracks are provided so that the equipment may be rolled out into the open

Suppose that the belt carried a film of oil meeting with a downward current of air. The obvious result would be a thickening of the film toward the top. Similarly, the electric film on the belt is "thickened" through the repulsion exerted by the terminal and the attendant piling up of the charge and it is only so that the exact balance between the mechanical and electrical power can be, under all conditions, automatically established. (See explanatory note on page 165.) The equality of these two quantities is an absolute and inevitable consequence of the law of conservation of energy, the remarkable feature of this process of dynamo-electric transformation being that it is effected with the highest efficiency, apparently without evolution of heat. Of course, there are great losses in the operation of the machine, but they do not concern the process itself.

IN an instrument designed primarily for scientific investigation, the efficiency is of relatively small importance and I shall dwell on it for the sole purpose of showing that in any application as a power producer such a generator would be hopelessly handicapped. The air friction of the belts at a speed of 30 meters per second will require about 3.73 kilowatt. With the repulsion work, the load on them will be 5.93 kilowatt. Under the working conditions as outlined, the belt drive may have an efficiency of 90 percent and the motor 85 percent so that energy will be drawn from the electric mains at the rate of 7.75 kilowatt. The net performance of the sprayer at 20,000 volts will be 1.324 kilowatt but taking into account the efficiency of the whole apparatus, at least 1.6 kilowatt must be assumed. There are also dielectric, magnetic, and radiation losses, making the total power input, perhaps, 9.5 kilowatt while the output is only 2.2 kilowatt. If this estimate is reasonably approximate, an over-all efficiency of 23 percent is about as high as can be expected from any electrostatic generator of this kind.

It was shown that the charge on each sphere at 5,000,000 volts is 0.00145 coulomb but as only 0.00022 coulomb can be furnished per second, it will take about 6.6 seconds to charge the spheres to the full potential. I have assumed

(*Please turn to page* 163)

Two of the four round and rectangular temples recently discovered in demolishing an old sunken square near the Corso of Rome

ROME'S ARCHEOLOGICAL TREASURES

A NUMBER of years ago the Italian Premier, Benito Mussolini, began to "sell" Italy to tourists and he has been highly successful. He realized that a few million lira spent on opening new roads, improving existing ones, and opening up new excavations would be returned a hundredfold. Among his projects are the Via dell' Impero which wipes out a whole slum district between the Coliseum and the great memorial to Victor Emmanuel. Every demolition serves to open up some object of antiquity generally very worth while.

Through the courtesy of the Italian Information Office we are enabled to present some of the latest views of archeological finds in Rome and vicinity. Among the recent excavations is one in the Largo Argentina, a low lying square off the Corso or main street of Rome. The four ruined temples in the Largo Argentina are important in so far that they retain much of their original appearance as of the 3rd Century B.C. The temples were brought to light during the demolition of blocks of buildings, and the ruins are being enclosed by gardens. The first temple found near the entrance is rectangular, while adjacent to it is a round one.

Right: **The capitol rises over the Forum where some remarkable discoveries are still being made. The columns of three temples are in the middle background**

A temple at Ostia, Rome's old seaport at the mouth of the Tiber

The third and fourth temples are rectangular. At this late date such an aggregation of temples in the heart of Rome is certainly a great find. It has not been ascertained to what deity they were dedicated, but their intact position affords evidence that they continued to be venerated under the Empire. In the picturesque view of the capitol are shown excavations which are being carried on in front of the three temples of Saturn, Vespasian, and Concordia.

Ostia, seaport of ancient Rome, abandoned to her own devices, underwent destruction and pillage at the hands of the barbarian; the atmosphere completed the work of destruction. The Italian Government began systematic excavations in 1910 and a trip to Ostia should be included in all Roman excursions.

Some New Astronomical Advances

Astronomical Gains Made Public at the Recent Boston Meeting of the American Association for the Advancement of Science and Its Associated Organizations

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington
Retiring President, the American Association for the Advancement of Science

THE continental expanse of the United States imposes troublesome conditions upon its scientific meetings. In a compact country like England or Holland frequent gatherings are easy, but over here the mere talk of traveling to the meeting place takes more time and much more money than men of science can often afford. The Royal Society meets every week (except in vacation times), the National Academy of Sciences twice a year. Hence our American meetings have to be intensive when we do get together. The sessions are long, the programs crowded and only a skilled presiding officer can make time for the discussions which add so much to the meeting's value.

The great holiday meetings are worse than a three-ring circus; there are often a dozen things going on at once. To be sure, no one would probably be greatly inconvenienced by simultaneous sessions of the Econometric Society, the Society of Parasitologists, the Association of Physics Teachers, and the section of Geology, but when the physicists themselves have to hold their sessions in different places at the same time the congestion becomes serious. If, added to all this, the delegate must devote a deal of time to committee meetings (as fell to the writer's lot a week ago) his impressions of the present state of advancement of science must perforce be sketchy. Yet, from this whirl of memories, supplemented by some recent publications, some notable things emerge which may now be told.

FIRST comes a series of investigations of the dimensions of galaxies—our own and the distant ones which we call star clouds or nebulae. Plaskett and Pearce of the Dominion Astrophysical Observatory in Victoria report the completion of their extensive work on the rotation of the galaxy. The theory of this is an old story now. If the whole Milky Way were rotating like a solid block, so that the period of revolution was the same at all distances from the center, we would have a hard job to find it out. Distances would be unaffected, and likewise radial velocities; all the stars would circle slowly about the heavens without changing their relative positions (except for superimposed random motions) and this would not be easy to detect. But if the rotation is faster near the center (as for the planets around the sun) there is more to observe.

Suppose that the sun is one of a vast swarm of stars all moving in circular orbits. A star ahead of us in the same circle, or one behind us, will move at the same speed and not change its distance. Stars nearer the center and moving in smaller orbits will go faster. Those right between us and the center will be at their nearest, and their distances will not change; but those which are ahead of this position will draw away from us and those behind it will approach us. On the other side of our track we will catch up with the stars ahead and run away from those behind. To use a nautical analogy, if we liken the sun to a ship, advancing along its orbit with the center to the right (starboard), the stars on our starboard bow will be receding, those on the port bow approaching, while on the port quarter we have recession again and on the starboard quarter approach. This effect, which goes through all its phases *twice* in the full circle, is characteristic. The mere motions of the sun itself among the other stars would cause all stars forward of the beam to approach and all abaft the beam to recede, producing a single period instead of a double.

BOTH effects are actually present. The second is shown equally by the nearer and remoter stars, but the first obviously increases with distance, since remoter stars differ more than near ones in their orbital speed. Random motions, different from star to star, are also present, so that it is no easy task to disentangle them all. Working on the stars of spectral class B, which are very hot and bright and can be seen a long way off, the Canadian observers find that the rotational effect is prominent, especially for the stars which appear fainter to the eye, and hence on the average are more remote.

By combining this effect with others which are observable in the proper motions, it is found that the center of rotation is in the direction of the constellation Sagittarius and at a distance of approximately 10,000 parsecs, or 32,000 light-years. The center of the great system of globular clusters, located nearly 20 years ago by Shapley, lies in the same direction and at about the same distance (modifying the older estimates a little to allow for weakening of the light of these remote objects by the faint haziness which hangs in space near the galactic plain). This "obscuration" intensifies into great, almost opaque clouds between us and the center, and doubtless hides the greater part of it from human eyes.

IN the opposite direction, in Auriga and Gemini, our view is little obscured, but the Milky Way is thin and poor because we are looking only toward the outer fringes of the great irregular disk-like mass of stars. Recent studies at Harvard, reported by Shapley, show that nevertheless we see things in this direction which are as remote as 30,000 light-years. The full diameter of our system is therefore of the order of 120,000 light-years. This much exceeds that of any other known star cloud or nebula, so that we are perhaps justified in calling it The Galaxy *par excellence*, till we learn more.

The neighboring galaxies, however, are larger than we had supposed. The Andromeda nebula, for example, is much larger than had been believed. On ordinary photographs its extensions fade out within two degrees of the center. But Stebbins and Whitford, working with a sensitive thermocouple attached to the Mount Wilson 100-inch reflector, have measured the brightness of the sky-background nearby (taking care to avoid visible stars). They find that, just outside what was previously supposed to be the edge of the nebula, the background, though apparently featureless, is five or six times brighter than that of the sky at large. At greater distances it fades off gradually, but it drops to the normal value only at almost twice the previously adopted diameter.

This result, obtained with the world's greatest telescope, is confirmed by pho-

tographs taken at the new Harvard station at Oak Ridge, Massachusetts, with one of the smallest, 1½ inches in diameter and 6 inches in focal length—a high-grade camera. To reveal a faint stellar point requires a large aperture, but in photographing an extended area the *ratio* of the lens diameter to the focal length is important, as any press photographer who must work in dull weather knows. Even with so rapid a camera the outer extensions of the nebula are scarcely visible on the plate, probably because they lack detail. But measures of the opacity of the negative with the microphotometer show again that a very faint and featureless glow extends far beyond the more conspicuous portions.

The full diameter of the nebula is thus shown to be between six and seven degrees, which corresponds to about 75,000 light-years. Though smaller than the Galaxy, it is of the same general size. No other known nebula or star cloud is as big. The Great Magellanic Cloud, 85,000 light-years away, extends obviously over a region some seven degrees in diameter, but star clusters and variables of a type characteristic of a cloud reach out much farther, and show that the actual diameter of the system is 14 degrees, corresponding to 21,000 light-years. This is nothing remarkable, as nebulae go. Measures made at Harvard show that on the average the largest nebulae in 25 different nebular clusters are about 15,000 light-years in diameter. This refers, however, to the inner and brighter portions, and the tiny but powerful instrument just described shows that their extreme extent is from 25,000 to 30,000 light-years. An average nebula, even excluding the faint extensions, would be 6000 light-years across, and their number is legion. A single plate, taken recently at Oak Ridge, shows 587 "new" nebulae. Hubbell has just published a discussion of the number and distribution of nebulae, based on 1283 plates taken with the great reflectors. Though these cover scarcely more than 2 percent of the whole sky area observable at Mount Wilson, they showed 43,201 nebulae!

NO nebulae at all (of the kind here considered) are found along the central line of the Milky Way, doubtless because they are all hidden by obscuring matter within it or not far outside its limits. This obscured zone ranges from 10 degrees wide near Sirius to more than 40 degrees in the direction of the galactic center, and is bordered by a region of partial obscuration 10 degrees or 15 degrees wide on each side. All told, it must conceal from us something like one third of the distant nebulae. Allowing for this, and extending his calculations to the limit at which nebulae may be photographed with the 100-inch under the best conditions, Hubbell estimates the total number of nebulae as 75,000,000. As the count is extended to fainter and fainter nebulae the numbers increase rapidly, showing that the nebulae are strewn in space up to 200,000,000 light-years distance as thickly as they are at smaller distances. What lies beyond we do not know—our deepest soundings show "no bottom." Greater telescopes will push the search farther, but an obstacle arises in the much discussed red shift usually attributed to recession. This makes very distant nebulae appear redder than they would otherwise be and hence harder to photograph. Hubbell concludes that this effect alone prevents us from detecting two thirds of the number which could otherwise be photographed with the 100-inch telescope. For a larger instrument the effect would be still more serious.

ANOTHER set of communications delivered at the recent meeting dealt with variable stars. Pettit and Nicholson, again at Mount Wilson, report a long series of measures of their heat radiation with the thermocouple. If we could "see" heat as well as light—that is, if our eyes were equally sensitive to radiation of all wavelengths—some classes of variables would look to us about the same as now. One would naturally expect this of the eclipsing variables, since the same proportion of all rays must be cut off. Yet careful observations on Algol show that at the middle of eclipse 67 percent of the photographic light is lost, but only 63 percent of the heat. The explanation is that the companion which eclipses most, though not all, of the disk of the principal star is considerably redder than its primary, and gives out more heat in proportion to its light. Two bright Cepheid variables, Delta Cephei and Eta Aquilae, which have almost exactly the same range, show a considerably smaller range of total radiation ($0^m.52$) than of visible light ($0^m.77$) or photographic brightness ($1^m.12$). [^{m} here refers to magnitudes.] This again is fairly explicable, for it is known that their variations are due mainly to changes in surface temperature—which themselves are determined by pulsatory oscillations in diameter. As the temperature falls (from about 5300 degrees to 4500 degrees, in this case) the rates of radiation of heat and of visual and photographic light should theoretically all diminish, but in increasing amounts. The observed changes are in close agreement.

At lower temperatures the bulk of the energy is radiated in the infra-red, leaving but a beggarly fraction in the visible region. Could we see heat, therefore, the coolest stars would come up so much in brightness as to change the familiar aspect of the constellations. Betelgeuse, for example, would look as bright as Sirius, and Alpha Hercules, to actual eyes a not very conspicuous star of the third magnitude, would rival Canopus. The long-period variables would show still greater changes. Mira Ceti, which to the eye rises to the fourth magnitude at maximum, to the thermocouple is as bright as Vega. At minimum it drops to the ninth magnitude, visually, but only to the first in terms of total energy. That is, the star's light drops to 1 percent of its maximum value, the heat only to 36 percent.

This extraordinary difference is due largely but not entirely to a change in temperature. The latter can be found with some accuracy by measuring what part of the radiation is transmitted by a water-cell, which stops the longer waves. The resulting temperatures range from 2500 to 1900 degrees. Such a change would reduce the visual brightness of a standard radiating surface to 6 percent of its initial value. The difference between this and the observed 1 percent arises from absorption in the star's atmosphere. This is full of the vapor of titanium oxide, which produces enormous bands, especially in the green, yellow, and red. At maximum temperature this compound is partly decomposed and the atmosphere becomes more transparent; though even then it cuts out three quarters of the light, while at minimum a star is enclosed in an almost opaque mantle. Substantially the same behavior is shown by the other long-period variables which Pettit and Nicholson had studied.

IN the infra-red this band absorption ceases and the observations give a much better idea of what the star is really doing. Even in the region accessible to photography on modern plates this disturbance is almost absent. From the Allegheny Observatory Dr. Hetzler reported on observations made with color filters giving a working wavelength of 9600 A, which give a range for long-period variables of the order of a magnitude and a half. These great stars are among the most remarkable objects in the heavens. Measured by their heat, instead of their light, they are among the brightest objects known. Their diameters are enormous, far exceeding that of the earth's orbit, and they are in every respect super-giants. The cause of their variation is imperfectly understood. It is probable that, like the Cepheids, they alternately contract and expand, and that this causes the temperature changes; but the details, both of this and of the remarkable spectral changes, must await further study before we understand them fully. —*Princeton University Observatory*, January 5, 1934.

In the Region of Billions of Cycles

By F. ZWICKY
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BY international agreement radio waves of less than ten meters wavelength are called *ultra-short* waves. These waves have recently come to the attention of the public because of the use by Marconi of 50 centimeter waves, and because of the establishment of a two-way wireless telephone connection between France and England on 18-centimeter waves.

Ever since the time of Newton and Huyghens the vast variety of electromagnetic waves has been a subject of intense interest to scientists. These waves constitute the so-called electromagnetic spectrum, which comprises in the sequence of decreasing wavelengths the ordinary and ultra-short radio waves, the infra-red, visible and ultra-violet light, the soft and the hard X rays, the gamma rays of radioactive substances and, last but not least, the cosmic rays as far as they are not swift particles of matter, such as electrons, protons, and so on.

Most of these waves have been thoroughly investigated with regard to their origin and their effects on all kinds of dead and living matter. Nevertheless, scientific research is still actively going on in all the different parts of the electromagnetic spectrum, covering wavelengths from many kilometers down to less than a trillionth of a centimeter.

Two relatively obscure regions in the electromagnetic spectrum especially appeal to the fancy of modern scientists. In the first place there are the cosmic rays, whose mode of creation is one of the darkest mysteries of modern science. These waves are of the unimaginable length of about a trillionth of a centimeter, corresponding to electromagnetic oscillations of more than a thousand billion billion cycles per second.

The general interest in cosmic rays has somewhat overshadowed the surprising advances which have recently been made in the second more modest dark region of the electromagnetic spectrum, the region of ultra-short radio waves. Ultra-short radio waves possess wavelengths from 10 meters down to about one millimeter. The scientific "age" of the shortest ones among them is now just six years, whereas the discovery of the cosmic rays by Gockel, Hess and Kohlhörster already dates 20 years back.

Ultra-short waves were produced first by means of oscillating electric sparks, and after that by means of vacuum tubes. The waves obtained from the electric spark are so badly damped that they never can be made monochromatic; that is, they are a mixture of various wavelengths. For this reason their scientific and technical applicability is extremely limited. It was therefore a tremendous advance when Professor Barkhausen in Berlin, in 1920, discovered that the tiny electrons in suitably built vacuum tubes can be induced to run periodically back and forth between a hot filament *F* and a cold plate *P* (Figure 1) at the tremendous pace of about one billion cycles per second. During this mad dance they induce undamped oscillations in circuits which are connected to the tube and which are properly tuned. The frequency of these oscillations in the tube naturally increases as the electrons are sped up in their course by application to the grid *G* of a higher positive voltage. The frequency also increases as the dimensions of the tube are made smaller and the electrons have to run less and less far. Unfortunately, these two ways of boosting the frequency soon mutually exclude each other. Indeed, on increasing the voltage and at the same time decreasing the dimensions of the tube a point is soon reached when the materials which make up the tube are not able to withstand the resulting high electric fields, so that breakdown takes place. For these reasons physicists quickly realized that with Barkhausen's method it was not possible to produce wavelengths shorter than about 30 centimeters.

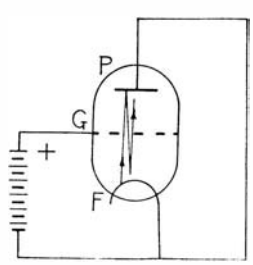


Figure 1

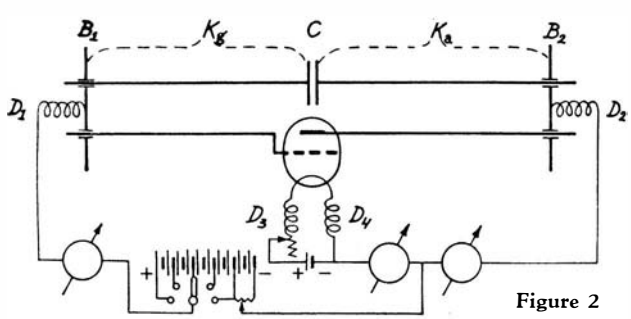


Figure 2

Upper left: **Professor Potapenko with a special tube.** *Above, Figure 2:* **His circuit for the generation of oscillations with frequencies up to several billions of cycles**

THUS, in spite of the incredibly small inertial mass of the electrons, this mass still is not small enough to permit physicists to chase the electrons back and forth more than about one billion cycles per second. For some years, little hope was maintained of ever bridging the spectral gap between the shortest Barkhausen waves of 30 centimeters and the longest infra-red heat waves of about 0.5 millimeters wavelength. But physicists kept on trying, and in 1927 Prof. G. Potapenko of the Moscow Mining Academy, working at that time at the University of Berlin, succeeded in filling the last spectral gap by an exceedingly ingenious and simple trick.

Professor Potapenko's idea is essentially this: Suppose that you are rocking a child in a swing, the natural frequency of which is such that it swings back and forth just once in exactly three seconds. The excursions of the swing will be the greatest if you push the child forward exactly every third second. However, you may find it too tiring to push so often. You therefore decide to push the child exactly once in nine seconds, and the results will still be quite gratifying. Nevertheless you will find that in the course of the two oscillations during which you are idle the excursions of the swing considerably diminish because of the frictional damping of the swing. To remedy this you may call in two more men who also push the child exactly every ninth second, but always three or six seconds after you. By this teamwork you will produce the same result as if you yourself had pushed the child every three seconds.

Applied to the oscillating electrons (pushing men) this means that we must divide them into groups which alternately replenish the oscillations of the circuits connected to the tube, just as our three men alternately replenished the energy of the swing. If, for instance, the electrons execute exactly one billion oscillations per second, which in a Barkhausen tube is the maximum frequency obtainable, we may tune the circuit (swing) which is connected to the tube to a characteristic frequency of exactly three billion oscillations per second. By proper tuning we can succeed in dividing our electrons into three groups, each of which will reinforce the oscillations in our circuit exactly every third oscillation. As the three electron groups work out of phase by exactly one or two periods of the outside circuit, the high-frequency oscillation in this circuit will be undamped and will emit monochromatic electromagnetic waves of three billion cycles frequency; that is, of 10 centimeters wavelength, in spite of the fact that the frequency of the electron oscillations will be equal to one billion cycles only, which corresponds to 30 centimeters wavelength. In this way it is possible to multiply the frequency of electron oscillations as many as 35 times.

By this ingenious method of Professor Potapenko's (see Figure 2) it is possible to obtain ultra-short waves as short as about three centimeters by application of a grid voltage of only 100 volts. The oscillations are undamped and therefore produce very nearly monochromatic ultra-short waves. In fact, it is possible to hold the wavelength constant within one part in a million.

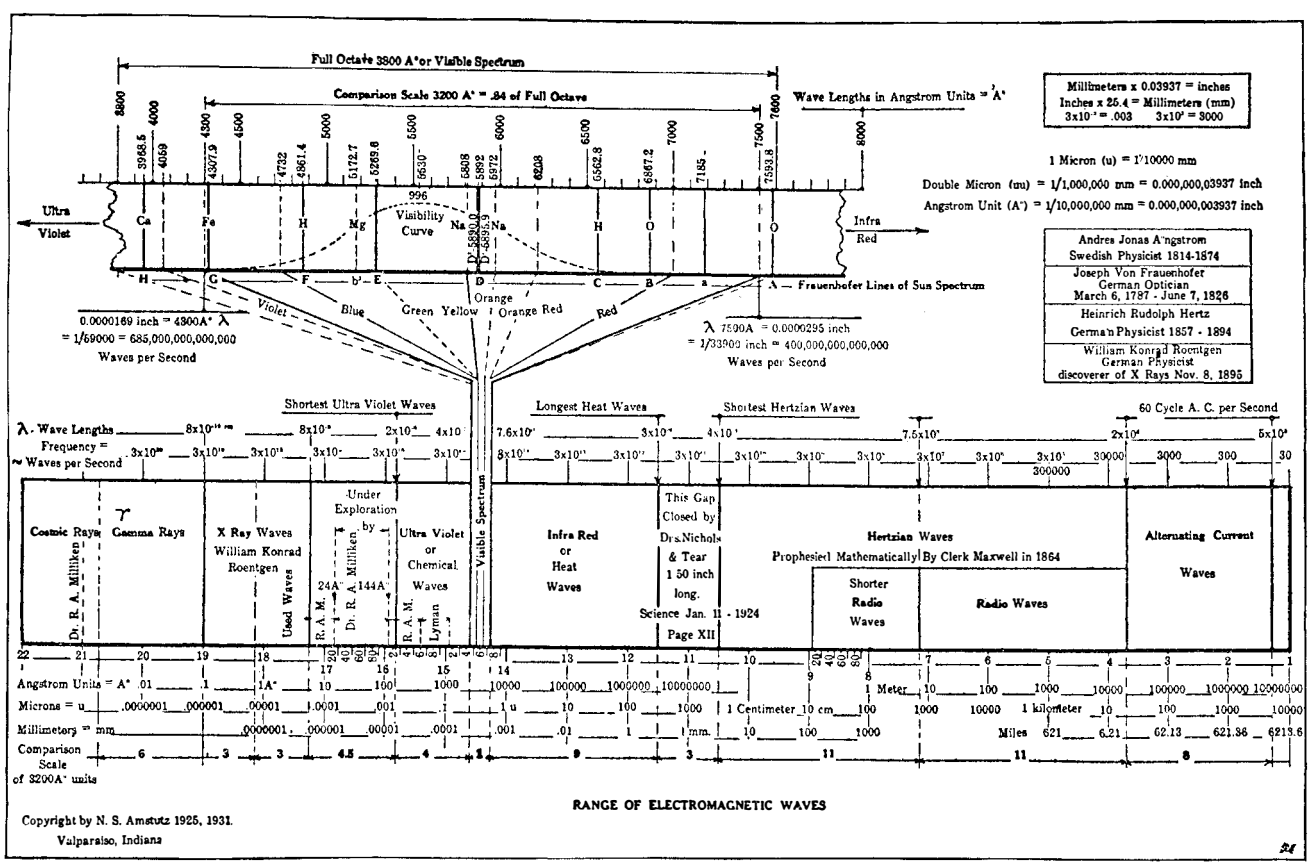
Among the many technical applications of high frequency oscillations and ultra-short waves, their use in radio transmission is the best known. Ultra-short waves are particularly well adapted for this purpose, because they can be focused and transmitted in the form of narrow beams of less than one square meter cross-section. Such a concentration of energy has two great advantages. In the first place no energy is wasted, inasmuch as it all arrives at the place of destination. Ultra-short waves are therefore very economical, in contradistinction to long waves, an overwhelming part of whose energy is wasted in space without ever being received. For example, by the use of waves of about 18 centimeters wavelength a radio telephone connection between France and England has been established with an energy output of only a small fraction of a watt.

SCIENTIFICALLY, ultra-short waves are used for the determination of many important properties of various kinds of matter. Every part of the electromagnetic spectrum can be used as a key to interpret the secrets of the structure of matter, and will reveal these secrets in its own characteristic manner. For example, from the emission, absorption, and scattering of gamma rays by a given substance much information can be deduced with respect to the constitution of the so-called atomic nuclei of this substance—or, in other words, the very heart of the atoms. Absorption and emission spectra in the regions of X rays, ultra-violet, and visible light have revealed to physicists the exact constitution of the atoms and molecules of all the most important substances. Finally the association or clustering of molecules—the constitution of ionic and neutral solutions, and so on—can effectively be studied with the help of ultra-short waves.

Recently, with the help of ultra-short waves, important results have been obtained with regard to what physicists call the problem of the solid state of matter. A very promising start in this direction has been made by Professor Potapenko and Dr. Sänger, working together at the California Institute of Technology. These investigations have thrown new light especially on the constitution of ferromagnetic substances, such as iron, nickel and cobalt, and new possibilities have been revealed for the use of these substances in the electrical industry.

While it is not possible here to give any more details about these fascinating researches, and while readers of this article who wish to obtain more information must be referred to the original publications in scientific journals,[1] it should be borne in mind that ultra-short waves are destined to become a universal tool in the hands of scientists and engineers.

[1] R. Sänger, Frequency Dependence of Superconductivity and Ferromagnetism. *Physical Review 44*, p. 302, 1933. F. Zwicky, The Problem of the Solid State of Matter, *Mechanical Engineering*, July, 1933.



Spanning San Francisco Bay

RUNNING several months ahead on all schedules on the 75,000,000-dollar San Francisco-Oakland Bay Bridge, that will span San Francisco Bay between the two cities, contractors confidently expect to complete the structure by early spring of 1937.

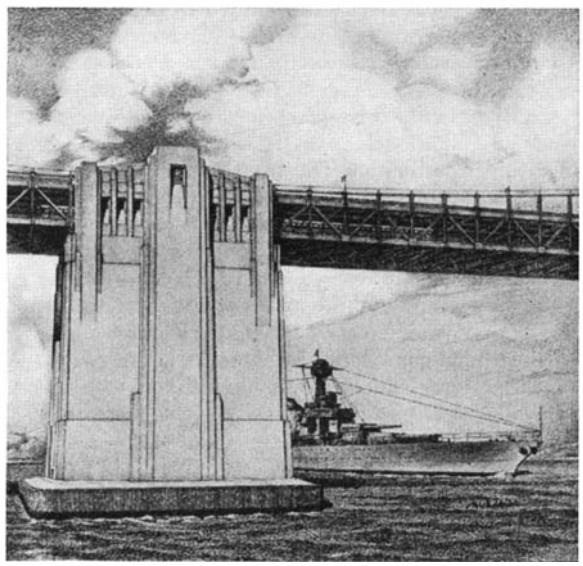
Satisfactory progress also is being made on the 36,000,000-dollar Golden Gate Bridge,* spanning another but smaller part of San Francisco Bay.

Completion of the two bridges in 1937 will form the basis for a World's Exposition and Celebration for the Bay area.

Extensive soundings in the bay for pier foundations had been in progress for three years; and plans and specifications having been approved to meet every requirement of the Government and the Reconstruction Finance Corporation, the first contract for the San Francisco-Oakland Bay Bridge was awarded February 28, 1933.

Within 30 days, all of the sub-contracts were awarded and work started simultaneously on both sides of San Francisco Bay and on Yerba Buena Island, about mid-way in the Bay.

The San Francisco-Oakland Bay Bridge is to be a double-deck structure 8¼ miles long from the end of its approach at Fifth and Harrison Streets in San Francisco to the end of its approach at Thirty-seventh and Market Streets in Oakland. The upper deck will be 58 feet wide and will carry six passenger automobiles abreast. The lower deck will carry three lanes of heavy trucks and two interurban car tracks. The bridge traffic will be limited to passenger automobiles, 40-ton trucks, and 70-ton interurban cars as a maximum tonnage.



The concrete anchorage between the two suspension spans from San Francisco to Yerba Buena

The West Bay Crossing between Yerba Buena Island and San Francisco consists of a 10,450-foot suspension bridge with a center anchorage of concrete in the middle connecting the main suspension spans, which are each 2310 feet in length. All West Bay piers will be founded on rock, and will range in depth from 200 to 235 feet below the surface of the water. The height of towers will be from 465 to 505 feet. From the bottom of a concrete pier in the West Bay to the top of the tower will be more than 700 feet, or taller than a 70-story skyscraper. The area of the piers at water level will range from 52 by 122 feet to 92 by 197 feet.

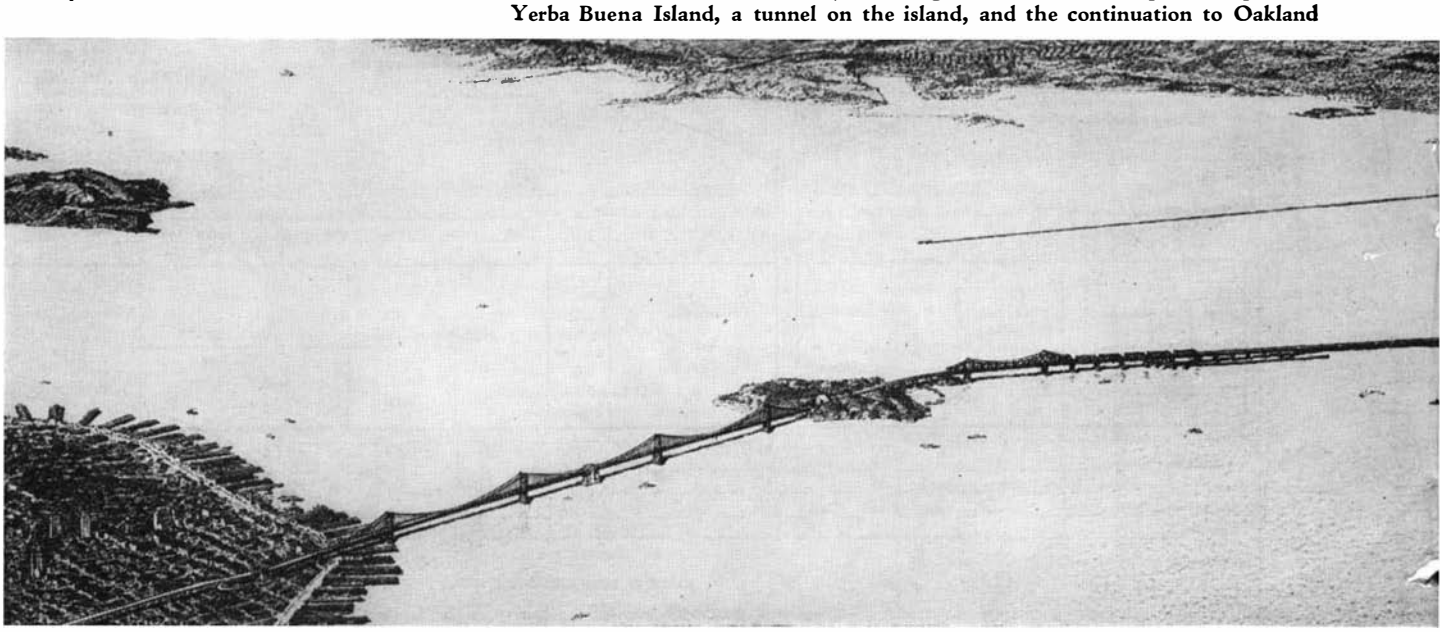
THE center anchorage will be approximately 92 by 192 feet in area without fenders, at the water line, and will rise 298 feet above the surface of the water.

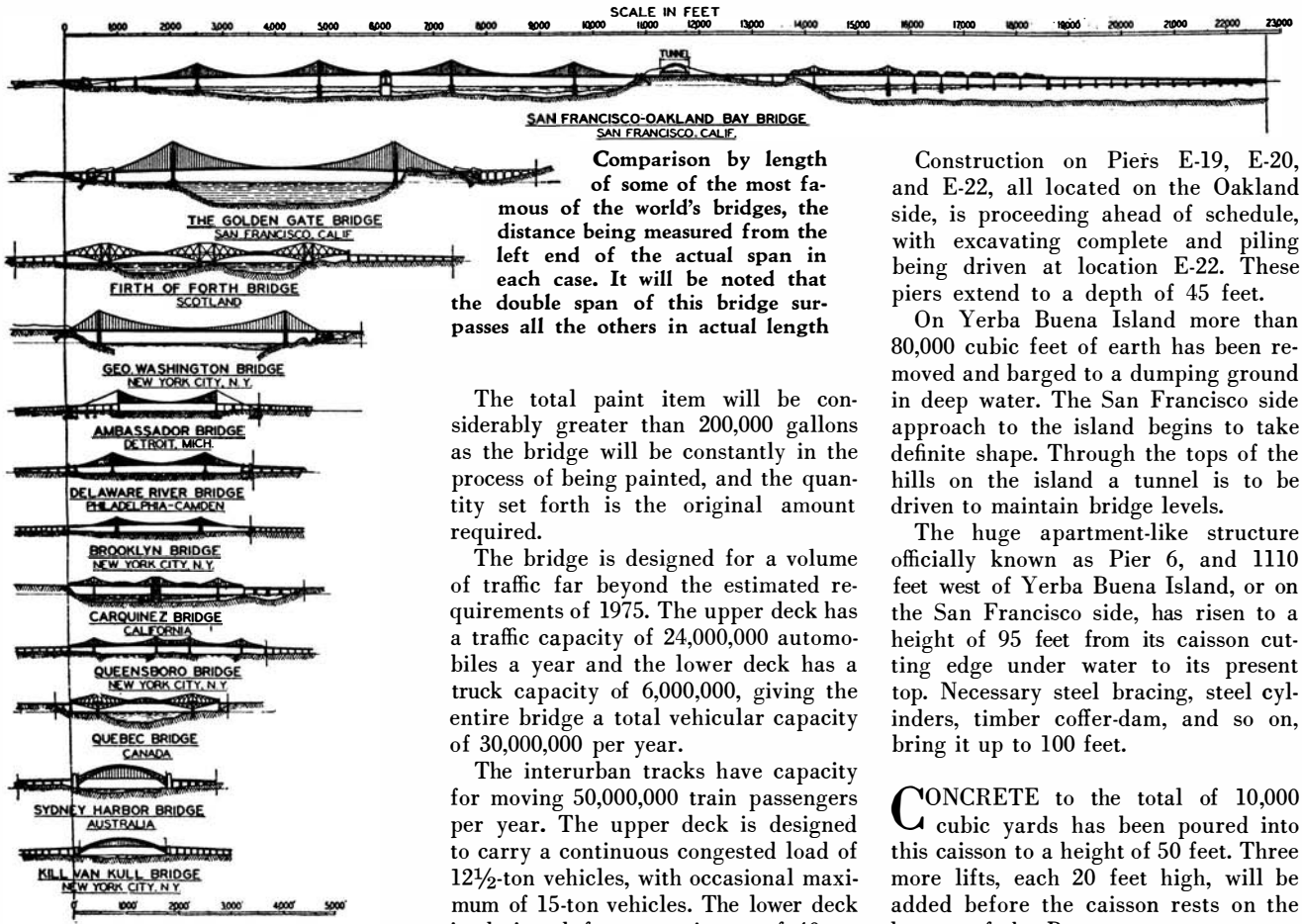
The cables supporting the suspension bridge will be 28 inches in diameter and will consist of 37 strands containing a total of 17,464 wires. These cables will be anchored in San Francisco in a giant block of concrete containing 68,000 cubic yards of cement and aggregates, and will be anchored on Yerba Buena Island in tunnels into solid rock and made fast by steel eyebars set in concrete. The pull on each cable will be about 37,000,000 pounds, both live and dead loads.

The Yerba Buena Island crossing will consist of a double-deck tunnel 540 feet long and 76 feet wide by 58 feet high, providing for six lanes of passenger automobile traffic on the upper

*An article on the Golden Gate Bridge is soon to be published.—*The Editor.*

From San Francisco on the left, the bridge consists of two suspension spans to Yerba Buena Island, a tunnel on the island, and the continuation to Oakland

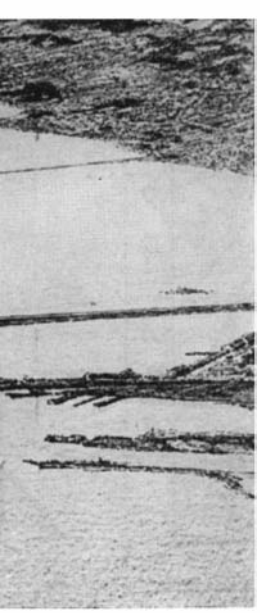




Comparison by length of some of the most famous of the world's bridges, the distance being measured from the left end of the actual span in each case. It will be noted that the double span of this bridge surpasses all the others in actual length

deck and three lanes of trucks and two interurban cars on the lower deck. This tunnel will be lined with bright surfaced steel and will be the largest bore tunnel in the world.

The East Bay Crossing, between Yerba Buena Island and Oakland, will consist of one cantilever span 1400 feet long, five simple spans each more than 500 feet in length, and a mole supported by concrete and wood piles. This bridge will parallel, slightly to the north, the Key Route Mole, and will continue double deck to the toll plaza near the Oakland shore, where the bridge approach widens out to prevent congestion.



The clearance of the East Bay Crossing will be 185 feet above high water.

The steel required for the bridge will constitute approximately 6.7 percent of the estimated output of the United States last year.

The lumber will be equivalent to the quantity of lumber which would be required to build 3000 five-room homes, or the number of dwellings in a town of 15,000 population.

The total paint item will be considerably greater than 200,000 gallons as the bridge will be constantly in the process of being painted, and the quantity set forth is the original amount required.

The bridge is designed for a volume of traffic far beyond the estimated requirements of 1975. The upper deck has a traffic capacity of 24,000,000 automobiles a year and the lower deck has a truck capacity of 6,000,000, giving the entire bridge a total vehicular capacity of 30,000,000 per year.

The interurban tracks have capacity for moving 50,000,000 train passengers per year. The upper deck is designed to carry a continuous congested load of 12½-ton vehicles, with occasional maximum of 15-ton vehicles. The lower deck is designed for a maximum of 40-ton vehicles and 70-ton interurban cars.

THE bridge will employ an average of 6500 men on location during its construction and will cause the employment of 5000 additional men in factories manufacturing materials for the bridge. At the outset of construction approximately 400 men were employed in actually building the bridge. This number will rise to a peak of approximately 12,300 men, and then decline gradually as the bridge approaches completion, giving an average of 6500 employed during construction.

The following figures cover progress of work on the Bay Bridge up to December 15, 1933: Employment on location work now totals 2100 men, with an additional 1200 men at work in steel mills. Bridge Builders, Inc., contractors for bridge foundations, are well along on the dredging on Pier E-5, 1000 feet west of the Key Route Mole, on the Oakland side. The cutting edge of the caisson is resting in the material at the bottom of the Bay and has only a few feet to go to its final anchorage.

Additional lifts of 20 feet have been placed on caisson at Pier E-4, 1500 feet west of the Mole, and the caisson cutting edge has been landed successfully 80 feet below the water surface and 40 feet into mud. The pouring of concrete has been going on rapidly and is now approximately 20 feet above the low water mark.

Construction on Piers E-19, E-20, and E-22, all located on the Oakland side, is proceeding ahead of schedule, with excavating complete and piling being driven at location E-22. These piers extend to a depth of 45 feet.

On Yerba Buena Island more than 80,000 cubic feet of earth has been removed and barged to a dumping ground in deep water. The San Francisco side approach to the island begins to take definite shape. Through the tops of the hills on the island a tunnel is to be driven to maintain bridge levels.

The huge apartment-like structure officially known as Pier 6, and 1110 feet west of Yerba Buena Island, or on the San Francisco side, has risen to a height of 95 feet from its caisson cutting edge under water to its present top. Necessary steel bracing, steel cylinders, timber coffer-dam, and so on, bring it up to 100 feet.

CONCRETE to the total of 10,000 cubic yards has been poured into this caisson to a height of 50 feet. Three more lifts, each 20 feet high, will be added before the caisson rests on the bottom of the Bay.

On the San Francisco Bay side at Pier 2, the concrete foundations have been completed. On these foundations will rest the enormous steel towers holding the bridge structure proper.

Caissons for Piers 3, 4, and 5, are ahead of production schedule at the Moore Dry Docks in Oakland. These are all for West Bay foundations.

Steel piling for Pier 1 on the east line of Spear Street in San Francisco is under construction by the Healy-Tibbetts Construction Company.

Approximately 18,000 cubic yards of concrete has been poured in the Rincon Hill anchorage on the San Francisco side, from which suspension bridge supporting cables will be anchored.

At Pier E-5, near the Key Route Mole, on the Oakland side, the contractors have placed approximately 12,000 cubic yards of concrete. The cutting edge of this caisson is now 113 feet below the surface of the water; the caisson stands 22 feet above the water line, or a total of 135 feet in height.

The San Francisco-Oakland Bay Bridge is being built under the California Toll Bridge Authority of which Governor James Rolph, Jr., is Chairman. Construction is supervised by the San Francisco-Oakland Bay Bridge Division of the Department of Public Works, of which Earl Lee Kelly is Director. C. H. Purcell, State Highway Engineer, is Chief Engineer in charge of the bridge.

SUNDIALS AND THEIR CONSTRUCTION—II

Determining a Meridian Line and the Declination of a Plane. Construction of the South Vertical Type of Dial

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

IT is just as necessary to place a dial properly as it is to be meticulous in laying out the hour lines, for if care is not taken in placing the dial, regardless of the care taken in inscribing the lines, it will be of little use.

The 12 o'clock line on a sundial always lies in the plane of the meridian*. Therefore the meridian line of the place

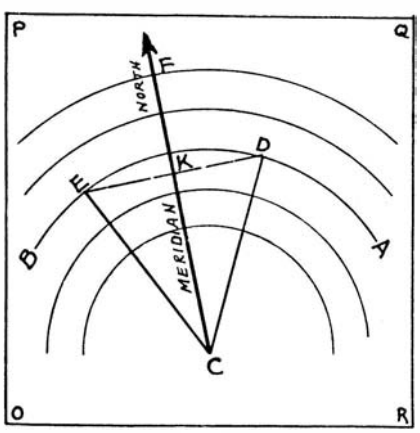


Figure 1

must be determined in one way or another. In the case of certain dials, such as vertical declining dials, the meridian line must be determined before the hour lines can be constructed.

The easiest way to set a dial is, first, to mark the meridian line on the top of its pedestal, or whatever the surface used to accommodate the dial, then produce the 12 o'clock line both ways to the edge of the dial plate and make faint marks at either extremity. Now place the dial on its pedestal so that the two marks made on the edge of the dial coincide with the meridian previously marked on the pedestal. After the dial has been leveled or plumbed carefully it will be in the position for which it was constructed.

It is much easier to work in daylight than at night; therefore the following methods of finding the meridian have been selected because they depend upon the sun.

In Figure 1, the square *OPQR* represents a carefully leveled board. At any convenient place on the board mark the point *C*. With *C* as a center, describe several concentric circles. At *C* erect a pin perpendicular to the board, and long enough to cast a shadow on the circles. Some time during the morning the shadow cast by the top of the pin will touch one of these circles, as *AB*, at *E*. Mark this point carefully with a pencil. In the afternoon the shadow of the top of the pin will again touch the circle *AB*, at *D*. Mark this point carefully as before. Draw the line *ED* and find its middle point at *K*. From *C*, through *K*, draw the line *CF*. This will be the true meridian line for the place.

Another convenient method, and one that consumes a minimum amount of time to accomplish, is by using the accompanying chart, which shows the relation between apparent noon (at which time the sun is on the meridian every day) and mean time (the time shown by the clock). From the chart, find the time at which the sun will be on the meridian at any given place and on any particular day. At that time the shadow cast by a plumb line on a flat level surface will show the true meridian line for that place.

STILL another method: Having previously leveled or plumbed the dial, find the time at which the sun will be on the meridian, from the accompanying chart; and at that time orient the dial so that the time shown by the dial will be exactly 12 o'clock. This method is not so accurate as those described above.

Occasion may arise to place a dial on a surface that does not face the cardinal points of the compass. Before the hour lines for such a dial can be computed it is necessary to know at what angle the plane, upon which the dial is to be inscribed, declines from the meridian.

The accuracy of the dial depends upon the care used in determining the angle of declination. In Figure 2, *AB* represents one side of a wall upon which it is desired to place a vertical dial. The board *OPQR* is pressed firmly against *AB* and leveled carefully. By one of the foregoing methods draw the meridian line *NS*.

*For definitions of "meridian" and other technical terms used in this article, see page 84, February, 1934, *Scientific American*.—*Editor*

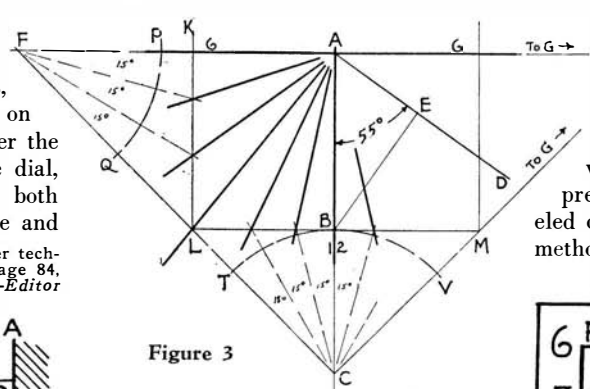


Figure 3

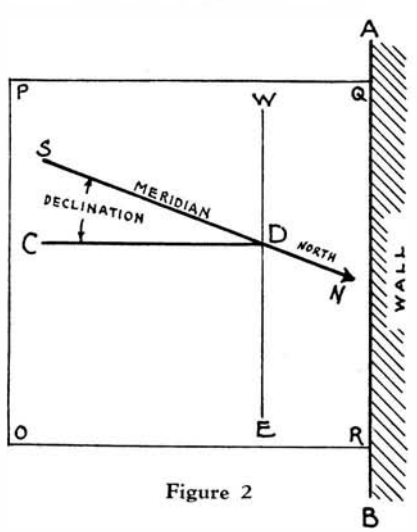


Figure 2

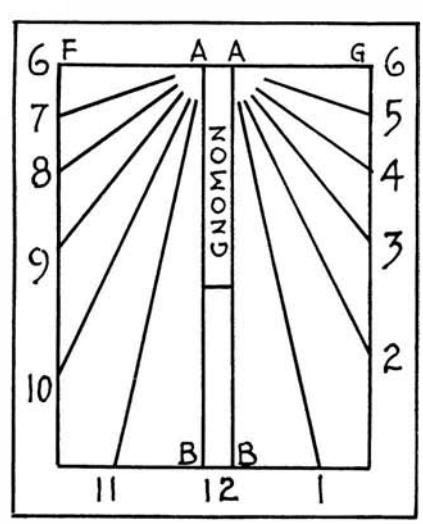


Figure 4

Then draw the line *EW*, parallel to *AB*, cutting *NS* at *D*. From *D* draw the line *DC*, perpendicular to *EW*. The angle *CDS* is the declination of the plane upon which the dial is to be placed, and *CDS* is also the declination of the dial. In the diagram, the wall faces the south and declines east. The declining dial will be described in a future article.

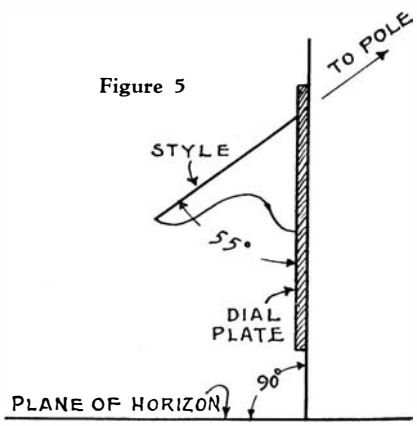
The plane of the direct south vertical dial is perpendicular to the plane of the horizon, and faces due south. Figure 3 shows the construction of the hour lines for latitude 35°.

The style points to the celestial pole.

The substile is the 12 o'clock line and lies in the plane of the meridian.

The height of the style is equal to the complement of the latitude, which in this case is 55° (90°—35°=55°).

Figure 5



Drawings and photograph by the authors

Draw the horizontal line *FA* (this will be the 6 o'clock line).

At *A* draw *AC* perpendicular to *FA* (this will be the 12 o'clock line).

Draw *AD* so that the angle *CAD* is equal to the height of the style, or 55°.

From *B*, on *AC*, draw *BE* perpendicular to *AD*.

Make *BC* equal to *BE;* then make *AF* equal to *AC*.

Draw the line *FC*. Through *B* draw a line parallel to *FA*, cutting *FC* at *L*. Through *L* draw the line *LK* parallel to *AC*.

With radius *BC* and centers at *C* and *F*, describe the arcs *TV* and *PQ*. Divide these arcs into equal parts of 15° each. Draw lines from *F* and *C* through the points thus found, until they cut the lines *LK* and *LB*, respectively.

Draw lines from *A* through the points found on *LK* and *LB*. Also draw a line from *A* through the point *L*. These lines will be those required for the morning hours.

To obtain the afternoon hour lines, extend the line *FA* to *G*, making *AG* equal to *AC*. Draw *CG* and continue the construction as shown above.

Figure 4 shows the hour lines transferred to the dial plate, and the way in which they should be numbered.

Figure 5 shows the position of the dial when in use.

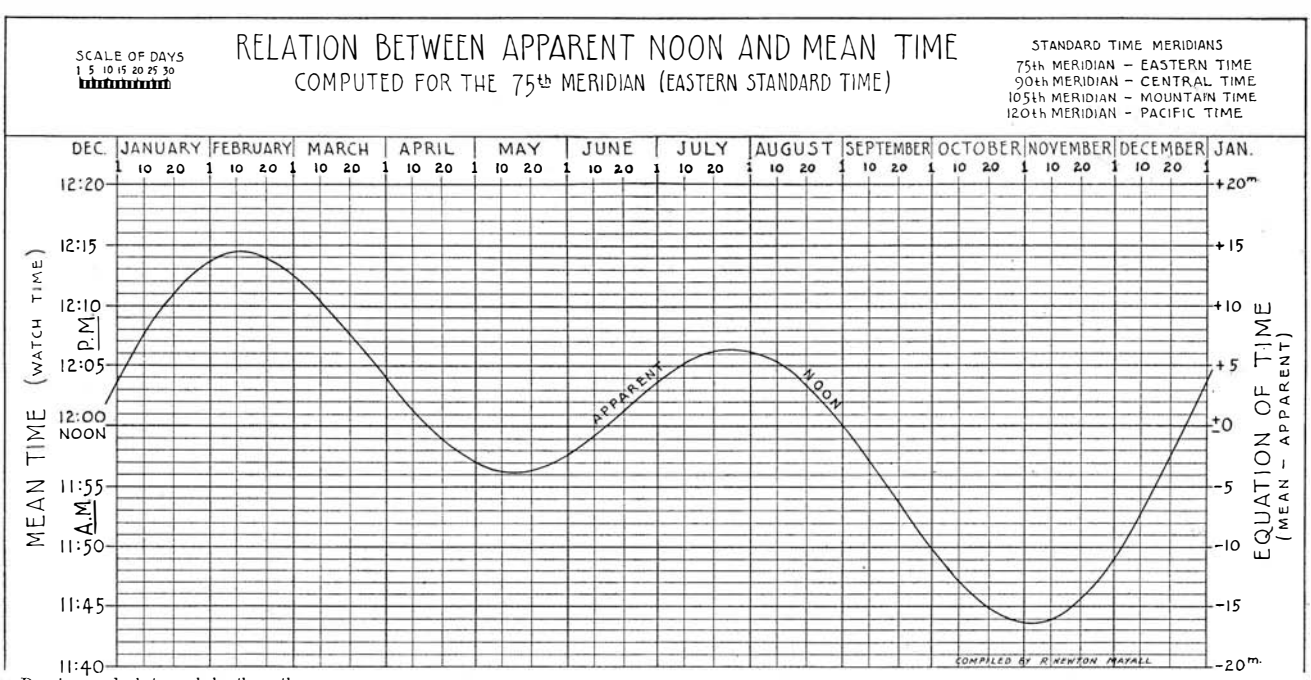
The sun will not shine upon this dial before 6 in the morning nor after 6 at night; therefore it is necessary to show only the hours between 6 A.M. and 6 P.M.

Vertical type of dial on side wall of dormitory, Mt. Holyoke College

This dial must be placed in a perfectly vertical position, so that the 12 o'clock line will lie in the plane of the meridian, and the plane of the dial will face due south, or in the plane of the prime vertical.

●

The next article will describe the construction of the north, east, and west vertical dials, and the polar dial. There will be at least three more articles, dealing with declining dials, the materials of construction and so on.



This chart shows, at a glance, the time when the sun will be on the standard meridian (at the left), and the equation of time (at the right), for any day in the year. A correction will have to be made for the observer's meridian, if his meridian is east or west of the standard meridian for the time zone in which he is stationed. This correction amounts to four minutes for each degree of longitude east or west of the standard meridian. If the observer's meridian is east of the standard meridian, the correction must be subtracted from the time shown on the chart; if west, the correction must be added. *Example:* Find the time the sun will be on the meridian at Boston, Mass., on March 20. According to the chart the sun will cross the 75th meridian at 12h 7.5m P.M. E.S.T. The longitude of Boston is 71.07 degrees. The difference between Boston and the standard meridian (75th) is 3.93 degrees. Applying the correction of four minutes for each degree of difference, 15.7 minutes must be subtracted from the time obtained from the chart, since Boston is east of the standard meridian. Therefore the sun would be on the meridian at Boston, March 20, at 11h 51.8m A.M. E.S.T. Note that the equation of time is equal to the mean time minus the apparent time. This chart is applicable to the standard meridians (see upper right hand corner)

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

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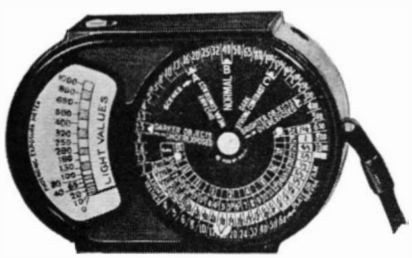
A. E. BUCHANAN, Jr.
Lehigh University

Perfect Exposures

CORRECT exposure is one of the vital problems of good photography. So many factors enter into proper exposure that even those of long experience, who pride themselves on their picture results freely admit their inability consistently to judge photographic light under all conditions. Now seasoned photographers no longer rely on their personal judgment of light values, but are able to devote all of their attention to composition. They determine exposures the modern and positive way—with a Weston Exposure Meter.

The untiring "electric eye" in the exposure meter never guesses. It properly gages the photographic light regardless of whether exposures are made in sunlight or deep shade, in various climes, or in mountainous country. Thus film wastage is eliminated and disappointment over the loss of prized pictures is a thing of the past.



A photo-cell exposure meter

Miniature camera owners will find this exposure meter an invaluable aid in obtaining uniformly high-grade negatives—negatives that will be worthy of enlargement expense. For the motion picture enthusiast an exposure meter is indispensable. It not only eliminates film spoilage, but assures a uniformity of film that brings complete satisfaction when projected on the screen.

New Treatment of Radium Poisoning

FUTURE sufferers from radium poisoning may have hope for recovery by a method now being developed by Robley D. Evans, physicist of the University of California and Dr. R. Ware of the Los Angeles General Hospital.

These investigators are now trying it out on the few survivors of the unfortunate luminous dial paint workers of 10 or more years ago, and so far the results are promising. Since radium workers in mines and in laboratories will always be exposed to the dangers of this dread form of poisoning, development of a successful method of treatment is much needed.

The method follows the work of Dr. J. C. Aub, Prof. F. B. Flinn, and Dr. S. M. Seidlin and depends on the fact that calcium and radium are very similar in chemical properties. The calcium absorbed by the body goes mainly into the bony structure and therefore the radium also accumulates there. Since the bones are comparatively permanent in composition the radium remains in place, giving off radiations which wreak destruction on the blood-producing centers as well as on the surrounding bone structure.

Now an excess of parathyroid gland hormone will disturb the normal calcium metabolism, causing the system to lose an excess of calcium. Consequently it ought to eject radium too. Of course, after this depletion of the calcium has gone far enough the diet must be made rich in calcium to give the bones a chance to regain their proper strength.

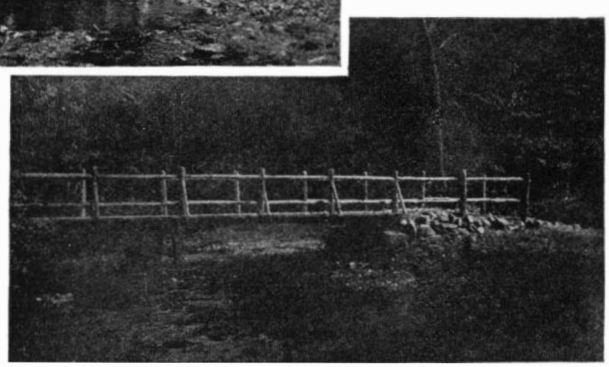
Essentially the process is a rinsing out of the radium-contaminated calcium and a substitution of fresh pure calcium. It is a drastic treatment.

To date it has speeded up the rate of elimination of radium to three times the normal rate. This is not yet enough to save the life of a victim, but information gained in these experiments has made possible a modified treatment which it is hoped may at least lengthen the remaining life span for those victims who have had radium poisoning for a decade or more.—*Science Service.*

"Soft" Milk

COMING generations of babies may be spared stomach-aches and their parents spared dreary hours of floor-walking, if the discoveries of Lyman, Browne, and Otting, reported in *Industrial and Engineering Chemistry*, bear fruit. These three chemists conceived the idea of putting cows' milk through a regular water-softening plant, such as many factories use to prevent scale from forming in boiler tubes. They found

Left: **A properly exposed photograph, the timing of which was determined by the exposure meter described in these columns**



Right: **The same scene as the one above, but improperly exposed as a result of determining time "by the eye"**

that this softening process made cows' milk very much easier on baby's stomach, because it removed some of the calcium naturally present and thus resulted in the formation of a soft, flaky curd in baby's stomach instead of the hard, dense curd which often causes baby's discomfort.

It was found that an ordinary zeolite water-softener would remove about 20 percent of the calcium present in milk, provided the milk was slightly acidified before processing. Milk thus modified curdles in the stomach in small, flocculent granules which digest rapidly. The sponsors of this process state that the appearance and taste of the milk are not appreciably altered by the zeolite treatment.—*A. E. B.*

American Grub Now Kills Snakes

CACTOBLASTIS cactorum, the little imported American grub that has reclaimed more than 3,000,000 acres of prickly-pear-infested land in northeastern Australia by the simple process of eating down the pear and killing the roots, is winning additional fame in some districts as the slayer of the Queensland adder.

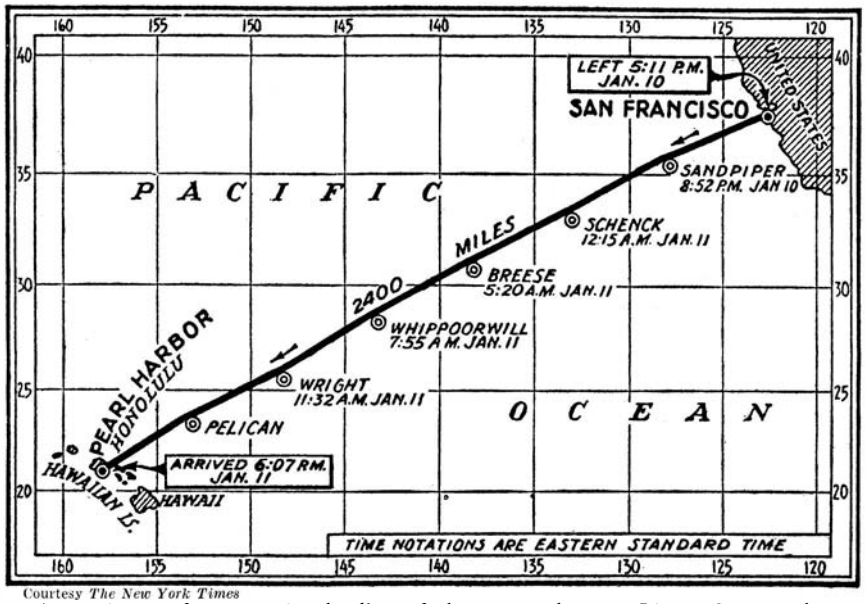
The adder, regarding the grub as a pest, eats it and dies from its meal. It is passing with the pear at a surprising rate.

One explanation is that the adder's motive for eating the cactoblastis is not hunger, but revenge. The destruction of the prickly pear cactus is robbing the snake of his shelter, and he regards the grub as nothing less than a home wrecker. The loss of his shelter has probably made the adder an open mark to emus and other birds which prey on his young and on the eggs.

Fruit Ice Creams Improved

THE familiar chunk of ice that almost always marks each bit of strawberry or peach or whatever it may be that is used in fruit ice creams will be a thing of the past when a new method of handling the fruit used in frozen desserts is generally adopted by ice cream manufacturers. The process, developed by dairy specialists at the State Experiment Station at Geneva, New York, involves the freezing of the fruit in a syrup at a very low temperature, followed by soaking for a short period in the syrup after thawing before incorporation in the ice cream mix. Fruit treated in this way does not freeze any harder than the ice cream itself, as the freezing point is lowered by the sugar which penetrates into the fruit.

The Experiment Station has just issued a bulletin describing the process and reporting on tests of the new method in the Station dairy laboratory. It is entitled, "Frozen Fruits for Ice Cream" and has been prepared by Prof. J. C. Hening and Dr. A. C. Dahlberg. In addition to the experimental work, the bulletin gives directions for making fruit ice creams on a commercial scale.



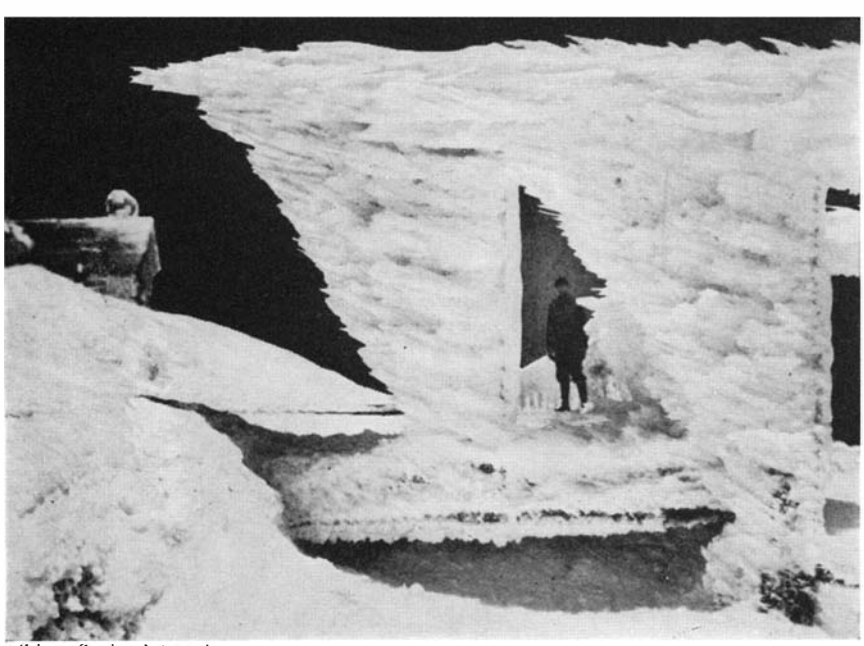
Courtesy *The New York Times*

A routine performance in the line of duty, was the way Lieut. Commander Knefler McGinnis characterized the flight of six Navy planes from San Francisco to Honolulu, January 11, 1934. Without mishap the planes flew along the course, shown on the map above, which was patrolled by the naval vessels noted. The total time of the flight was 24 hours and 56 minutes for a distance of 2400 miles. The aviators encountered fog, but maintained their schedule

Artificial Marble

IMITATION marble is now being manufactured by a patented process described in *Solvent News*. An exact likeness to a real marble slab is first obtained on a photographic film by the use of color filters. The design is then transferred to a transparent cellulose plastic compound in sheet form. This, in turn, is colored to give opaque and translucent effects as desired, and finally laminated between two pieces of glass.

The resulting product looks exactly like the original marble but has the advantage of greater durability, is more easily cleaned and can be perfectly "booked" or matched in graining, ordinarily a long and expensive process where quarried marble is used. —*A. E. B.*



Science Service photograph

A typical formation of frost "feathers," more common on Mt. Washington than anywhere else in the country, is shown in the above photograph. These "feathers" built out three feet in 12 hours at 10 degrees above zero. Strangely, the formation "grows" into the wind, the wind blowing left to right in photo

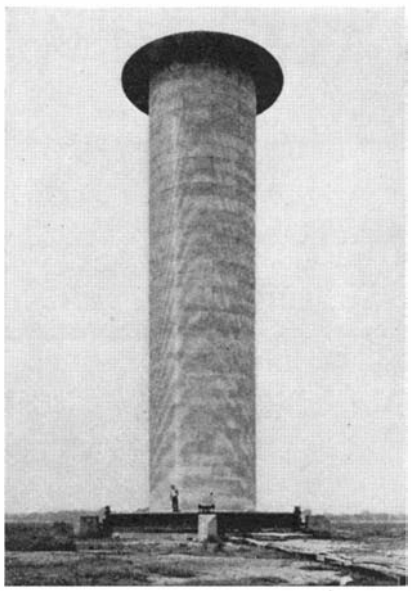
Setting the Clock Back to Tomorrow

ENORMOUS disks, spinning at high speed in an almost perfect vacuum, will replace the familiar generators and motors of modern electrical plants. Thus Dr. R. J. Van de Graaff, brilliant young physicist of the Massachusetts Institute of Technology, prophesied before the recent meeting of the British Association for the Advancement of Science at Leicester, England.

These disks would be great electro-static machines, producing direct current electricity at tremendously high voltage. The vacuum would be necessary in order to prevent the production of tremendous sparks that might wreck the whole machine and would in any case prevent the electricity from being led out on wires to be usefully employed. Dr. Van de Graaff believes that vacua sufficiently high to insulate the machines against such electrical breakdown

can be produced, even in the large housings that would be required for the industrial production of current by electro-static machines. He exhibited designs for such machinery.

If Dr. Van de Graaff's prophecy is realized, it will be, in a sense, progress made by setting the clock back. For the electrical machines that were used by the 18th Century school of "natural philosophers" of which our own Dr. Benjamin Franklin was a brilliant member, were all of the electro-static type. They generated electricity by friction on large disks. Instruments of the same kind are still used for special purposes in laboratories.



One of the Madaras rotors, showing corrugated shell and cap at the top

The trouble with such machines has always been that the air was not a sufficient insulator to prevent sparks, after a certain potential had been built up. For this reason the development of the electric age had to await the discovery that electricity could be generated in another way, by moving a conductor in the field of a magnet. All our present generators are elaborate arrangements of magnets, past which systems of wire coils are rapidly moved, with arrangements for capturing and leading off the current thus produced. They are the best we have; but their working efficiency is admittedly not as high as could be attained, at least in theory, by properly arranged and insulated electro-static machines. Dr. Van de Graaff believes that such theoretically possible machines can actually be built. (See also article on page 132.—*Ed.*)

Dr. Van de Graaff has attracted much attention among physicists by the simple but tremendously impressive electro-static machines he has already built, first at Princeton and latterly at the Massachusetts Institute of Technology. These have produced "artificial lightning" measured in hundreds of thousands of volts, used in atom-smashing experiments.—*Science Service.*

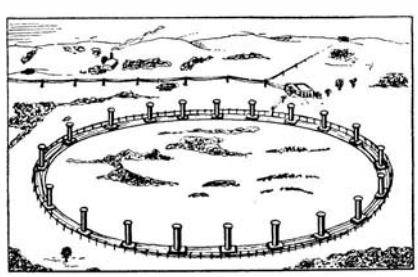
Fiber Pan Improves Pies

PAPER pie plates are no novelty, but heretofore they have been used only after the pie is baked. Nothing had been found to take the place in the oven of the old-fashioned tin pie-pan until a treated fiber board pan made its appearance recently. The fiber board is impregnated with titanium oxide, making it resistant to oven temperatures. This new style pie-pan is finding a ready sale to bakers of pies who can put their wares through their ovens in these fiber pans which, it is claimed, help produce as dry and flaky a crust on the bottom as on the top of the pie.—*A. E. B.*

Madaras Rotor Power Plant

INTERESTING experiments have recently been made at Burlington, New Jersey, on one unit of a rotor power plant, the ingenious invention of Julius D. Madaras.

The rotor power plant, as shown in the artist's diagram, is to consist of a number of large cylinders—each 90 feet high and 22 feet in diameter. These units, when turned about on their own axes in a wind, generate a large lateral force by what is known as the Magnus Effect. This force is many times greater on the spinning cylinder than on the same cylinder at rest in a wind. Each spinning cylinder is mounted on a car or truck which travels on a circular track. By properly adjusting the revolutions of the cylinder to the speed of the wind, a great tractive effort will be exerted, driving the whole system round and round the track, with appropriate reversal of the cylinder in rotation when changing its direction of travel relative to the wind. Each car will carry a large electric generator geared to the wheels. As the wind pushes against the spinning cylinder and moves the car along the track, the wheels will drive the generator and develop electric power, just as a motor on a street car running down-hill acts as a generator and feeds electric power into the line.



An artist's drawing of the set-up of a Madaras rotor power plant

On a track one half mile in diameter, 40 rotors would be required and 50,000 kilowatts would be available in electric energy. It is claimed by the inventor, and his calculations have been checked up by public utility experts, that the cost of power will average far less than the average cost with either a steam or a hydro-electric plant.

Of course, a great many mechanical and electric problems remain to be solved, but the project is one of importance.

One of our photographs shows a rotor as it is set up at Burlington, New Jersey, with corrugated outer shell, and the top capped. Another shows the huge internal tower on which the outer shell rotates with a minimum of friction. The outer shell is driven by a large steel shaft, running from the very bottom of the structure. While the shell is of corrugated dural, the internal structure of the tube is of welded steel.

Coefficients of pressure on the tower have been obtained by coordinating the indications of four thrust dynamometers at the base of the rotor with the readings of a number of anemometers placed on towers at strategic points.

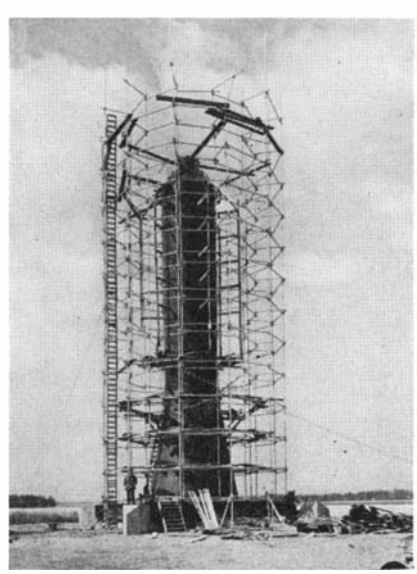
The next step will be the construction of a complete rotor plant somewhere where the wind is steady and appreciable in magnitude. These experiments are being very carefully watched by aerodynamicists and electric power executives and technicians—*A. K.*

Danger on the Ground

CHARLES DOLLFUS, Curator of a French aeronautical museum, a balloonist and an expert on lighter-than-air craft, has flown thousands of miles in airships and crossed the Atlantic on the *Graf Zeppelin* in its trip to the Chicago Century of Progress. Arrived at Chicago, he took a ride in a new three-wheeled streamlined car, which turned over in a bad accident. M. Dollfus has only recently emerged from the hospital. Joining in the discussion of the papers (reviewed in the following paragraphs) by Dr. Arnstein and Commander Fulton, he pointed out that engineers were too prone to think mechanical equipment alone could ensure safety in transportation. In the case of airship navigation, M. Dollfus stressed the immense importance of personnel. Thus, on the *Graf Zeppelin*, each man takes only a four hour shift, and there are three men to every man really required. It is true that this superabundance of crew means loss of payload, but what a record this system of plenty of hands and generous relief for men on duty has earned for Dr. Eckener in the *Graf Zeppelin!*—*A. K.*

Airship Progress

THE American Society of Mechanical Engineers recently had the privilege of hearing two eminent airship men lecture to its members: Commander Garland Fulton, of the Bureau of Aeronautics, Navy Department, and Dr. Karl Arnstein, Chief Engineer of the Goodyear-Zeppelin Corporation. Their authoritative and up-



The welded steel tower on which rests the outer shell of a rotor unit

to-date papers were so closely allied that our readers may prefer a joint review.

The most important improvements in performance of future airships will come through developments in the power plants. Since in an airship thrust must be not only reversible, but also applicable in an upward direction (for complete flexibility in maneuvering, particularly near the ground) the airship's power plant is considerably more complicated than that of the airplane. Again, the long cruising range of the airship necessitates complete reliability. No wonder that the power-plant weight of existing airships is abnormally high—and that is why the greatest room for improvement exists in the power plant.

Airship engines hitherto have been of the water-cooled type. There is no reason why they should not be air-cooled, but arrangements for internal mounting and for the reversing and tilting propeller may be somewhat cumbersome for air-cooled engines.

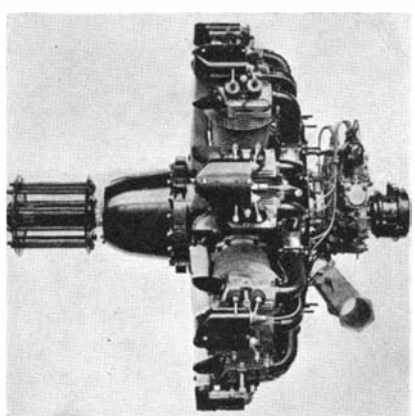
It is highly desirable to use a heavy fuel-oil engine in airship work, to decrease fire hazard and reduce fuel consumption. Efforts to obtain a light-weight compression-ignition engine to burn heavy fuel have not been entirely successful as yet, but the British engine described below holds great promise. Recent work on safety fuels, usable in the ordinary spark-ignited internal-combustion engines, yet having a flash point of about 115 degrees Fahrenheit, is very promising.

An airship must always be in approximate static balance for efficient navigation. As fuel is consumed this balance is broken and compensation is made by condensing the water in the exhaust gases. Such "water ballast recovery" means large radiators of considerable resistance and hence a loss in speed, and also weight and complication. The most likely method for supplanting the water ballast recovery system is the possibility of using "hydrogen ballast"; that is, burning hydrogen from the gas bags in the engines. With hydrogen as a fuel, consumption of fuel could be exactly balanced by the decreased content and buoyancy of the gas cells. Engines and carbureters functioning with hydrogen are perfectly feasible, but there is then risk of fire. It is now proposed to combine the good features of both helium-inflated and hydrogen-inflated airships by carrying hydrogen in interior ballonets or bags completely surrounded by helium. This scheme will permit higher lifts, fuller initial inflations, reduced dead weight, and lower drag. It is most gratifying to learn that the Navy is now trying out this plan on a comparatively small non-rigid airship of 300,000 cubic feet.

The public is inclined to be contemptuous of the speed of the airship. There are very good reasons why airship speeds can not be suddenly jumped from the present speeds of 80 to 85 miles per hour, to the much better sounding 100 miles per hour. To overcome the added drag at high speed means more power plant and hence weight. But what is equally serious is that to withstand the pressures of high speed, the structure must be made much stronger and heavier. In fact it is quite possible that rigid airships of the fabric covered type are unsuitable for high speeds. Rather, the added strength may have to come from an airship with a thin metal covering, placed under tension by internal pressure—in other words, the metal-clad type which we have had occasion to describe in these columns.—*A.K.*

A British Compression-Ignition Engine

AFTER five years of research on single cylinder units, the Bristol Aeroplane Company has produced a compression-ignition engine, the Phoenix, working on the four cycle principle, and developing 350 horsepower in its nine cylinders. The net dry weight is 990 pounds, which is not excessive for an engine of this type, employing ordinary commercial heavy fuel.



Side view of a Phoenix engine, indicating placement of accessories

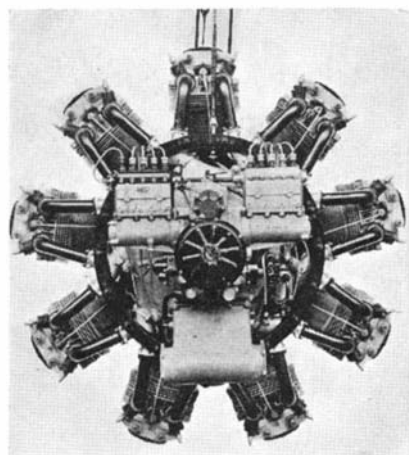
The British compression-ignition engine installed in a Westland "Wapiti"

Tests both on the motor dynamometer and in flight have been satisfactory.

This information and three pictures are all that the British Air Ministry has released to-date.

Will our readers look at the photographs of the engine and join us in guessing?

There is no carbureter and there is a two-way pipe at the rear of the engine,



Rear of Phoenix engine; compressors for fuel are above center line

with what looks like a throttle lever at its side. The rear view of the engine looks as if there was a good deal more than an ordinary crankcase involved. Our guess is that air is drawn in through the pipe and considerably compressed in a compressor built right into the engine. From this compressor the air at high pressure is drawn through induction pipes to each cylinder.

The fuel is evidently drawn into small reciprocating compressors. From this fuel pump or compressor bank the fuel is led through a narrow pipe into each cylinder and presumably admitted at just the right point of the stroke. The fuel, mixing with the high compression air charge, is self-igniting. Each cylinder has four valves, two inlet and two exhaust. The cycle is the ordinary four-cycle: intake at high pressure, further compression in the cylinder, instantaneous admission of the fuel, compression-ignition, working stroke and then exhaust. If our hypotheses are wrong, we shall learn in a few months. The main point is that a practical compression-ignition engine for aircraft use is now available.—*A. K.*

Continual Watchfulness

ON a recent visit to Newark Airport, New Jersey, we noted that the operations managers of the various airlines all wore a watchful, slightly worried air.

Mr. Richard W. Robbins, President of Transcontinental & Western Air, an airline operator who is making a great reputation for himself, explains this strain by an interesting story. Operators are constantly in touch with the various planes of their systems by means of two-way radio telephone. Generally this is helpful. It is better to know than to wonder whether something is wrong. Sometimes even the two-way radio fails to bring peace of mind. Thus, at one time during the night, Mr. Robbins received a message to the effect

Sleeping berths installed in an Eastern Air Transport plane

that a pilot had lost a cylinder from his engine. The next message was to the effect that the plane was in flames. Nothing more was heard for six hours! Fortunately this was a plane being ferried from one airport to another without passengers. The pilot, a tenacious and plucky man, would not leave his ship until every hope of saving it had gone. He "bailed out" only at the last moment and landed in isolated territory from which he could send no message.

The pilot reported that a great peace came over him as he left the burning ship and sailed down calmly through space. To see the ship fall ablaze through the sky was an awe-inspiring sight.

If operators have to think of these things, it is no wonder they look worried sometimes. It is because they worry that air travel is so safe.—*A. K.*

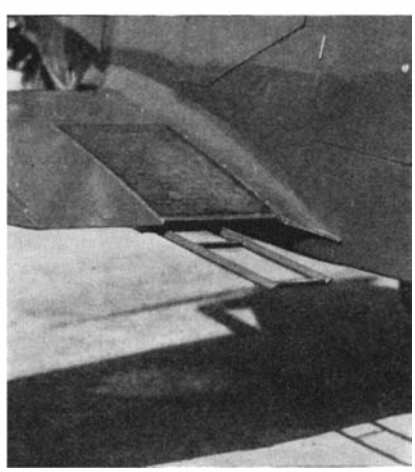
Ozone Causes Gas Engine Knock

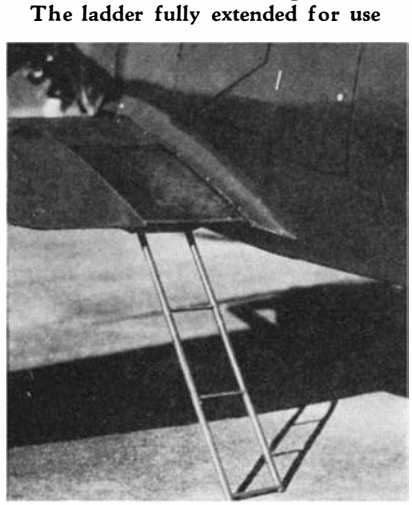
OZONE is an exceptionally active form of oxygen. The idea of feeding ozone to the carbureter of an automobile engine in order to produce quicker and more complete combustion has been suggested often. But recent research by the Bureau of Standards discourages this scheme, for it has been found that ozone is more potent in causing detonation, or "fuel knock," than tetra-ethyl lead is in suppressing it. As little as .002 of 1 percent will cause an increase in detonation equal to that occasioned by substituting regular gasoline for premium gasoline. By using somewhat higher concentrations—up to .01 of 1 percent—regular and premium gasolines were made to knock as badly as does kerosene. These concentrations of ozone, however, had no effect on power or efficiency when the compression of the engine was such that no detonation occurred.

While the average motorist is more interested in suppressing detonation than in obtaining it, and while stratosphere flights are still too far in the future to cause concern over the possible effect of ozone on the engines used in that region, this discovery gives automotive and petroleum technologists a new tool with which to study detonation and to test theories. As ozone and tetra-ethyl lead have opposite effects of the same order of magnitude, a study of the action of ozone may throw light on the mechanism whereby tetra-ethyl lead suppresses detonation.—*A. E. B.*

A Built-in Passenger Gang Plank

ON one of the latest Pitcairn Autogiros, a built-in step ladder or gang plank has been provided which makes passengers independent of portable ladders for entry into the cabin.





Above: **The built-in passenger gang-plank on an Autogiro partly withdrawn from its housing.** ***Below:*** **The ladder fully extended for use**

Normally the ladder is entirely concealed in the fixed wing of the autogiro. When the ladder is thus telescoped into the wing, a steel spring clip holds it in place. To use the ladder it is only necessary to reach into a small slot in the under-surface of the wing, unlatch the spring, pull the ladder out to its full length, and then let it fall to the ground. Reversing the process is equally simple. The ladder is made of welded chrome-molybdenum tubing for lightness and strength.—*A. K.*

Sleeping in Flight

EASTERN Air Transport now offers sleeper berths on its run between New York and Atlanta, in the large Curtiss-Condor planes. The interior of the transport plane certainly resembles a Pullman sleeper in our photograph! The length of each berth is six feet five inches; the width is two feet four inches. Steel tubing, so current in airplane practice, is used for the construction of the berths, which can be taken down or made up with ease.

Reading lights, call buttons, Pullman-type draw curtains, clothes hangers, clothing nets, sheets, blankets, and pillows add to the comforts of life. There are individual ventilators, regulated at will in both upper and lower berths. It has been customary to complain of the discomforts of Pullman sleeper travel, and to say how nice it was to avoid them by flying! Now the same complaints will be made of the airplane. The only difference is that instead of three or four sleeper nights across the continent one will be the limit of "torture" for the air traveler.—*A. K.*

Fireproofing Airplanes

AS a general rule we make it a point to exclude from these columns any accounts of chemical developments unless we are able to obtain full technical details and to verify the scientific accuracy of the information. This policy is necessary to protect our readers against the many pseudo-scientific reports of a sensational character that frequently find their way into the non-technical press. If such chemical "quackery" appears to be harmless, we ignore it; if it seems to threaten to mislead the public in a dangerous direction, we expose it.

We are tempted to make an exception to this policy, however, to report what seems to be a promising discovery by an officer in the Belgian Aviation Reserve Corps—a system of rendering airplanes fireproof. The reports of his experiments seem to be authentic and although the chemical details of his invention have not been revealed, it is quite likely that this reticence is due to a desire to preserve a military secret.

The inventor gave the following explanations to an eye witness of his experiment: "My device consists of partitions, screens, or panels which contain chemical products with the property of resisting, not only the effects of flames of a fire, but also the heat intensity of a brazier, no matter what the nature of the generator producing the flame and heat. Among other properties, this device fails to give off any chemical emanations which are either toxic or merely disagreeable."

The inventor has given no details relative to the nature of the product or products employed. It is known that these "anti-fire"

and "anti-heat" substances are not metallic or of wooden base. They appear in the form of rigid plates which are not very thick. The inventor asserts that their weight per square meter "remains within the limits set for materials to be used in airplane construction." The following results illustrate the first tests carried out: an airplane hood covered with the new product was placed near a fire which gave out heat of 1100 to 1300 degrees, Centigrade. The hood contained a gasoline tank, a metallic mail box, and the inventor. Container and contents suffered in no way from the heat. —*A. E. B.*

Pin Worms Exonerated

THE lowly pin worm, which both popular and medical opinion has blamed as a cause of appendicitis, is seldom if ever responsible for this trouble, except in most exceptional cases. This conclusion is stated after an examination of 26,051 surgically removed appendixes by Dr. Harold Gordon, of the University of Michigan Pathology Department, in an article in the *Archives of Pathology*.

Some authorities have held in the past that pin worms, finding their way into the appendix, irritated the walls of the organ, making openings for the entrance of inflammation producing germs. In all his thousands of cases, Dr. Gordon found the parasites present in only 311, and of this number, only 12 showed any injury to the delicate mucous membrane inside the organ. Even these cases did not show that germ infection had followed at the point of the lesions.

Although pin worms are not a cause of appendicitis, infection of the organ with the parasites has increased in recent years, probably due to the increased eating of uncooked vegetables and fruits, Dr. Gordon found. In 20,969 appendixes examined up to 1931, the "oxy-urids" were present in 1.04 percent of all, while, with the addition of 5082 specimens since, the percentage has risen to 1.19. The earliest specimens, running back to 1894, showed the smallest percentage of pin worm infection. Since the modern diet is generally better for health than the old, however, and since the worms do little or no harm, the increased occurrence of the parasites means little and could easily be reduced by careful washing of fresh foods, Dr. Gordon believes. Infestation is most common in the first decade of life and practically unknown after the age of 46 in Michigan, he found.

Water Erodes Steel

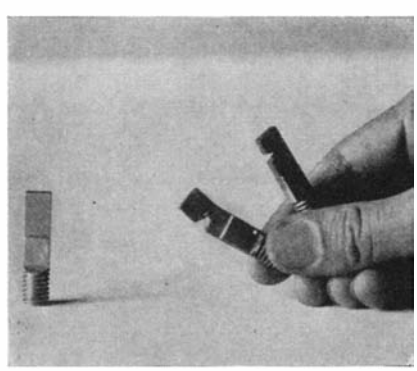
WATER jets cutting, or eroding, the edges of test pieces of the hardest steel in a few minutes are a feature of a test carried out by the Westinghouse Electric and Manufacturing Company. The test pieces, small but solid, are screwed into diametrically opposite points in the rim of a disk which may be revolved at many thousands of revolutions per minute so that the test pieces cut through the fine jet of water.

The question of metal erosion is fast becoming a problem of prime importance in many of the present day applications which are subjected to its destructive influence. The pitting of ship propellers and hydraulic turbine runners has long been a problem. Numerous investigations have been made in this country and in Europe in an effort to determine the cause of such pitting of metals. In one report covering data on 225 water turbines, 90 showed erosion to a more or less marked degree. Steam turbine blades and airplane propellers are also subjected to erosion.

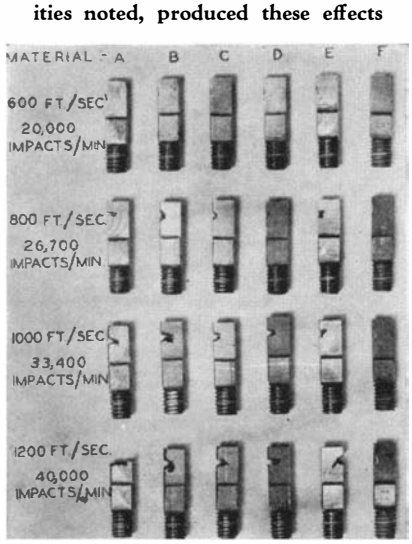
Finger points to water jet in machine for determining erosion of steel by water

This wearing action was first thought to be of a chemical nature, the only part attributed to erosion being that of carrying away the products of corrosion. No doubt the two actions, chemical and mechanical, aid each other, but in most cases one or the other will be the predominating factor. The present opinion is that the erosion is caused by the impingement of water drops on the fast moving parts in the case of airplane propellers and steam turbine blades and to high pressures built up due to collapsing cavities in the case of hydraulic turbines and ship propellers. The theoretical pressure built up on the surface of the metal upon impact with a drop of water has been calculated by several investigators to be from 50,000 to 70,000 pounds per square inch for a velocity of 1000 feet per second. Pressures in the order of 140,000 pounds per square inch may result from collapsing cavities of water-hammer effect.

To withstand these high pressures it is necessary that new and harder material be found. Before applying new alloys, however, some knowledge of their erosion-resisting properties should be collected. It would hardly be desirable, however, to wait until such information has been obtained from ordinary service operation. A means must be provided for rapid determination, by accelerated erosion tests, of the probable behavior of the various alloys when subjected to conditions similar to, but very much more severe than, those met in service. Hence the water jet tests from which many data have been obtained.



Above: **Sample ready for test (left) and eroded pieces.** ***Below:*** **200,000 impacts of water jet, at velocities noted, produced these effects**



New Anesthetic

EXPERIENCE with a new anesthetic which is injected directly into the blood and which may prove as valuable as ether for certain types of surgical operations was reported by Dr. Gavin Miller of Montreal to the Canadian Medical Association.

The new anesthetic is called evipan and was produced by a German pharmaceutical manufacturer. It has been tried extensively in Germany and England. Only one death was attributed to the anesthetic in over 20,000 cases in which it was used. Chemically, evipan is known as the sodium salt of N-Methyl-C.-C.-cyclohexenyl-methyl-barbituric acid.

The anesthetic, injected directly into the blood stream through a vein in the arm,

produces a deep, normal sleep within 30 seconds. The operation can be started immediately. After the operation the patient awakens easily and gradually without any unpleasant after-effects. In Dr. Miller's experience, evipan is more effective if morphine or a similar drug is given first.

"If further investigation confirms my present experience," he concludes, "this drug may become as valuable to the surgeon as ether or novocaine for suitably chosen operations."—*Science Service.*

British Roadway Tunnel

A SUBMARINE highway tunnel, 2.13 miles long and 44 feet in internal diameter under the Mersey River, in England, has been built to improve communication between Liverpool and Birkenhead, and also to connect extensive highway systems which at present are separated by the river. The two towns, of 1,000,000 and 150,000 population, respectively, are on opposite sides of the river, but hitherto have been connected only by ferry steamers and the tunnel of the Mersey Railway, a local electric line. The main part of the new vehicle tunnel is complete, but some of the auxiliary works remain to be completed, and it is expected that the new route will be opened to traffic early in the summer of 1934.

The main portion of the tunnel, 5274 feet, or about a mile in length, is of circular section, 46 feet 3 inches in outside diameter and 44 feet clear diameter inside the lining. It is in a fissured and water-bearing sandstone formation and has a lining of cast-iron segments filled with concrete on the inside. A reinforced-concrete deck or floor, 18 inches below the horizontal diameter, provides a 36-foot four-lane roadway and two 4-feet sidewalks for the use of the patrolmen and tunnel staff. Two partition walls supporting this deck form a large central compartment for pipe lines or for some special form of transportation that may be developed in the future, while the two side areas are for the fresh-air supply to the tunnel.

In the main parts of the approaches on each side of the river, the tunnel is practically semicircular in section, with an invert about 7½ feet deep below the roadway slab. In these main approach tunnels the roadway width is 36 feet. On each side of the river there is a dock-side branch approach, consisting of a horseshoe tunnel 26½ feet in inside diameter, with a 19-foot roadway for two lanes of traffic. In both the main and dock-side approach or subterranean tunnels the entire invert space below the deck slab forms the conduit for the fresh-air supply.

The four open-cut approaches aggregate about one quarter of a mile, making the total length of roadway about 2.87 miles including the auxiliary or dock-side branches. On the direct route the length between main entrances is 2.13 miles, while between the dock-side entrances the distance is 2.08 miles.—E. E. R. Tratman, in *Engineering News-Record.*

Nickel's Fight for Life

NICKEL, so named because it was the "bad boy" of the metallurgical world, has become one of the most substantial citizens in the industrial empire. This development, during the past 50 years, provides a striking example of the value of scientific research.

Fifty years ago, says S. J. Cooke, in *Industrial and Engineering Chemistry*, nickel was worth a dollar a pound, and at that time the famous Krupp firm is said to have rejected, with more or less amusement, a suggestion that nickel might be used in the manufacture of armaments, on the ground that there was not sufficient nickel in the world to warrant experimentation in this field. Today, as the result of research, the Sudbury area in Canada supplies more than 90 percent of the world's consumption, which amounted to 57,000,000 pounds in 1932. An investment of more than 50,000,000 dollars is represented by this gigantic enterprise and thousands of employees earn their livelihood in this thriving industry.

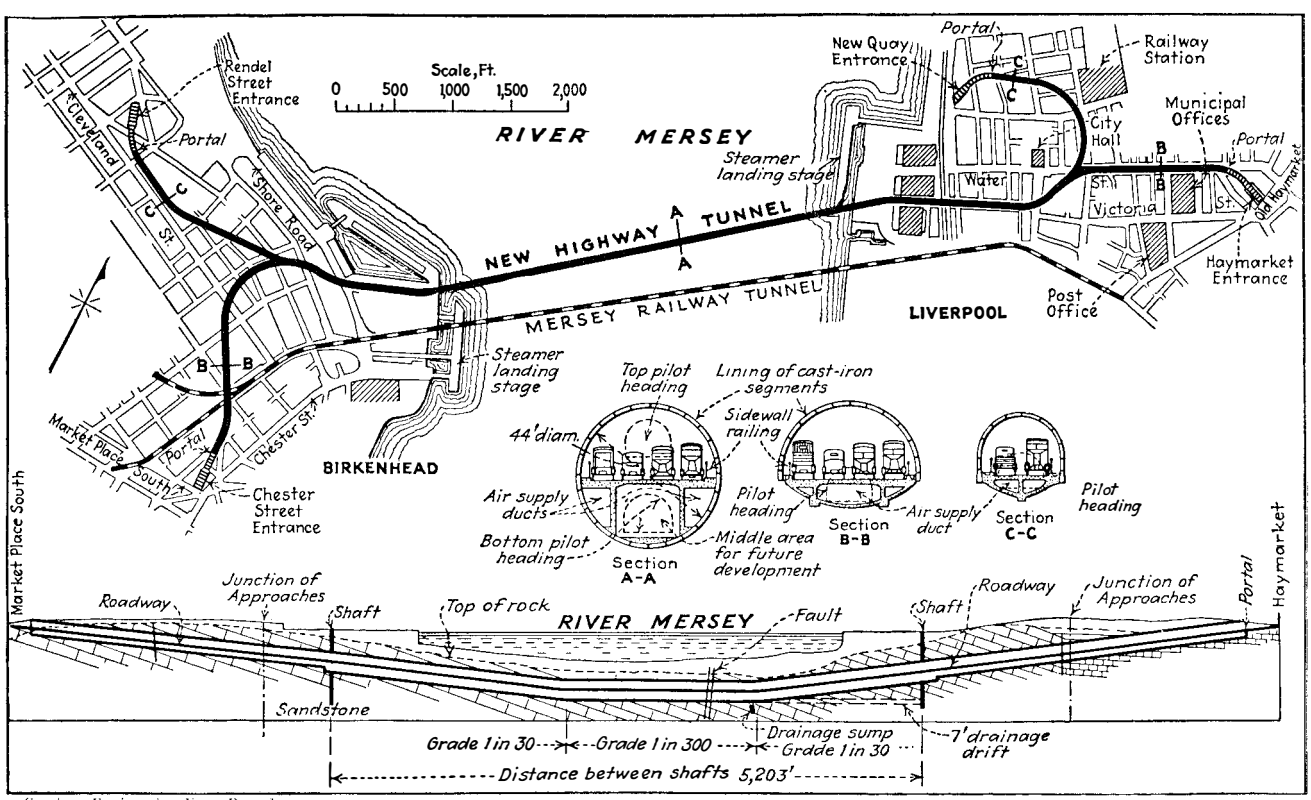
While production of nickel rose slowly in the years before the World War, the demand for armament purposes doubled the output in 1918. Then the consumption of nickel dropped to negligible quantities.

Volumes might be written about nickel's post-war progress. In many ways it is more spectacular than the chronicles of the early days. A huge enterprise, suddenly crippled, turned with courageous resourcefulness to make a place for itself in the ways of peace. For several years the situation seemed hopeless. Then slow and persistent research began to show results. How well the task of creating a peace-time work for nickel has been accomplished is evidenced by the fact that today it is used for hundreds of purposes and the world's annual consumption is 20,000 tons greater than it was at the peak of the war-time nickel demand.—*A. E. B.*

"Safe" Dry Cleaners Sometimes Dangerous

EXPLOSIONS of "safe" dry cleaning fluids have added another hazard to home dry cleaning efforts. Some of the so-called safe solvents sold for home use have been found to be decidedly unsafe. Fluids demonstrated to have been perfectly safe when first used have exploded after being used a few times.

This contradictory behavior has been simply explained by the results of laboratory experiments. These dry cleaning flu-



Courtesy *Engineering News-Record*

Diagrams of the Mersey River Tunnel which is described in detail in the columns above

ids are made up of regular dry cleaners' naphtha to which has been added enough of an inert solvent, carbon tetrachloride, to make them non-flammable. One half carbon tetrachloride and one half naphtha makes a suitable mixture.

While in use the carbon tetrachloride evaporates more rapidly than the naphtha, thus leaving a mixture rich in naphtha and hence explosive. Experiments show, for example, that when 37 percent of a total mixture originally composed of 43 percent carbon tetrachloride and 57 percent naphtha had evaporated there remained a mixture made up of 29 percent carbon tetrachloride and 71 percent naphtha—a decidedly unsafe product.

Fluids made up entirely of carbon tetrachloride or other non-flammable solvents remain safe indefinitely.—*Science Service.*

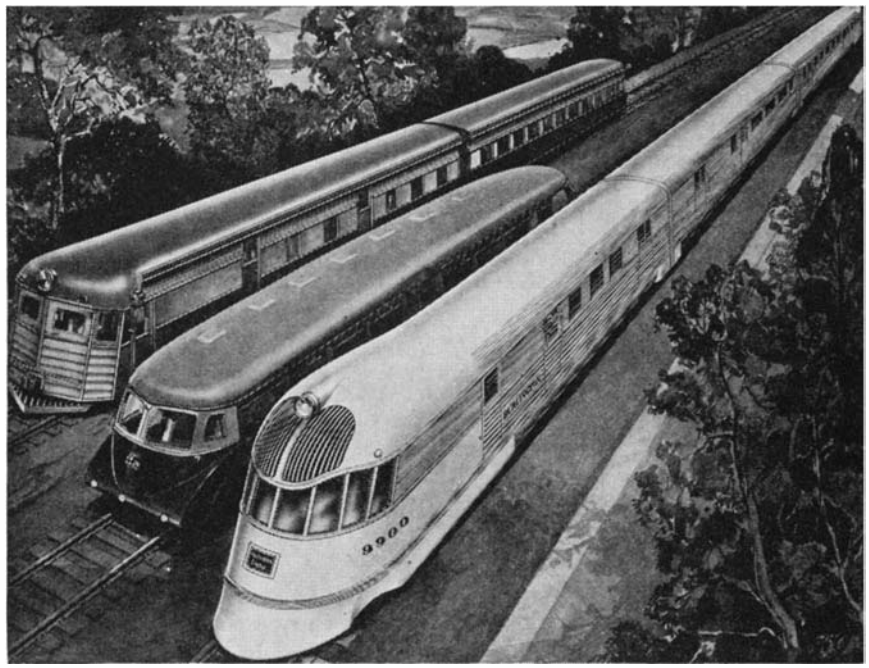
Motor Trains in Contrast

SO swiftly is motorization coming to the railways that already an evolution in equipment is taking place.

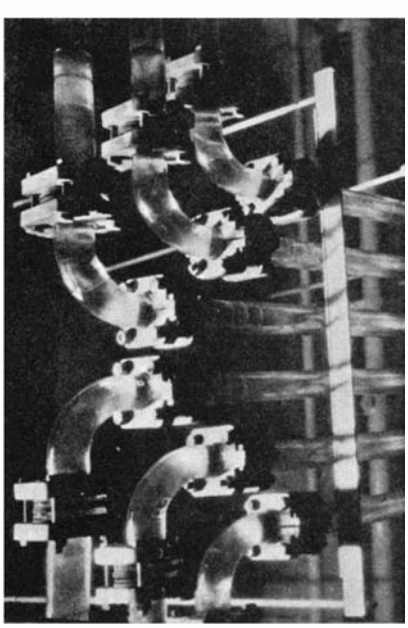
The upper left train in the photograph is the Texas and Pacific two car train, now running daily between Fort Worth and Texarkana, Texas, a distance of 249 miles. It is equipped with two 12-cylinder gasoline engines. An air conditioner changes the interior atmosphere every few minutes. Moderate streamlining reduces wind noises as well as wind resistance. Seventy-eight miles per hour is the maximum speed of this *Texas Ranger.*

In the center of the picture is Britain's first streamlined railroad car, shortly to be introduced by the Great Western Railway between Reading and Slough. As yet British operators have not taken to the "articulated" train, preferring to experiment with individual self-contained units. The Britisher is of unique design, resembling a huge seaplane float. It has a seating capacity of 69, is capable of 60 miles an hour and is driven by a single 130 horsepower oil-burning engine.

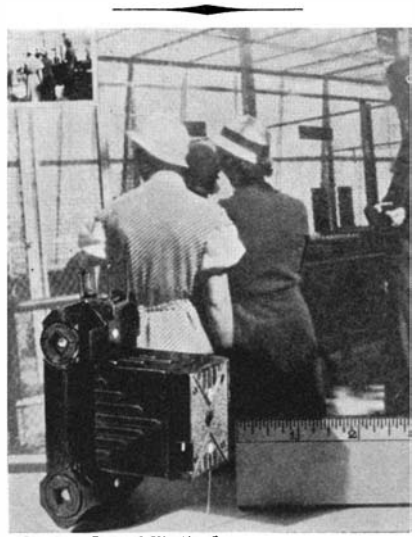
In the foreground at the right is a photo-sketch of the Burlington *Zephyr,* product of the E. G. Budd Manufacturing Company in Philadelphia. It is hailed as the "last word" in motorization due to its full aerodynamic lines and its 600 horsepower Diesel engine, capable of a maximum speed of 2 miles a minute.



Comparative drawings of two American and one British motor trains



Glass Pipes in Industry: The laboratory glass-ware of the chemist is probably responsible for the application of glass in commercial processes. The above installation of glass piping has advantages of resisting the action of chemicals that would ruin any ordinary pipe



Courtesy General Plastics Inc.

Durez, a new synthetic plastic, has made possible a "pee-wee" camera that takes real pictures, yet costs only 50 cents. Shown in foreground, the camera takes vest-pocket film and makes negatives that, as indicated in the background and upper corner, are capable of being satisfactorily enlarged

Oxygen's Rôle in Corrosion

THIRTY years ago, R. W. Whitney, now vice-president of the General Electric Company, announced that the corrosion of metals was an electrochemical process and this view is now generally accepted, says *Water Works and Sewerage.* When a metal is in contact with even slightly acidic solutions, corrosion takes place by the chemical process of the metal replacing the hydrogen in the acid. The acid dissolves the metal and thereby hydrogen is released.

Released hydrogen coats the metal surface with an electrically charged layer that prevents the chemical reaction from continuing at the initial rate. If the hydrogen layer is built up to a sufficient thickness the reaction is practically stopped. However, under natural conditions, the hydrogen combines with the oxygen of the air or that dissolved in the water to form more water and solution of the metal goes on. The amount of oxygen available to remove the protective hydrogen blanket determines the extent of corrosion.

Impure metals are corroded more quickly as a rule than pure metals. Electrochemists believe that this is due to the impurities taking up the oxygen. Contrary to the popular belief, however, pure metals are subject to corrosion under the action of certain acid solutions. Prof. O. P. Watts of the University of Wisconsin has recently shown that if oxygen is absolutely excluded, copper will not corrode in a solution of sulfuric acid, a reaction that is very rapid in the open.

The importance of the dissolved oxygen content of the atmosphere, of corrosive water and other liquids, is thereby once more emphasized as an important factor in the corrosion of iron and steel that costs America a staggering sum each day.—*A. E. B.*

Meteorite—Or What?

READERS of scientific journals frequently report meteorites, or supposed meteorites, found in their vicinities and such reports are usually turned over by the editors to some astronomical authority specializing in meteors. In answer to one such report, Professor C. C. Wylie, of the Department of Astronomy at the Iowa State University, Iowa City, Iowa, and head of the Midwest Meteor Society, names three kinds of finds which have so odd an appearance that they are often reported as meteorites:

"Light and porous material, a little different from the ordinary power plant cinder, may be made in three different ways —or at least we get specimens which are apparently made in the three different ways.

"One of these is the foundry cinder, made by melting the sand surrounding the casting which is being made.

"Another is the straw-stack cinder. When a dry stack of straw on the farm is set on fire it sometimes burns with great heat. In the interior, where there is little air, the heat may be sufficient to melt the silicates in the straw. As the melting silica bubbles, a very porous cinder is formed.

"The third is the fulgurite, which is formed when lightning strikes in a sandy soil. A similar fulgurite may be formed when a power line goes down and the high voltage current arcs into sandy soil.

"I have seen no definitely authentic specimens of meteorites which are really porous."

Heredity to be Controlled by X Rays?

FOR generations it has been the dream of the experimental biologist to change the hereditary characteristics of animals and plants—to make and control variations, and to originate new species at will. In his attempt to do so he has subjected living matter to every sort of stress which he could think of—to the action of heat and cold, starvation and repletion, chemicals and electric currents directly applied. And always, no matter how great might be his injury to an animal or plant, it continued to reproduce normally. The agriculturist was dependent upon the method of hybridization, cleverly using chance variations, to perpetuate those improvements which he might detect in plants.

Very shortly after the invention of the cold-cathode X-ray tube in 1899, it was realized that there was something very odd about the way in which these new electromagnetic radiations affected living tissue. But the cold-cathode X-ray tube, because of its uncontrollably variable characteristics, was a poor tool, and for long the genetic action of X rays remained shrouded in complete mystery.

In 1926, Dr. E. L. Johnson employed a hot-cathode tube capable of yielding known doses of radiation of known characteristics. By a careful study of the effects of various exposures of X rays on the seedlings of tomatoes, sunflowers, and cosmos, she found that her seedlings not only developed the most unusual characteristics such as ribbon-shaped stems, increased branching, dwarfing, doubled leaves and flowers, but developed a shorter period from planting to flowering. Also an initial decrease, followed by a marked increase in the growth rate.

Many of the unusual characteristics were actually transmitted faithfully to following generations, and it was made clear that here was a field in the application of electricity to plant growth which was worthy of the most vigorous investigation. Vigorous investigation has followed. Dwarf, giant, and odd-leaved tobaccos, odd tomatoes, mosaic maize and other grains, cotton strains in which the seed is free of the lint and which produce giant seeds, and rapidly maturing potatoes are but a few of the results of the toil of hundreds of work-

ers, who, all over the world today, are studying genetic effects of X rays.

They have found that X rays have the power to perform a miracle which can be brought about by no other known agent, save cathode rays, under man's control today—the power virtually to cause evolution, to produce new forms of plant life whose descendants will be like themselves. Changes are due to the action of the rays on the chromosomes—those minute bands of protoplasm-fiber which lie at the center of every living cell and are responsible for every characteristic of the plant or animal bearing them. Chromosomes can be broken, reunited, and deformed in dozens of ways by X rays, and, depending upon the minute nature of those deformities in the germinal cell of the plant, that plant and all its descendants may present variations.

The possibilities, as applied to man's welfare, of being able to modify in controlled fashion the heredity of domestic plants are nearly endless. Even by the entirely empirical methods which have been used in the past, remarkable results have been achieved, and what may the future hold? A cold-resistant orange type might result that would extend the citrus-fruit orchards much farther to the north. New vegetables and new flowers will always find a ready market if they are superior to old ones, and the general life-level of humanity will be raised at the same time.—*From a talk by C. P. Haskins of the Research Laboratory, General Electric Company.*

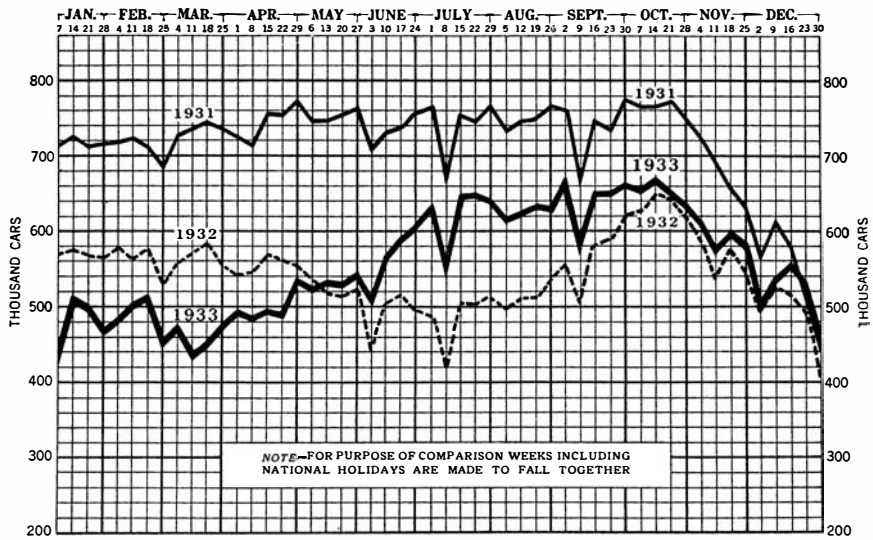
Apparatus to Move Full Grown Trees

IN the old days trees used to stay put—at least until they felt the sting of an axe. With the aid of modern tree moving machinery such as that shown in the accompanying photographs, however, tree men now move and transplant 60- and 70-foot trees like so many pots of crocuses. In other words, if you want a 90-year old tree in your front yard, you don't need to wait for a sapling to grow up. You can have a veteran elm moved in tomorrow.

The mover shown in one of the photos is used to maneuver specimens weighing up to 30 tons or more. It's all steel—and it's all-electric welded in the shops of the Davey Tree Expert Company, Kent, Ohio. The smaller mover carries loads up to around 10 tons.

Due to the nature of the service, these movers are frequently over-loaded, stuck in heavy mud, twisted, pulled, pushed but seldom broken. Having been welded with equipment manufactured by The Lincoln Electric Company, it is reported that no weld failures have ever occurred.

Above: **A tree mover with a capacity up to 10 tons.** *Right:* **A beautiful specimen of a huge tree loaded on an arc-welded mover with a dead-weight capacity of 30 tons**



One of the most important barometers of economic conditions: Revenue freight-car loadings for 1933 (heavy black line). It will be noted that in May, loadings per week exceeded those of the same weeks of the year 1932; and that in December, 1933, the loadings even jumped ahead of those two years ago

"Children of Depression"

ONE of the most interesting exhibits at the 1934 Chemical Show was that of *Industrial and Engineering Chemistry* entitled "Children of Depression." In this display was shown samples of the many new products that have been developed in American chemical laboratories as a result of efforts to reduce production costs and to introduce new and improved products by means of which the chemical industry has attempted to work its way out of the depression. Among the new products were the following:

Windows for Tin Cans. Inserts of Pyrex glass are now placed in can tops to allow visual inspection of contents. The tops containing the inserts are rolled and soldered into the cans on standard automatic production machines without change of adjustment. All or any proportion of the cans finished on the machine can be provided with glass insert tops.

Gasoline Antioxidants. DuPont monobenzyl-*p*-aminophenol is a powerful antioxidant for use in cracked gasolines to stabilize them against gum formation. It is effective in a concentration of one pound (0.45 kg.) in 100,000 gallons. DuPont Gasoline Antioxidant No. 2 is used to stabilize cracked gasoline against discoloration in concentrations of 1 pound in 35,000 gallons.

Nembutal. Sodium ethyl (l-methylbutyl) barbiturate. It possesses an unusually high pre-anesthetic and hypnotic efficiency, and is also sedative and anti-spasmodic in small doses. As a pre-anesthetic sedative it induces sleep without struggle, allays apprehension and fear, allows the quiet induction of anesthesia, reduces the amount of volatile anesthetic required, tends to prevent undue subsequent reactions with local anesthetics, and diminishes post-operative complications.

Inconel. An alloy of 80 percent nickel, 14 percent chromium, and 6 percent iron. It is stainless, resists heat and acids, and has high design strength. It is used for dairy and creamery equipment and for numerous purposes in the process industries as well as for heating elements.

S-D-O. A polymer of divinylacetylene dissolved in solvent naphtha. It serves as a synthetic drying oil and is used as a coating for the protection of metals, concrete and wood against corrosive action of acids, alkalies, solvents, and other deteriorating influences.

Dreft. A synthetic detergent made from the fatty alcohols produced by the catalytic reduction of the ordinary fatty acids with hydrogen. Its active constituent is sodium alkyl sulfate. Its outstanding characteristic is its solubility in hard water. It lathers and cleanses as well in sea water as in distilled water and is not precipitated by acid, alkali, or metallic salts.

Kork-O-Tan. A material originally developed for use in gaskets. It is strong and compressible and is ideally suited for use with many organic solvents. It is made from granular cork with rope and jute fibers saturated with a flexible binder. It is extremely flexible, is easily cut to true edges, does not harden with age, and can be folded

or bent without cracking or permanent distortion. It is also used under rugs to prevent slipping and in press blankets for modern high-speed printing presses.

Vinethene. Divinyl oxide (CH_2:CHO-CH:CH_2) is a general anesthetic having an anesthetic potency seven times that of ether and chloroform. Complete surgical relaxation is obtained in two to four minutes, and recovery is complete in 30 to 60 seconds. Post-operative vomiting and other undesirable by-effects are less frequent than with ether.—*A. E. B.*

Starchless Potato Produces Diabetic Sugar

CREATION of a starchless potato has been accomplished through the efforts of Dr. Harold Hibbert, Professor of Industrial and Cellulose Chemistry at McGill University, and Dr. R. F. Suit, Professor of Plant Pathology at MacDonald College.

Starch in the potato has been displaced by a complex sugar known as inulin. This sugar, Dr. Hibbert pointed out, "offers no trouble to the diabetic, in contrast to that of starch, which is derived from glucose."

The experiments by which the starchless potato was produced are described by Dr. Hibbert as follows:

"Following the conversion of sugars into synthetic cellulose by bacteria, and of the cellulose in turn into artificial silk, thus completing the synthetic conversion of sugar into rayon, the idea presented itself that perhaps it might be possible to alter a given plant species by introducing into the growing plant either the living organisms, bacteria, or the enzymes which these bacteria create during their life cycle.

"For this purpose it was necessary to select a type of plant, such as the potato, in which the enzymes (in the course of plant growth) under the influence of light convert the carbon dioxide and water present in the air first into sugars and then into starch, and to use for comparison a similar type of plant; for instance, the artichoke, the enzymes of which convert the sugar present into a substance known as inulin, a fructose type of sugar and not a glucose as in starch.

"Experiments were initiated in co-operation with Professor Suit in which a foreign bacterial culture—namely, one more nearly associated with the inulin type of sugar-forming bacteria—was introduced into the young, growing potato plant.

"The culture found its way into the roots from a supply located on a stout stem. In a few days the new bacteria gave rise to the formation of a starch-free potato."

Dr. Hibbert said if the reproductibility of the new types could be established it might "provide the possibility of obtaining a variety of other new types capable of serving as special foodstuffs."

Microscopic Sherlocking

THE following *Science Service* note should be of especial interest to those who have been following our series of microscope articles, one of which appears on page 130.

Dr. Johannes Grüss, research professor at the Institute for Fermentation Industries at Friederichshagen near Berlin, might well be termed the scientific pot-snooper of the centuries. A great part of his research con-

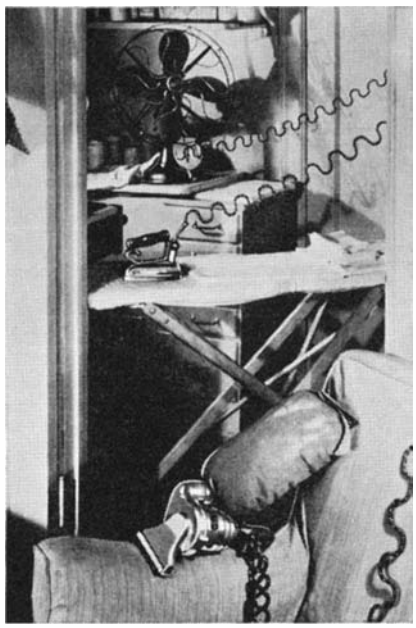
sists in the minute examination, with microscope and test-tube, of dregs and lees and pot-scrapings found dried and hardened at the bottoms of vessels dug up in ancient towns and tombs. He knows what yeasts fermented beer in ancient Egypt—and how careless Pharaoh's servants were about filtering the water they put into the jars. He knows what the women of the Bronze Age in Germany cooked for their men—and how they sometimes let the milk scorch, presumably while gossiping with the neighbors. In Dr. Grüss' patient and painstaking hands, the meanest dregs become significant.

His latest investigation, as related in *Die Umschau*, has been the microscopic and chemical examination of several earthen pots found in a village site of northern Germany that dates back to the earlier Middle Ages—somewhere between the 7th and 10th Centuries. As found in the ruins, these pots were filled with lumps of earthy material, containing a certain amount of fatty substance.

Microscopic examination isolated cells characteristic of the flax plant. Presumably therefore these pots once contained linseed oil. This presumption is strengthened by the presence of tiny scraps of linen fabric, dyed in two colors, reddish and slate-blue. However, the fat in one of the vessels may have come from hazelnuts, for the microscope also showed up fragments of hazelnut shell.

Before the pots were used for holding linseed oil they had been used for cooking—and none too well cleaned afterward, for Dr. Grüss found remains of various kinds of vegetables in them, as well as bits of finely crushed bone. There were starch grains from two species of wheat, slivers of ruta-baga or beet, fragments of radish. One of the pots had an identifiable scrap of carrot and cells of either beans or peas: possibly that old standby of modern tables, carrots and peas, dates back at least a thousand years.

Certainly two of man's unwelcome insect house-guests were there, for in one of the pots Dr. Grüss found microscopic scales from the wing of a clothes-moth, as well as the remains of a bedbug. The latter insect, he explains, is not exclusively a blood-sucker, but will take to any kind of liquid food on occasion. Apparently the six feet of this unlucky specimen slipped and it found itself in the soup, to remain there for more than a millennium, until a German archeologist-with-microscope should find it and tell its little tragedy.—*Science Service.*



Built into this new cord for use on many electrical appliances is a spring-like arrangement that prevents kinking of the cord at all times and thus lengthens its life

Gin Comes Out of the Bath Tub

PROHIBITION, no matter what else it accomplished or failed to accomplish, did at least one thing. It lifted gin out from the shady and somewhat disreputable regard in which it was held before the dry era and made it fashionable. Tipplers who once disdained it, save in an occasional cocktail, not only learned to drink it, but actually to make it—or rather to make something that was sold and drunk as gin.

Leading manufacturers of distilled spirits are inclined to give gin a prominent place on their production schedule. Plants, closed or operating on a restricted basis during the long years of aridity, are being modernized and reopened with increased capacity. New ones are springing up both in this country and Canada. Thirsty Americans, having become accustomed to the bath-tub variety, are now to have full opportunity of tasting the real product.

However, true gin can not be made by bath-tub methods. The genuine liquor contains about 50 percent alcohol by volume and is smooth with a delicate flavor possible only with the proper equipment and careful methods. That raw harshness so commonly associated with gin is entirely a product of the bootleg era.

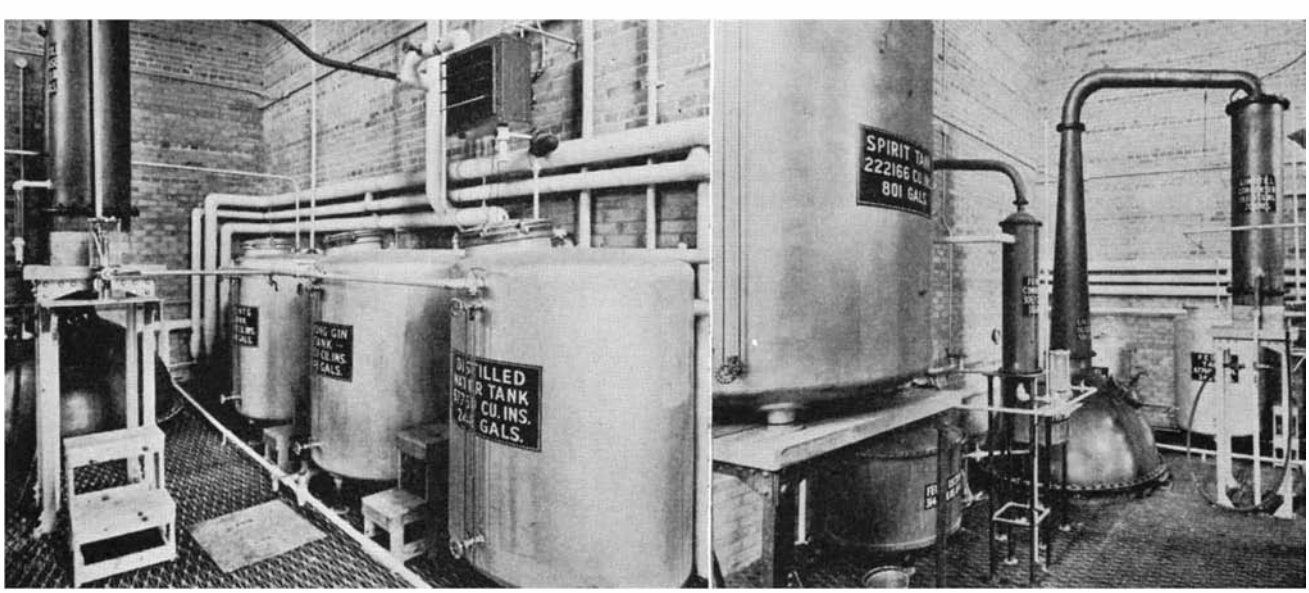
Contrary to a widely accepted belief, gin never was made by the distillation of fermented juniper berries. It is produced from alcohol obtained by the distillation of a cereal mash. The exact ingredients of this mash differ in the English product or London gin, and Holland gin or schnapps.

In the past, gin distillers have experienced considerable difficulty through metallic contamination of the distillate, which is corrosive to many metals and detrimental to its delicate flavor and brilliancy. The accompanying illustrations were taken in the new plant of W. and A. Gilbey Limited at New Toronto, Ontario. Here pure nickel and Inconel—the new nickel-chromium alloy containing approximately 80 percent pure nickel—are used extensively for equipment coming into contact with the distillate in various forms to prevent this contamination. Both of these metals are resistant to corrosion and are without effect on the flavor and brilliancy of the product.

The Universe in Miniature

A MINIATURE planetarium, literally a working model of the Universe—that is an apt description of the "astrophane," just installed on the Rockefeller Center Observation Roof, atop the RCA Building, 70 stories above the sidewalks of New York.

The astrophane, designed by Otto J. Russert of Hoboken, New Jersey, an engineer, artist, and amateur astronomer, consists of a large transparent globe supported by a wooden base. This globe represents the celestial sphere, and on its surface are



Two views in a gin-making plant: A far cry from the "bath tub" of prohibition days

shown in colors the various constellations of the sky and the visible stars.

Inside the globe, supported on thin metal sticks, are represented the visible planets in their general location about the Sun. These include Mercury, Venus, Earth, Mars, Jupiter, and Saturn.

By means of an operating mechanism within the base of the astrophane, the relative positions of the planets to each other

The astrophane described here

and to the Sun, and to the constellations and stars, may be indicated at any selected year, month, and day. The various constellations and stars may readily be identified by reference to the globe and to the sky.

The transparent globe of the astrophane, representing the celestial sphere, is marked with the outlines and names of the various constellations. Several thousand stars are shown in their relative positions in the constellations by star-shaped figures and dots. The significant stars are connected by dotted lines, so that the figures as pictured by the ancients may readily be found. Commonly known stars of the different constellations are designated by their names or Greek letters. The order of magnitude is shown by their relative sizes and colors.

The celestial equator is indicated on the globe by a circumferential white line in a horizontal plane midway between the portions representing the north and south poles of the universe. Right ascension lines from pole to pole and declination lines parallel to the equator enable the position of any body in the sky to be located, in a manner similar to the location of a point on the earth by reference to its longitude and latitude.

Unique Automatic Pencil

OF all the thin-lead mechanical pencils which we have seen in recent years perhaps the most complete in every respect was recently called to our attention by the Stylofede Corporation. This pencil has a combination of automatic features which does not seem to have been approached by any other.

In the first place, the feed of an entire supply of 12 leads placed in the barrel is continuous and automatic until all the leads have been used. When the point wears down or is broken off, it is only necessary

(*Please turn to page* 161)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

PITTSFIELD, Massachusetts, amateur astronomers and telescope makers (Berkshire Astronomical Society) have long been rarin' to go and now they are going places, according to a screed sent in by A. H. Scott, 20 Bishop Parkway, that city. Read:

"Pittsfield, Massachusetts, the home of A. R. Everest, the discoverer of *H. C. F.*, is now permanently on the astronomical map —its first observatory has been formally

Roofing the observatory

dedicated. The builder was Guglielmo Camilli, a General Electric Company engineer who entertained 30 of his fellow star gazers at a dedication dinner prepared in true Italian style. In honor of the great Florentine physicist Galileo Galilei, who was the first to apply the principle of the telescope to astronomy, in 1609, the observatory was christened The Galileo Observatory.

"Patterned after its conventional big brothers, with revolving dome and electrically operated 'scope, the observatory is scientifically constructed throughout. The building is 12 feet in diameter, with reinforced concrete walls six feet high. The concrete pier on which the telescope is mounted extends four feet into the ground and insures absolute rigidity. A series of rollers and guides is embedded in the top of the concrete wall and supports a channel iron bent in the form of a perfect circle. Supported by semi-circular cross members, the galvanized iron dome is built of 45 segments, all accurately cut to size and punched for rivets in advance. Nearly 3000 rivets and 50 pounds of solder hold the dome together and make it water-tight.

"The 'scope is an eight-inch reflector with a mirror by Everest, and is electrically operated by means of a Telechron clock mechanism. The axes can also be adjusted by hand wheels. All the machine work and scale graduations are of the greatest accuracy.

"The only cost was for materials, as enthusiastic fellow astronomers helped Mr. Camilli from start to finish of the project. All trades, from wood choppers who cut 300 trees, to electrical engineers and professional mathematicians were represented. To place the observatory in operation it was necessary to extend a transmission line through a swamp a quarter of a mile to the isolated knoll on which it is built. Electricity therefore lights and heats the building (when work is to be done in cold weather and no observations are scheduled). Resistance wire around the sliding door in the dome, but insulated from it, can be used to thaw it loose in cold weather in case of ice or snow accumulations. The grounds outside have not been neglected, rose bushes and other shrubs being planted on the carefully leveled terraces around the building."

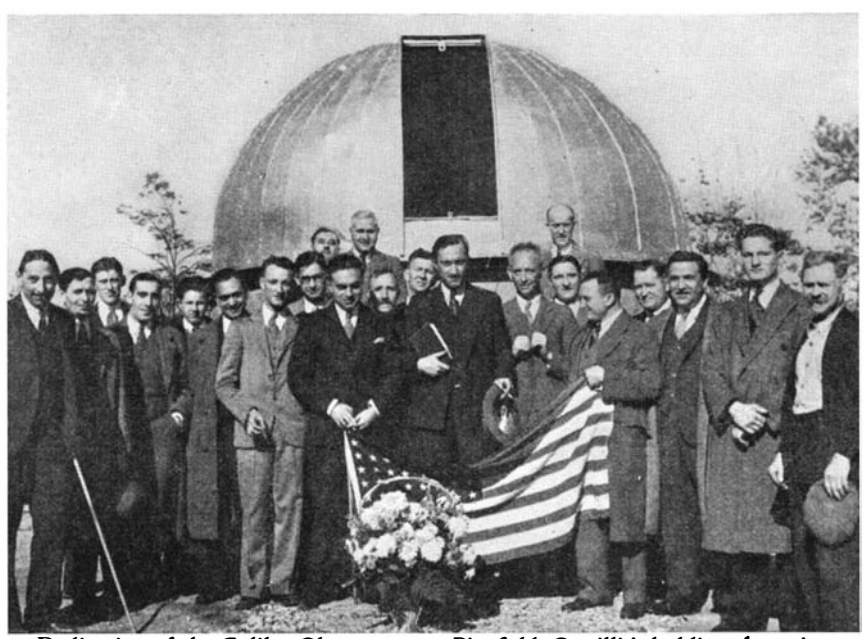
It sounds like business—doesn't it!

Mr. Camilli and 8-inch 'scope

ONE lady who evidently thinks telescope making is more fun than embroidering is Miss Wandalee Nickell, 716 North Isabel Street, Glendale, California. Here is what she wrote to us recently. Read it, show it to your mother, wife, daughter, girl friend, or what have you, and proceed to introduce her to the sacred rites of glass grinding.

"I had my first view through a telescope two years ago, at the moon," says Miss Nickell. "The moon has been the cause of many events in life, but it gave to me that evening a most compelling urge to possess a telescope of my own, in order to study its beauty whenever I desired. I was 17 at that time and felt rather helpless, knowing I could not buy one. But something inside would not let me put the desire aside.

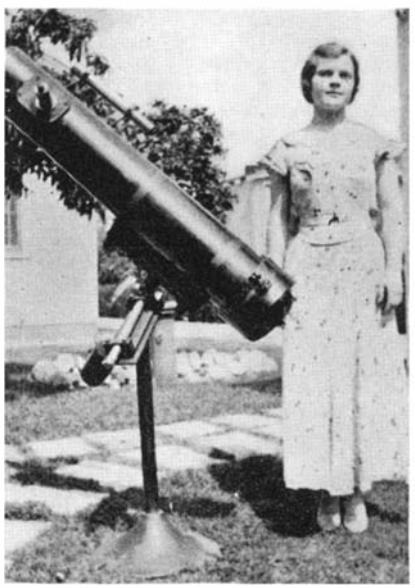
"I was studying astronomy in high school and my instructor told me of your column, 'The Amateur Astronomer,' in the SCIENTIFIC AMERICAN. Until then I was unacquainted with the magazine but I have never missed a copy since. In the first copy that I turned to I found information which spurred me on—it was a picture of Mr. A. B. Stephens grinding a mirror in Burma, China. He was returning to this country, so I immediately got in touch with him. He is the nephew of the beloved optician, the late Dr. John A. Brashear. Was it a kind hand which guided me to him? I think so, as he proved to be my sole inspirer and I surely needed plenty of encouragement at the time, as my age, sex, and lack of optical knowledge were all against me. He had me obtain 'Amateur Telescope Making,' which was, I assure you, all Greek at first. But with plenty of hard studying on my part and patience on the part of a kind physics teacher under whom I was studying, I soon was able to get under way with my six-inch



Dedication of the Galileo Observatory at Pittsfield. Camilli is holding the union end of the flag, while Everest stands with both hands on the lapels of his coat

mirror. I shall never forget the inner thrills I experienced when knowledge was dawning upon me while I ground away hour after hour with success always in front of me—I never once thought of having a failure.

"As my mirror progressed I was worrying about the mounting. I had conquered optics to a certain extent, but mechanics were and still are a mystery to me. I owe



The lady and the telescope

a great deal to my father and other friends who helped me so wonderfully in getting it constructed.

"As I went along I learned by making mistakes. My first one was not fine grinding long enough with my last grade of Carborundum, so I had to polish for 30 hours to get the polish complete. I had the usual turned-down edge, but did not encounter any real difficulty in parabolizing. My mirror has a very excellent figure. The focal length is 37¼ inches. I can use up to 300 power with good definition. In the picture you will notice that I have a finder on the telescope. I am proud to say I also ground and polished the lenses for this, and have made two eyepieces to date. I worked on the instrument over a period of ten months, and the cost was approximately 75 dollars.

"I have used my telescope now for a considerable time and cannot begin to relate all the happy hours it has given, not only to me but to hundreds of others. I want to say here that 'Amateur Telescope Making' was the life saver and giver of many hours of beauty to be spent with the heavenly bodies. I hope this story will spur other girls on into the beautiful field of telescope making. There is no reason why it should be limited to men. If one girl can make one, hundreds of others can."

So far as we know, Miss Nickell is the fourth woman who has qualified as a telescope maker and we wish there were more. Women often get the notion, based on a preconception, that they cannot do any kind of mechanical work simply because they are women. Yet take needlework—is it not mechanical work? Some of it, embroidery for example, is too refined for the average mere man. Men make good tailors, and even your scribe can sew on a button—with a six-inch upholstery needle. So there is no "man's" or "woman's" work. Ladies, try a telescope.

CURRENT BULLETIN BRIEFS

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

SOME RESULTS FROM FEEDING SPRAY CHEMICALS TO ALBINO RATS (Research Bulletin 183, College of Agriculture, Agricultural Experiment Station), by T. J. Talbert and W. L. Taylor. It is now common knowledge that the United States Food and Drug Administration of the Department of Agriculture does not permit foreign or interstate shipments of apples which contain an arsenical residue of more than a certain tolerance. The so-called tolerance or amount of arsenic trioxide permitted on the fruit was apparently arrived at without adequate scientific information or evidence. The writers have therefore undertaken to secure experimental evidence to show the toxicity of spraying chemicals. *University of Missouri, Columbia, Missouri.—Gratis.*

INDUSTRIAL RESEARCH LABORATORIES OF THE UNITED STATES (Bulletin of the National Research Council No. 91). A 203-page alphabetized listing of 1575 industrial and consulting laboratories, with addresses, names of staff members, and work done in each. *National Research Council, 2101 Constitution Ave., Washington, D. C.—$2.00.*

A REPLY TO INLAND WATERWAYS, being comments of the Mississippi Valley Association upon a memorandum submitted to the Hon. John Dickinson, Ass't. Sec'y. of Commerce, by the Association of Railroad Executives. The pamphlet can be obtained from the *Mississippi Valley Association, 511 Locust Street, St. Louis, Missouri.—Gratis.*

NOTES ON A PHOTO-ELECTRIC GLOW-DISCHARGE OSCILLATOR, by B. Melchor Centeno V., E. E. This new device is an improvement over the usual type of glow-discharge oscillators, permitting a greater elasticity in the control of the generated oscillating currents and making possible many new and practical applications in the field of electronics. *Melchor Centeno V., 202 West 81st Street, New York City.—20 cents.*

THE EVOLUTION OF INTERNATIONAL AMERICAN CONFERENCE SERIES (Congress and Conference Series No. 11), by William Manger, Ph. D., Chief Division of Financial Information, Pan American Union. International co-operation has always been a characteristic of the American continent. In fact, the very existence of many of the republics as independent nations is due in large measure to the assistance mutually rendered during their struggle for independence. With the achievement of independence this policy of mutual helpfulness and co-operation found expression in the practice of convening international conferences, dating from 1826. This brief pamphlet describes the earlier conferences. *The Pan American Union, Washington, D. C.—Gratis.*

DAIRY FARMING AND FRUIT GROWING are bulletins and circulars issued by the New York State Agricultural Station. A list of the publications can be obtained from *Prof. J. D. Lucksett, Station Editor, New York State Agricultural Experiment Station, Geneva, N. Y.—Gratis.*

MODERN TUBE INDEX NO. 2 is a large table giving the type and use, the base type (referring to diagram), the plate ratings, the screen ratings, the grid volts, characteristics, normal services, and remarks about radio tubes. Other information is given in subsidiary tables. *John F. Rider Publications Inc., 1440 Broadway, New York City.—25 cents.*

WAR DEBTS (International Conciliation, November, 1933, No. 294), which contains articles by Harold D. Gideonse and Irving Brant, deals with a very practical subject. Few know how the debts were contracted; this pamphlet tells about it. *Carnegie Endowment for International Peace, 44 Portland St., Worcester, Mass.—5 cents.*

SMOKELESS SHOTGUN POWDERS, by Wallace H. Coxe, Ballistic Engineer, Burnside Laboratory, deals with their development, composition, and ballistic characteristics as they affect the action of shotguns. It is packed with 103 pages of valuable information, fully documented, and the bibliography is excellent. It is an extremely valuable contribution to the subject. *E. I. du Pont de Nemours & Company, Inc., Wilmington, Del.—50 cents.*

WHY UNITED STATES REFINERS COMPLAIN. The question of sugar is of perennial importance. The refineries of the United States are already overbuilt, so it seems unnecessary to import refined sugar from Cuba and our island possessions, which means a duplication of mainland facilities, and represents a departure in national policy, resulting in less wages, as well as less use of materials, containers, fuel, and power in the United States. *American Sugar Refining Company, 120 Wall Street, New York City.—Gratis.*

WINTER FEEDING OF WILD LIFE ON NORTHERN FARMS (Miscellaneous Publication No. 159, U. S. Department of Agriculture), by Wallace B. Grange. Wild life in northern climates needs man's help in winter. The sheaf of grain that in some European countries is raised on a pole at Christmas time symbolizes man's response to the need of wild life; but more than a symbol, more than an offering at a single season is required. This pamphlet gives rational directions for feeding. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

GUIDEBOOK OF THE WESTERN UNITED STATES (Geological Survey Bulletin 845), by N. H. Darton, deals with the Southern Pacific Lines—New Orleans to Los Angeles—which pass through a great variety of geographic and industrial conditions. There are numerous maps and illustrations and the volume of information is enormous. It makes a book of 301 pages and is a capital guidebook to the region covered. *Superintendent of Documents, Washington, D. C.—$1.00 (money order).*

REPORT OF NAT. SCREW THREAD COMM. (Bureau of Standards misc. publications No. 141). Machine tool manufacturers have been waiting for some years for this pamphlet, which is a complete study of screw threads. A vast amount of work was involved in compiling this pamphlet. It is illustrated by 56 engravings. *Superintendent of Documents, Washington, D. C.—15 cents (coin).*

A READY REFERENCE FOR PLASTICS. This is a compilation of data by a company who mold phenolics, ureas, and cellulose acetates into various forms and shapes. This is a brief description of commonly used plastics and has been compiled for the guidance of engineers and buyers, and, as far as we know, gives a unique set of figures. *Boonton Molding Company, Boonton, New Jersey.—Gratis.*

ALDEN PRODUCTS CO. This catalogue gives a very complete radio socket layout chart, together with information on modernizing obsolete tube checkers and set analyzers, and is brimful of valuable information *Alden Products Company, 715 Center St., Brockton, Mass.—Gratis.*

HORIZONS, by Norman Bel Geddes. We are entering on a new era which is characterized by design in various specific phases. Thus we have streamlined locomotives, automobiles, cars, and ocean-liners. Mr. Geddes is a well known designer of theater scenery and properties. This pamphlet is an excerpt from a book published by the De Soto Motors Corporation, a division of the Chrysler Corporation. The complete book, issued by Little, Brown and Company, sells for $4.75. The pamphlet is issued by the *Institute of Aerodynamic Research, General Electric Building, New York City.—Gratis.*

AMERICAN PSYCHICAL INSTITUTE (Bulletin 1.) This is the opening publication of a newly organized society for psychical research. Its main content is a 75-page account of exhaustive experiments on the mental independence of a spirit control apart from the conscious or subconscious mind of the medium. *American Psychical Institute, 20 West 58th Street, New York City.—$2.00.*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 157)

to press the point of the pencil firmly against a hard surface and lift up quickly in order to have a new lead project outward to the proper writing length. The pocket clasp lies perfectly flush with the surface of the barrel while the pencil is in use but for attaching to the pocket this clasp is raised by a simple twist of the barrel and is released to catch the pocket firmly by pressing its upper edge.

The Stylofede is neatly made of a hard composition with gold-finished metal parts and is well balanced to the hand.

Odd Uses of Sulfonated Oils

FOR many years sulfonated vegetable oils have been used in the textile trade as softening and finishing agents. Of late, however, these same sulfonated oils have been applied to a wide variety of other very interesting uses, some of which are described by A. J. Kelly in a recent issue of *Chemical Markets*. The distinguishing property of the sulfonated oils is their ability to solubilize or emulsify practically every type of water-insoluble solvent or lubricant.

The cosmetics industry is now consuming a considerable quantity of turkey red and other sulfonated oils. Many shampoos, as well as permanent-wave preparations, are based on sulfonated castor oil. Brushless shaving creams also contain this versatile product. And there is one compound which is to be added to the bath and is advertised to bring a breath of the pine woods to the bath room. Neutral turkey red oil and a little of some aromatic pine derivative such as terpineol does the trick. Sulfonated castor oil is used to solubilize perfumes for the manufacture of theater sprays, as well as other deodorants or anti-odorants. In fact, water soluble perfumes for every sort of use are prepared by blending the essential oils with the sulfonated oils.

Sulfonated oils are used in preparing asbestos products. They are quite largely consumed in the processing of leather, and for this application sulfonated cod oil is often desired. Sizing preparations for paper and for book-binding materials sometimes contain sulfonated castor oil. It is also used on wood in a few particular lines. Cutting oils for the metal workers can be and are made with sulfonated oil. And certain water soluble tints and stains are improved with soluble oils.

Sulfonated castor oil will clean paint brushes handily—and mixed with kerosene will remove grease and dirt from the hands, with no harmful action on the skin.—*A. E. B.*

Women Poorer Reasoners, Better Hint Takers Than Men

IF women do not reason as well as do men, they are better at taking hints, with the result that they may more nearly approach the achievements of men. This is one conclusion drawn from a series of reasoning tests given 384 students at the University of Michigan by Dr. Norman R. H. Maier of the University psychology depart-

ment, reported in the *British Journal of Psychology*.

Using students in the beginning psychology course as subjects, Dr. Maier divided them into two groups, one of which received some general hints on what not to do when solving the problems presented. The second group received no suggestions. The problems varied from abstract puzzles, such as dividing equally an odd-shaped diagram, to constructive work with simple material available. The group receiving suggestions was from 20 percent to 40 percent more efficient. In a variation of the experiment, the 384 students were subjected to two problems of equal difficulty. The hints were given in connection with one of these problems and it was solved by twice as many individuals as the other problem on which no hints were given.

Because the suggestions were, in general, advice against depending on habitual patterns of thought and blind persistence in attempting to solve problems, and because the tasks were best done when the hints are given, it is concluded from the experiments that the type of reasoner most successful in problem solving is the one who can suppress or inhibit his habitual lines of thought to allow free play of new ideas and thought patterns. Of practical importance is the fact that proper training in how to reason tends to improve the problem solving ability of both good and poor reasoners.

The women students were regularly poorer than the men in problem reasoning, even though all the problems were not of a "mechanical" nature, which might be more favorable to men, Dr. Maier says. Those in the group receiving suggestions, however, raised their solving average markedly, apparently benefiting comparatively more from the hints than did the men in the same group. The men's scores in this group rose decidedly, but the rise of the women's scores was much more.

New Invention Speeds Surveying

A SCIENTIFIC device which speeds up surveying and map-making and renders unnecessary a lot of computations has been invented and is now part of the instrument which surveyors call the Abney level. The inventor is Professor John Sammi of the Department of Forest Management of the New York State College of Forestry at Syracuse University.

The Abney level is the most efficient instrument for making maps and running boundary lines for forestry purposes and Professor Sammi has made it still more efficient. In fact, it will now solve problems in geometry for the surveyor that only the human mind was believed able to do, leaving only a few resulting calculations which can often be made mentally. The new device consists of an extra set of graduated marks inscribed on the metal face of the arc of the Abney level. The instrument has always had one set of graduated marks which are not disturbed by Professor Sammi's set. His set is simply inscribed above the old and an additional indicator added to the movable arm of the instrument.

By means of Professor Sammi's device it is now possible to measure to any fixed point on a slope of land and find the horizontal distance to the point by consulting

the graduations on the arc of the level. It is necessary to have this horizontal to find out the height of the point on the slope, a feature essential in making topographic maps. It was not possible to determine such distances except by the use of a specially graduated tape or without using tables before this improvement in the Abney level was made.

Metallurgy of Watch-Making

H. W. GILLETT, director of Battelle Memorial Institute, Columbus, Ohio, has announced the establishment at the institute of a research project sponsored by the Elgin National Watch Company, for the study of the metallurgy of watch-making.

Various alloys are used in watch parts, but they have remained the same for many years. Metallurgical advances that other industries have developed and applied have been singularly lacking in the horological industry. Improvement and standardization of the metal in watch parts are the primary aims of this project.

The Elgin National Watch Company, in the spirit of the word "national" in its name, has developed the manufacture of its own parts rather than relying on foreign sources. It is thus in a position fully to utilize metallurgical research developments and to work out new alloys especially to meet their particular requirements.

James L. Gregg and A. W. MacLaren, metallurgists, and H. W. Russell, chief physicist, have been designated by Doctor Gillett to work on this research program. —*A. E. B.*

Renewable Point Fountain Pen

ONE of the most interesting recent developments in fountain pens is that of the Esterbrook Steel Pen Manufacturing Company of Camden, New Jersey. This company has not only developed a pen which makes use of its long-famous steel points but has added the further feature of renewability of points.

To outward appearance the Esterbrook fountain pen is much like that of any ordinary make. The point, however, is of a new steel called Duracrome, which was developed by the company. This new steel has a platinum-like appearance and takes and holds a finely tempered point.

To suit the handwriting of various persons these points are mounted integrally on a plug which screws firmly into the barrel of the pen. This interchangeability permits the purchaser to choose any point he desires and eliminates the necessity of returning the fountain pen to the factory for repairs. The pens complete cost from one dollar up, and the new points 25 cents.

POSSIBILITIES OF ELECTROSTATIC GENERATORS

(*Continued from page* 134)

that the current from the sprayer is continuous and not a rectified one, in which case the efficiency will be appreciably smaller. The streamers from pointed electrodes are generally considered as a sort of corona involving an insignificant loss of energy, but this view is erroneous. Such a

discharge is very concentrated, approximating an arc in intensity, so much, in fact, that the heat evolved sometimes imposes a limit to the use of points.

In the absence of a detailed description, the performance of this sensational generator can not be closely determined and the actual results may be different from those I have indicated, but not greatly so. While the energy supply may be increased by raising the tension of the sprayer and increasing the number of the discharging and sucking points, there are limitations in this respect and it is perfectly evident that, no matter how big, such a contrivance is nothing more than a toy compared with the commercial machines employed in the transformation and transmission of electrical energy.

In view of this, and the low efficiency, its application will be confined to scientific experiments in which useful results may be achieved either by a feeble working current under high tension or by successive explosions. The latter method seems more promising because under proper conditions it is possible to discharge the spheres in a time interval incomparably shorter than that consumed in charging them and so amplify enormously the intensity of the actions.

Any device depending on static electricity carried by a belt will fail in damp weather and will have to be operated in a closed space in which the air is properly conditioned. Also, the belts are apt to deteriorate rapidly through the action of ozone, nitrous and nitric acid produced by the point discharge.

ALTHOUGH there is nothing radically new involved in the construction and working of this high voltage generator, it is, nevertheless, a distinct advance over its predecessors, the result of a scholarly effort towards producing an instrument suitable for scientific research. I think though, that whatever can be accomplished with it by virtue of the continuity of action, can be even better achieved by the use of cosmic rays. Moreover, the time consumed in the passage of a charged particle from one to the other end of the tube is so brief that it makes practically no difference whether the current is direct or alternating. In availing ourselves of the latter we are doing away with all the limitations as to voltage and strength of the current and, consequently, the intensity of the effects which it is the chief object to produce.

As far back as 1899 I made experiments with 18,000,000 volts and in some tests I was able to pass a current of 1100 amperes through the air. With my transformers a potential difference of 30,000,000 volts, or more, could be easily obtained and in the present state of the technical arts a tube or other device capable of taking up very great energy might be manufactured. I do not say this in disparagement of electrostatic generators; on the contrary, I believe that when new types are developed and sufficiently improved a great future will be assured to them.

At first thought it might appear that the performance of such a generator could be doubled by using the free side of the belt for carrying away electricity of opposite sign. In this case the repulsion on one side of the belt would be balanced by the attraction on the other so that, theoretically,

the spheres could be charged without expenditure of power. But this is contrary to fundamental laws of nature and it may, therefore, be safely inferred that such a plan would not work.

Static electricity may be eventually harnessed for driving motors and this prospect is attractive on account of the enormous power output of such a machine at very high voltages. The efficient generation and control of these is the chief impediment in this direction. As an interesting experiment the two units of the generator described might be separated and so an electric drive improvised. It would be operative but inefficient.

WHILE it is quite evident that exceptionally favorable conditions for accurate observation will be realized in this instrument, it is highly probable that the attempts to smash the atomic nucleus and to transmute elements will yield results of doubtful value. Certainly, much of the ingenuity and skill now devoted to these illusionary tasks might be better employed. The nucleus is a neutral body consisting of tightly packed particles of the same kind which were originally positive and negative. When the body is smashed the particles again acquire their charges, without distinction, and instantly form neutral pairs so that we have nothing for our pains. It is folly to expect useful results from transmutation brought about through such bombarding of targets. If anything of considerable practical value is ever achieved in this direction it will be by the use of a quasi-intelligent agent causing a sorting and regimentation of the particles and their orderly arrangement as required in the formation of a new structure. Such a power is possessed by a catalist and it will be eventually harnessed and controlled successfully for all sorts of purposes.

Author's note: Reference to page 134.

The required increment of density can be determined by a simple calculation. At the spraying points, due to their constant action, there can be no change in the value 1.8333 found before, but from there on the density will increase and at the very top of the charged area it may be 1.8333+a. Since the law of variation is quite immaterial to this argument it may be assumed that the increment is proportionate to the distance from the spraying points, especially as this is most likely to be the case. Under such conditions, a transversal strip of the belt one centimeter long and at a distance X from the center of the sphere, will contain a charge

$$q=120(1.8333+a\frac{d-x}{d-r})$$ e.s.u. Hence the repelling force exerted by the charge Q on the terminal will be

$$F=\int_r^d Qx120(1.8333+a\frac{d-x}{d-r}\frac{dx}{x^2}$$

This integral can be readily solved by expanding and yields the value

$$F=2756352+1088367a \text{ dynes}$$

The mechanical work at the normal belt speed of 3000 centimeters per second will, consequently, be equivalent to

$$W=0.8269056+0.3265101a$$ kilowatt seconds and must be equal to the electrical work of the machine with an overflow current of 0.00022 ampere under a tension of 5,000,000 volts; namely, 1.1 kilowatt seconds for each terminal so that

$$a=\frac{1.1-0.8269056}{0.3265101}=0.8364$$ electro-static units.

With this excess density and distribution of the charge as set forth, the net power of both belts, expressed in electrical units, will be 2.2 kilowatts which is exactly the performance of the generator with the overflow current of 0.00022 ampere and terminal tension of 10,000,000 volts. It is evident that just as water finds its level so this balance is instantly established under all working conditions and is effected by a varying slip of the charge; that is to say, by reduction or increase of its translatory velocity according to the changes of the load.

Books SELECTED BY THE EDITORS

STEEL TRAILS—THE EPIC OF THE RAILROADS

By Martin D. Stevers

A NEW book on railroads has been needed for the last 40 years. While this one is not quite as pictorial as we would desire, still there is a great deal which the layman can absorb with profit. The writer gives us the lure of the railway when he expatiates upon the climb from the ground to the locomotive platform, which seems to be an awful climb yet in reality is only a few feet, with a brawny fireman to help you over the last lap. Corners are constantly being cut in railroading and an engineer who will not conserve his sand will soon be brought to book. There is no business in the world as complicated as freight rates, yet when once decided on there is no trouble even with the book-keeping or the collection. There are some pertinent questions which Mr. Stevers does not answer, probably because he would have to get an I. C. C. decision. There are other points which might have furnished interesting reading such as the fact that you pay car fare whether you ride in the locomotive or in a Pullman. The references to bus competition are pertinent and sound. Electrification is a good thing if you can afford it but the steam locomotive will, we think, outlast most of us.—$4.00 postpaid.—*A. A. H.*

VALUABLE HINTS TO INVENTORS

By A. F. Gillet

A HANDY volume in which the author deals with such subjects as: Who are inventors?; How to invent; What to invent; When to apply for a patent; How to make a patented invention pay; and so on. 90 text pages plus a comprehensive index. 5 by 7¾ inches.—$1.10 postpaid.—*A. P. P.*

SPECTROSCOPY IN SCIENCE AND INDUSTRY

By S. Judd Lewis, D.Sc., F.I.C., Ph.C.

THE author of this book has packed into its 91 small pages as much solid material in available form as is contained in many books five times its size, and this material is practical, not vague and general as material in too many treatises is. Its scope is the use of the spectroscope for practical problems in chemistry and industry, with a few digressions. The chapter headings tell the story: Elementary Principles; Spectroscopic Equipment (types of spectroscopes); Spectra (types of); Spectrum Analysis (of materials); Quantitative Spectroscopy (for minute traces); Industrial and Scientific Applications (metallic analyses, discovery of elements, organic substances); Spectrophotometry; Absorption Spectroscopy and Applications. There are 41 figures including ten splendid plates of spectra. A valuable pocketful. This compact work and its contents are well worth knowing no matter what use the reader has for a spectroscope.—$2.00 postpaid.—*A. G. I.*

GOD AND THE ASTRONOMERS

By William Ralph Inge, K.C.V.O., D.D., F.B.A.

THE famous Dean Inge, whose name is said to rhyme with wing, goes to the mat once more, this time with those of the astronomers who believe that the universe is being run down. He is not content to let the astronomers answer the problem alone, and his book is a long discussion of the philosophic aspects of the problem as they bear on religion. Those who do not like the idea of living in a gloomy universe that is not winding itself up while it runs down will gain much comfort from the dean's talks—especially if their beliefs in scientific matters are based merely on their wishes—$4.20.—*A. G. I.*

ELECTRIC METERS

By Richard R. Ranson, B.S., E.E., Exp. Dept., Cutler-Hammer, Inc.

AN elementary text on electric meters, in which the reader is given not only the fundamental details of various types of meters, but is also told how to use and care for them. This book is eminently practical in scope, and will be found useful to testers and operators in electrical work as well as to the student.—$2.15 postpaid.—*A. P. P.*

THE FUTURE COMES

By C. A. Beard and G. H. E. Smith

THIS 170-page book is a study of the New Deal—an analysis of the present recovery program. The senior author is familiar to the reading public as the author of "The Rise of American Civilization" and his thesis is that history does not repeat itself—we never return to conditions as they were and must always forge new tools and new methods to fit newly arising circumstances. The authors see the present as a pivotal point in American history. Their analysis is packed with facts and makes pleasant, easy reading.—$1.90 postpaid. —*A. G. I.*

THE SHAPE OF THINGS TO COME

By H. G. Wells

IT is a sad and gloomy picture of the future of those of us now living which Mr. Wells paints in his newest book. Read it and commit suicide—if you believe its predictions—is this reviewer's advice, for you have little left to live for. The Hoover depression is to last 30 years, by the end of which civilization will have sunk to a shadow and a shambles. Europe's horrible next war (1940-49) will be partly the cause of this but not the primary cause, which is our intellectual deficiency—our inability to understand what is the matter with us. Mr. Wells proceeds to tell us what is the matter with us.

After the European War with its gas and germ methods, awful air raids on civilian populations, and a ghastly two year plague which halves the world's population, comes world impoverishment, disintegration, chaos, hunger, filthiness, decadence—New York City abandoned in 1958, Radio City falling down from disrepair, Detroit producing only 1000 cars a year. At last, in 1965-75, comes the recovery of prosperity and the organization of the Modern World State (somewhat socialistic). We then see a picture of what a Better World might be if only we humans were not such fools, according to Mr. Wells.

Ho hum—this is Mr. Wells at his worst and best. If you really enjoy self-induced shivers read this book, but if you are already worrying about stocks, give it to some enemy. But there is a lot in it that is well worth thinking about.—$2.70 postpaid.—*A. G. I.*

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Member of the New York Bar

Remarks on Protecting Intellectual Priority

BY E. H. WESTLING

LOOKING back over the April 1933 number of SCIENTIFIC AMERICAN, page 219, I found a highly interesting article on a method of proving priority of inventions. For over 20 years, however, I have used a procedure which I consider much better than the one described. It has the advantage that you can open the letter and show it, if you want to, and have as many duplicates as you see fit. As follows, then:

You write out, as completely as you wish, all you want to say about your invention. Have your friends, as many as you desire, witness the papers. But what I now shall say will demonstrate that no witnesses are really necessary, as the instrument as such is a self-contained, authentic witness. There are two ways, both incontrovertible, and iron-clad, as it were:

1. Have all your writing on one sheet of tracing paper, and then make a blue-print. Next, fold the blue-print, with the white side out, sealing the edges with a gummed label or two. Then use no envelope, but write the address and put stamps on the outside of the blue-print itself and mail it to yourself, or to anybody else. The address on the outside is not important, but it is essential to have the Post Office cancellation stamp on the instrument itself. It is self-evident that the question of whether it has been opened or not will never arise. When the document was sent through the mail, it already was a blue-print.

It is entirely impossible to send an empty blue-print through the mail, then make lines on it with acid, or the like, pretending that such lines were there when the blue-print was sent, because the microscope will show the fraud.

It is possible, however, to send a white paper through the mail, then impregnate the paper with blue-print mixture, and make a blue-print, still retaining the Post Office mark on the other side. But that is very difficult; perhaps more so than making counterfeit money. The microscope will show that the document has been wet, and then dried again, after the postmark has been stamped on. However, to avoid even this possibility, a notary public may stamp the blue side of the paper, before mailing.

2. Instead of making a blue-print of your brain-child, take a photograph of the description and drawings of the same, and make a print on one of those postcards to be had at any photographer. Address the print, put a stamp on, and send it through the mail. Never mind if the writing can not be read without a magnifying glass. Such can easily be obtained whenever you need it. And it might be of advantage. Postal employees who sometimes read those cards would not take the trouble, or have the time, to hunt up a magnifying glass.

Obviously, there is no need to register such a letter or card. But there is nothing to prevent it.

And finally it should be remarked that the generous offer of the SCIENTIFIC AMERICAN to store such documents is of great value to the inventor. He should also avail himself of that safeguard.

Government Radio Control

GOVERNMENTAL control over radio broadcasting operations in Denmark, which ranks first among nations in the number of receiving sets in proportion to population, is said to be giving complete satisfaction. Furthermore the control system is self-supporting financially, says the Department of Commerce.

Danish broadcast programs are controlled by a supervisory board of 15 members which accepts suggestions from civic organizations which have been formed for the purpose of seeking an improvement in radio programs.

Receiving sets are licensed at about $1.75 a year and the broadcasting monopoly receives the entire sum. In most European countries the government levies a tax on receiving sets.

There is about one receiving set for each seven persons in Denmark, while in the United States the estimate is one set for eight and a third persons.

Paint Not a Trade Mark

IN *ex parte* Potosi Tie and Lumber Company, First Assistant Commissioner Kinnan held that the company, of St. Louis, Missouri, is not entitled to register, under the Act of 1905, as a trade mark for telephone, telegraph, and electric power poles, the mark described as consisting of a silver colored coating applied to the transversely cut ends of the poles.

The ground of the decision is that this painting would not function as a trade mark.

In his decision, the First Assistant Commissioner said:

"The cut ends of fence posts permit the water to enter lengthwise of the grain of the posts to a greater extent when the posts are in vertical position than when the water merely strikes the sides of the posts . . . it is believed the public on seeing the posts with painted ends would consider the paint applied for protection rather than for trade-mark purposes and would not get the impression of trade-mark significance."

Shellac Substitutes

IT has been directed by the Federal Trade Commission that Acme Shellac Products Corporation of Long Island City, New York, shall discontinue advertising and selling its products as "Shea-Lac" when not made from shellac gum dissolved in alcohol or when shellac gum is not the predominant element.

Exception to this order is permitted if the word "Shea-Lac" or any other word which in appearance or sound simulates the word shellac, is accompanied by the word "substitute," or by "other apt and adequate words, in equally permanent and conspicuous lettering, clearly indicating that such product is a substitute for genuine shellac."

The American Flag for Advertising Purposes

THE Legation of the United States at Prague has been advised by the Ministry for Foreign Affairs that the Ministry of Commerce has taken measures necessary to cancel from the register all trade marks and marks which contain the American flag or emblems. It is further indicated that proceedings would be brought against firms which use the American flag in advertising in direct contravention of the Czechoslovak law.

Argentine Trade Marks

THE Argentine Supreme Court has just handed down a decision to the effect that foreign language trade marks registered in Argentina may be re-registered when they expire.

Several months ago a law was passed requiring trade marks to be registered in Spanish or a dead language, exception made for proper names. Shortly afterwards, a firm applied for re-registration of its French trade mark which had been obtained prior to the passing of the new law. The application was denied because of its foreign language features. The case, which was appealed, finally reached the Supreme Court which rules that the new law was unconstitutional as regards its application to trade marks already registered at the time it was passed. In his decision the Judge stated that trade marks constituted acquired rights and are consequently considered as private property, which is rendered inviolate under Article 17 of the Constitution. This decision is particularly welcome to foreign companies whose trade marks are of definite value.

Danish Patent Statistics

A TOTAL of 2530 patent applications were filed in Denmark in 1932. During the same year 1661 patents were granted, divided by country of domicile of the patentee as follows: Denmark, 519; Norway, 53; Sweden, 134; Germany, 372; France, 48; Austria, 21; England, 141; United States of America, 165; other countries, 208.

At the end of 1932 there were 6899 patents in force in Denmark compared with 7109 at the end of 1931.

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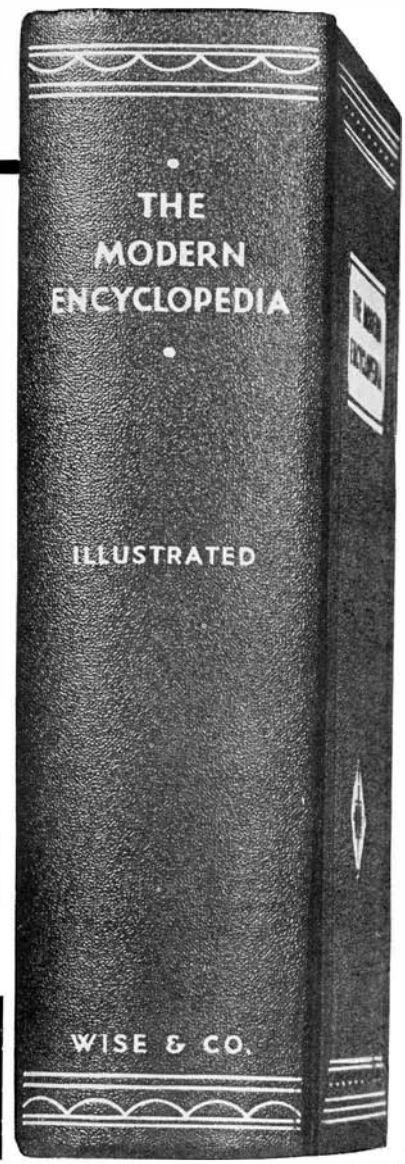

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